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NTC Great Lakes

INITIAL ASSESSMENT STUDY

NAVAL COMPLEX (NC) GREAT LAKES, ILLINOIS

UIC: N00210

Prepared by:

Rogers, Golden & Halpern
1216 Arch Street, Sixth Floor
Philadelphia, Pennsylvania 19107

in association with

BCM Eastern Inc.
One Plymouth Meeting Mall
Plymouth Meeting, Pennsylvania 19462

Contract No. N62474-84-C-3386

Initial Assessment Study Team Members

Jack A. Halpern, Principal-in-Charge
Roger D. Moose, Project Manager/Hydrogeologist
Ron Kaiserman, Site Coordinator/Hydrogeologist
Terence Vogt, Environmental Engineer
Stephen P. Risotto, Biologist
Larry Johnson, BCM, Industrial Hygienist
Sandy Dechert, Technical Writer
Rob Zeiders, Geologist

Naval Energy and Environmental Support Activity

John Accardi, Project Manager

Elizabeth Luecker, Environmental Engineer

Prepared for:

ENVIRONMENTAL RESTORATION DEPARTMENT
Naval Energy and Environmental Support Activity
Port Hueneme, California 93043

March 1986

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EXECUTIVE SUMMARY

This report presents the results of an Initial Assessment Study (IAS) conducted at the Naval Complex (NC) Great Lakes, North Chicago, Illinois. NC Great Lakes consists of the Naval Training Center (NTC), the Naval Hospital (NAVHOSP), and the Public Works Center (PWC). The purpose of the IAS is to identify and assess sites posing a potential threat to human health or to the environment due to contamination from past hazardous materials operations.

Based on information from historical records, aerial photographs, field inspections, and personnel interviews, a total of 14 potentially contaminated sites were identified at NC Great Lakes. Each of the sites was evaluated with respect to contamination characteristics, migration pathways, and pollutant receptors.

Both surface water and ground water are potential contaminant migration pathways in the study area. Runoff from the activity may enter either Skokie Ditch or Pettibone Creek; furthermore, ground water supplies much of the flow for Pettibone Creek and may supply water for intermittent flow in Skokie Ditch. Although neither of these streams is used as a source of potable or industrial water in the immediate area of the activity, both streams do flow into other bodies of water that are used for these purposes. Moreover, Pettibone Creek flows directly into Lake Michigan, which is used extensively for sport fishing, while Skokie Ditch becomes the Skokie River, which eventually drains into the Mississippi River.

This study concludes that, while none of the sites poses an immediate threat to human health or to the environment, seven sites warrant further investigation under the Navy Assessment and Control of Installation Pollutants (NACIP) program to assess potential long-term impacts. A Confirmation Study, involving sampling and monitoring of the seven sites, is recommended to either confirm or refute the presence of the suspected contamination and to better define the extent of any problems that may exist. The seven sites recommended for Confirmation Studies are:

- Site 1, Golf Course Landfill
- Site 4, Fire Fighting Training Area
- Site 5, Transformer Storage "Boneyard"
- Site 6, Mainside Transformer Storage Area
- Site 7, RTC Silk-Screening Shop
- Site 8, Exchange Service Station
- Site 12, Harbor Dredge Spoil Area

The results of the Confirmation Studies will be used to evaluate the necessity of conducting Remedial Measures or cleanup operations at these seven sites.

This study also recommends that a cleanup operation be undertaken at Site 10, NTC Rifle Range, due to documented contamination of the site caused by the accumulation of 70 years' worth of lead in the soil.

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FOREWORD

The Department of the Navy developed the Navy Assessment and Control of Installation Pollutants (NACIP) program to identify and control environmental contamination from past use and disposal of hazardous substances at Navy and Marine Corps installations. The NACIP program is part of the Department of Defense Installation Restoration Program and is similar to the Environmental Protection Agency's "Superfund" Program authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

In the first phase of the NACIP program, a team of engineers and scientists conducts an Initial Assessment Study (IAS). The IAS team collects and evaluates evidence of contamination that may pose a potential threat to human health or to the environment. The IAS includes a review of archival and activity records, interviews with activity personnel, and an on-site survey of the activity. This report documents the findings of an IAS at the Naval Complex (NC) Great Lakes, Illinois.

Confirmation Studies under the NACIP program were recommended for seven sites at NC Great Lakes. Northern Division, Naval Facilities Engineering Command (NORTHNAVFACENGCOM) will assist NC Great Lakes in implementing the recommendations. In addition, a cleanup operation was recommended for an eighth site where a contamination problem has already been documented.

Questions regarding this report should be referred to NEESA Code 112N at AUTOVON 360-3351, FTS 799-3351, or commercial 805-982-3351. Questions concerning confirmation work or other follow-on efforts should be referred to NORTHNAVFACENGCOM Code 114 at AUTOVON 443-6280 or FTS/commercial 215-897-6280.

R. S. Moreau
LCDR, CEC, USN
Environmental Officer
Naval Energy and Environmental Support Activity

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- Activity personnel who gave their time and provided details of present and past waste generation and past waste disposal practices

CHAPTER 1. INTRODUCTION

1.1 PROGRAM BACKGROUND. Past hazardous waste disposal methods, although acceptable at the time, have often caused unexpected long-term problems through release of hazardous pollutants into the soil and ground water. In response to a growing recognition of these problems, the U.S. Congress directed the U.S. Environmental Protection Agency (EPA) to develop a comprehensive national program to manage past disposal sites. The program is outlined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of December 1980.

1.1.1 DOD Program. Department of Defense (DOD) efforts in this area preceded the nationwide CERCLA program. In 1975, the U.S. Army developed for DOD a pilot program to investigate past disposal sites at military installations. In 1980, DOD named this program the Installation Restoration Program and instructed the services to comply with program guidelines.

1.1.2 Navy Program. The Navy manages its part of the program, the Navy Assessment and Control of Installation Pollutants (NACIP), in three phases. Phase one, the Initial Assessment Study (IAS), identifies disposal sites and contaminated areas caused by past hazardous substance storage, handling, or disposal practices at naval activities. These sites are then individually evaluated with respect to their potential threat to human health or to the environment. Phase two, the Confirmation Study, verifies or characterizes the extent of contamination present and provides additional information regarding migration pathways. Phase three, the Remedial Measures, provides the required corrective measures to mitigate or eliminate confirmed problems.

1.2 AUTHORITY. The Chief of Naval Operations (CNO) initiated the NACIP program in OPNAVNOTE 6240 of 11 September 1980, superseded by OPNAVINST 5090.1 of 26 May 1983. Naval Facilities Engineering Command (NAVFACENGCOM) manages the program within the existing structure of the Naval Environmental Protection Support Service (NEPSS), which is administered by the Naval Energy and Environmental Support Activity (NEESA). NEESA conducts the program's first phase, the IAS, in coordination with NAVFACENGCOM Engineering Field Divisions (EFD's). Activities are selected for an IAS by CNO, based on recommendations by NAVFACENGCOM, the EFD's, and NEESA. Approval of the Great Lakes Naval Complex, North Chicago, Illinois, for an IAS is contained in CNO letter ser 451/5U393185 of 15 March 1985.

1.3 SCOPE.

1.3.1 Past Operations. The NACIP program focuses attention on past hazardous substances storage, use, and disposal practices on Navy property. Current practices are regularly surveyed for conformity to State and Federal regulations, and therefore are not included in the scope of the NACIP program. The IAS addresses operational nonhazardous disposal and storage areas only if they were hazardous waste disposal or storage areas in the

past. Current operations are investigated solely to determine what types and quantities of chemicals or other materials were used and what disposal methods were practiced in the past.

1.3.2 **Results.** If necessary, an IAS recommends Remedial Measures to be performed by the activity or EFD, or recommends Confirmation Studies to be administered by the EFD under the NACIP program. Based on these recommendations, NAVFACENGCOM schedules Confirmation Studies for those sites which have been determined by scientific and engineering judgment to be potential hazards to human health or to the environment.

1.4 INITIAL ASSESSMENT STUDY.

1.4.1 **Records Search.** The IAS begins with an investigation of activity records followed by a records search at various government agencies including EFD's, national and regional archives and records centers, and U.S. Geological Survey offices. In this integral step, study team members review records to assimilate information about the activity's past missions, industrial processes, waste disposal records, and known environmental contamination. Examples of records include activity master plans and histories, environmental impact statements, cadastral records, and aerial photographs. Appendix A lists the agencies contacted during this study.

1.4.2 **On-Site Survey.** After the records search, the study team conducts an on-site survey to complete documentation of past operations and disposal practices and to identify potentially contaminated areas. With the assistance of an activity point-of-contact, the team inspects the activity during ground and aerial tours, and interviews long-term employees and retirees.

Information obtained from interviews is verified by data from other sources or from corroborating interviews before inclusion in the report. If information for certain sites is conflicting or inadequate, the team may collect samples for clarification.

1.4.3 **Confirmation Study Ranking System.** With information collected during the study, team members evaluate each site for its potential hazard to human health or to the environment. A two-step Confirmation Study Ranking System (CSRS), developed by NEESA, is used to systematically evaluate the relative severity of potential problems. The two steps of the CSRS are a flowchart and a numerical ranking model. The first step is a flowchart based on type of waste, containment, and hydrogeology. This step eliminates innocuous sites from further consideration. If the flowchart indicates a site poses a potential threat to human health or to the environment, the second step, the model, is applied. This model assigns a numerical score from 0 to 100 to each site. The score reflects the characteristics of the waste, the potential migration pathways from the site, and possible contaminant receptors on and off the activity.

1.4.4 **Site Ranking.** After scoring a site, engineering judgment is applied to determine the need for a Confirmation Study or for an immediate Remedial Measure. At sites recommended for further work, CSRS scores are

used to rank the sites in a prioritized list for scheduling projects. For a more detailed description, refer to NEESA 20.2-042, Confirmation Study Ranking System.

1.4.5 Confirmation Study Criteria. A Confirmation Study is recommended for sites at which (1) sufficient evidence exists to indicate the presence of contamination and (2) the contamination poses a potential threat to human health or to the environment.

1.5 CONFIRMATION STUDY. Generally, the EFD conducts the Confirmation Study in two phases -- verification and characterization. In the verification phase, short-term analytical testing and monitoring determines whether specific toxic and hazardous materials, identified in the IAS, are present in concentrations considered to be hazardous. Normally, the IAS recommends verification phase sampling and monitoring. The design of the characterization phase usually depends on results from the verification phase. If required, a characterization phase, using longer-term testing and monitoring, provides more detailed information concerning the horizontal and vertical distribution of contamination migrating from sites, as well as site hydrogeology. If sites require remedial actions or additional monitoring programs, the Confirmation Study recommendations include the necessary planning information for the work, such as design parameters.

1.6 IAS REPORT CONTENTS. In this report, the significant findings and conclusions from the IAS are presented in Chapter 2. Recommendations are presented in Chapter 3. Chapter 4 describes general activity information, history, biology, and physical features. Chapters 5 through 8 trace the use of chemicals and hazardous materials from storage and transfer, through manufacturing and operations, to waste processing and disposal. The latter chapters provide detailed documentation to support the findings and conclusions in Chapter 2. A general location map of NC Great Lakes is shown in Figure 1-1.

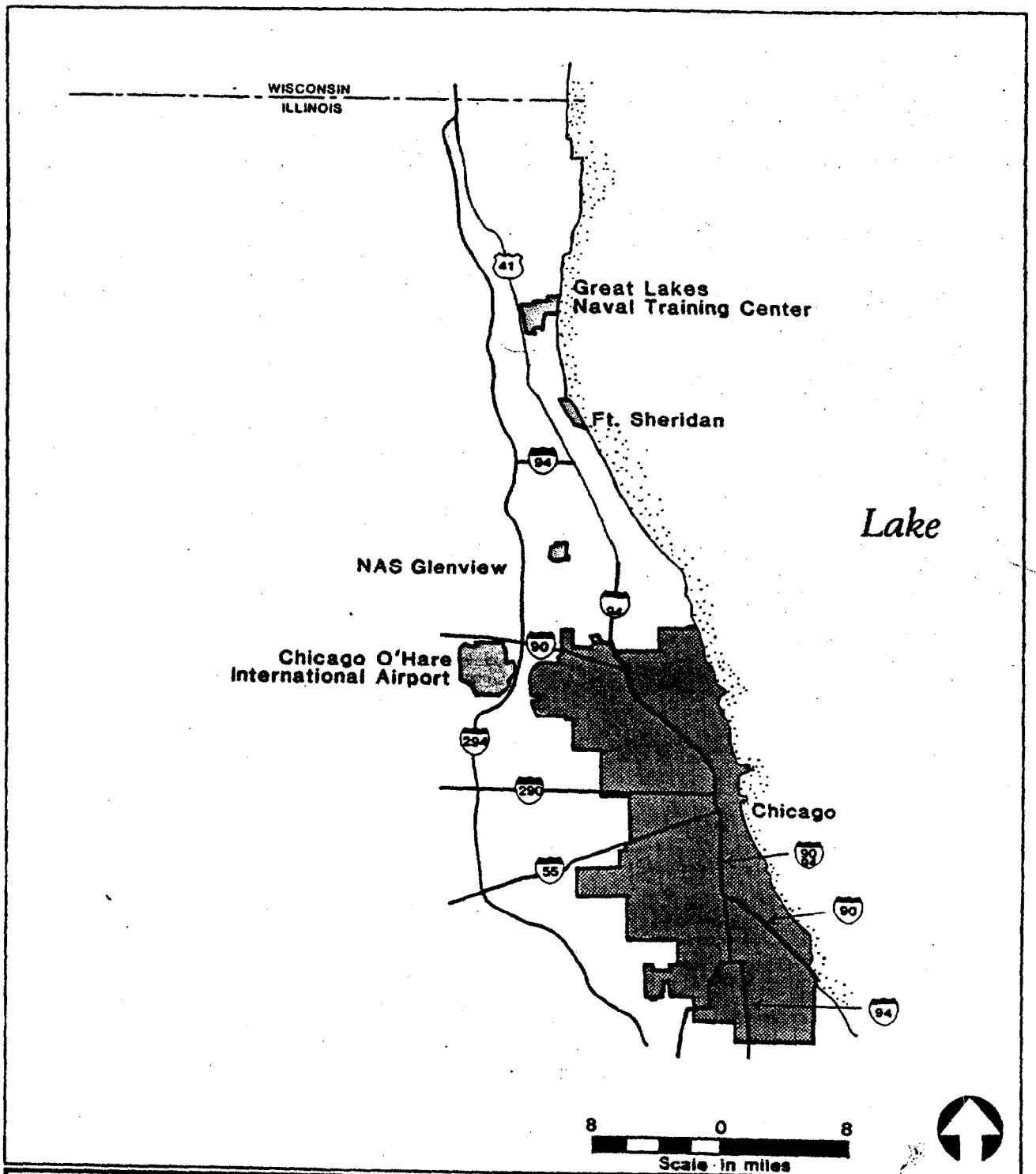

Figure 1-1

General Location Map,
NC Great Lakes

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

CHAPTER 2. SIGNIFICANT FINDINGS AND CONCLUSIONS

2.1 INTRODUCTION. This chapter summarizes the significant findings and conclusions of the Initial Assessment Study (IAS) regarding characteristics of the disposal and spill sites identified at Naval Complex (NC) Great Lakes. First, aspects of the local geology, surface drainage, and hydrogeology are discussed with regard to potential contaminant migration pathways. Next, conditions at sites recommended for Confirmation Studies are summarized. Finally, sites not recommended for Confirmation Studies are discussed.

2.2 HYDROGEOLOGY AND MIGRATION POTENTIAL. Two pathways for the migration of contaminants exist at NC Great Lakes. These pathways are ground water transport in the shallow till and sand-and-gravel aquifers, and surface water runoff to Skokie Ditch or Pettibone Creek.

2.2.1 Ground Water. NC Great Lakes is underlain by a sheet of glacial material up to 250 feet thick. This material ranges from completely unsorted to well sorted. Where unsorted, the glacial till commonly forms aquitards; sorted materials comprise local aquifers. Figure 4-8 maps the locations of buried aquifers at NC Great Lakes.

Hydraulic conductivities in till are typically very low, with values in the range of 10 to the minus 12 centimeters per second (cm/sec). The generally flat nature of these sheet-like deposits results in very low hydraulic gradients. Ground water flow through these materials is governed by these low conductivities and gradients, and is severely restricted.

Aquifers interspersed throughout the till represent pathways for the migration of pollutants. In the area of NC Great Lakes, the gravelly aquifer between the glacial till and the underlying limestone is occasionally tapped for water; this aquifer lies at a minimum depth of 170 feet. It can be concluded that there is infinitesimal likelihood of contaminants reaching this tapped aquifer.

It must be noted that NC Great Lakes is underlain by three shallower, localized aquifers. These lie at depths of 10 to 15 feet, 15 to 50 feet, and 50 feet or more beneath NC Great Lakes and the surrounding area. The shallowest of these local aquifers may serve as a conduit for the migration of polluted ground waters; it is highly unlikely that polluted ground waters can reach any of the deeper aquifers. None of these aquifers is utilized as a source of potable water. Figure 4-8 shows the location of these aquifers.

Locally, aquifers near NC Great Lakes are hydraulically connected to the local streams, and contaminated ground water from these aquifers may reach Skokie Ditch or Pettibone Creek, and then be carried off-base.

2.2.2 Surface Water. NC Great Lakes lies in two drainage basins - the North Branch Chicago River Drainage Basin and the Lake Michigan North Drainage Basin. The divide between the basins lies along Green Bay Road. Precipitation which does not infiltrate the relatively impervious surficial material will travel as overland flow into either Skokie Ditch or Pettibone Creek.

Water in Skokie Ditch is not potable or suitable for agricultural purposes. Illinois water quality standards for ammonia-nitrogen, fecal coliform, and dissolved oxygen are commonly violated in Skokie Ditch downstream from NC Great Lakes. It is doubtful that NC Great Lakes is a significant contributor to these pollution loads, as the only discharge from the activity that may reach Skokie River comes from the storm sewers that drain Forrestal Village. This condition is typical of the poor water quality in the entire North Branch Chicago River Drainage Basin (Northern Division, Naval Facilities Engineering Command (NORTHNAVFACENGCOM), 1980).

Pettibone Creek drains the Mainside area of NC Great Lakes and empties into Lake Michigan at the activity's harbor. Pettibone Creek has on occasion been a conduit for spilled chemicals generated by industrial activity immediately off-base. According to the Illinois Environmental Protection Agency (IEPA), Pettibone Creek has the highest incidence of violations of water quality parameters and the highest number of separate violations in the Lake Michigan North Drainage Basin. Sediments in the Boat Basin receive these pollutants, which accumulate therein.

Contamination from Pettibone Creek could possibly enter the water intake serving the activity, although this is not considered a serious problem due to the intake's remote location (8,000 feet offshore) and the dilution of any contamination by the waters of Lake Michigan.

2.3 SITES RECOMMENDED FOR CONFIRMATION STUDY. Of the 14 disposal or spill sites identified at NC Great Lakes, seven are recommended for Confirmation Studies. Figures 2-1a and 2-1b show the locations of these sites.

2.3.1 Site 1. Golf Course Landfill. The Golf Course Landfill (Figure 2-2) is a 49-acre site, located at the northwestern corner of NC Great Lakes. The site is located under the fairways, greens, and tees of at least 12 holes of the present Golf Course. The northern and western boundaries of the site are also activity boundaries. The Fire Fighting Training Area forms parts of the southern and eastern boundaries of this disposal area.

The site was the active disposal area for NC Great Lakes during the period 1942 through 1967. There was a hiatus during the years when the land title was passed to the Veterans' Administration. No record of other land disposal areas existing during this time period was found. It is estimated that as much as 1.5 million tons of material may have been burned or disposed of at this site. In 1967, the area was closed and covered with ash and a thin layer of topsoil.

The site was operated as a trench-burn landfill. A dragline was used for trench excavation. Each trench was approximately 8 feet wide and was dug to at least the top of the water table (6 to 8 feet in this area). Occasionally, the trenches had several feet of water standing in the bottom. General refuse and trash were disposed of directly into these trenches. Free liquid oil, such as waste engine oil, from activity shops was also disposed of in this manner. When a significant volume of material was disposed of into a trench, the pile was ignited and allowed to burn to

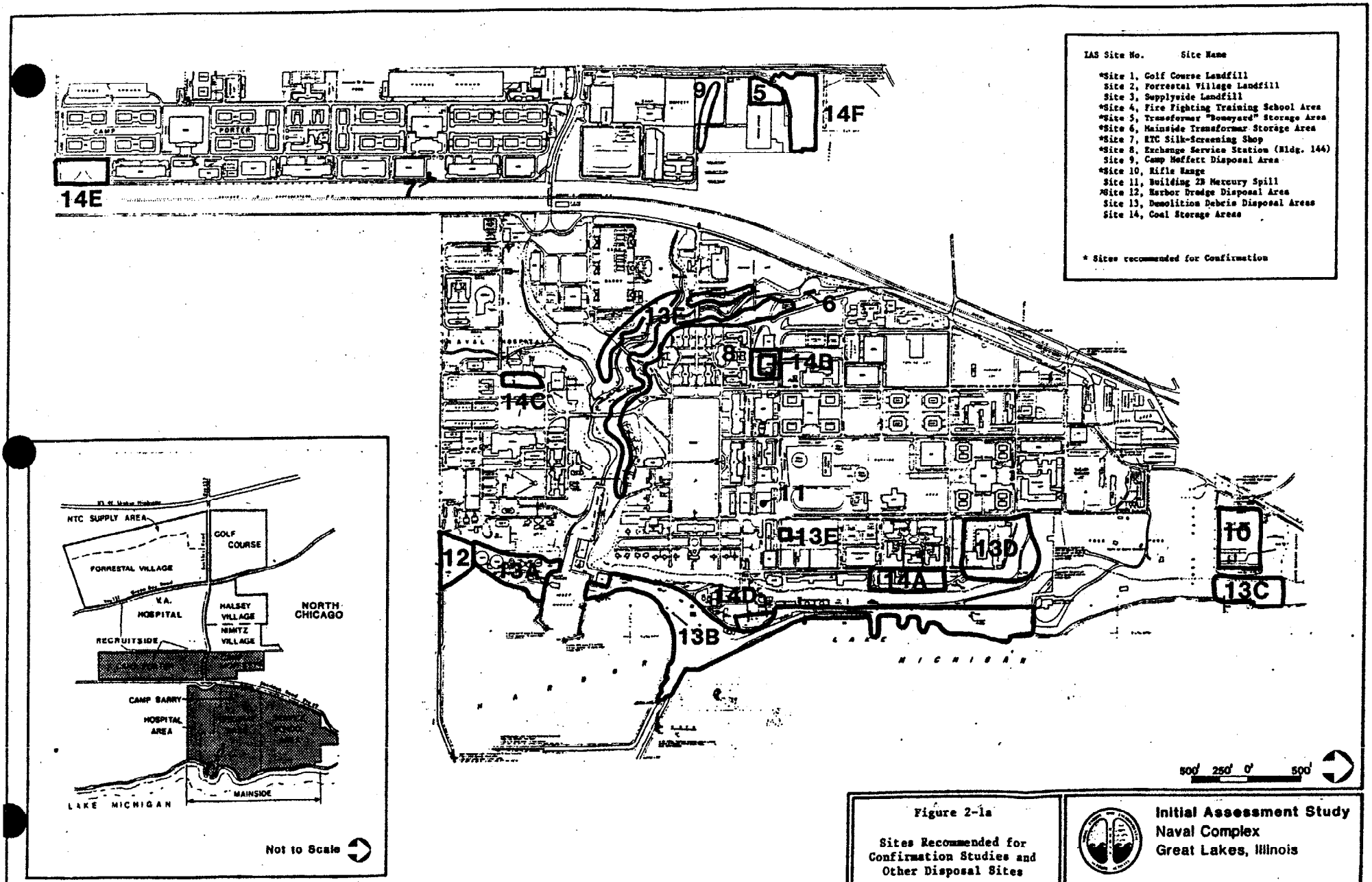

Figure 2-1a

Sites Recommended for Confirmation Studies and Other Disposal Sites

Initial Assessment Study
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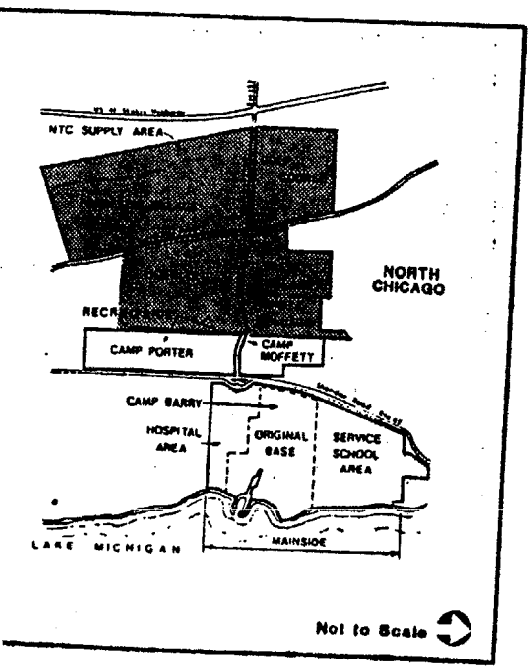
IAS Site No.	Site Name
*Site 1,	Golf Course Landfill
Site 2,	Forrestal Village Landfill
Site 3,	Supplyside Landfill
*Site 4,	Fire Fighting Training School Area
*Site 5,	Transformer "Boneyard" Storage Area
*Site 6,	Mainside Transformer Storage Area
*Site 7,	RTC Silk-Screening Shop
*Site 8,	Exchange Service Station (Bldg. 144)
Site 9,	Camp Moffett Disposal Area
*Site 10,	Rifle Range
Site 11,	Building 23 Mercury Spill
*Site 12,	Harbor Dredge Disposal Area
Site 13,	Demolition Debris Disposal Areas
Site 14,	Coal Storage Areas

* Sites recommended for Confirmation



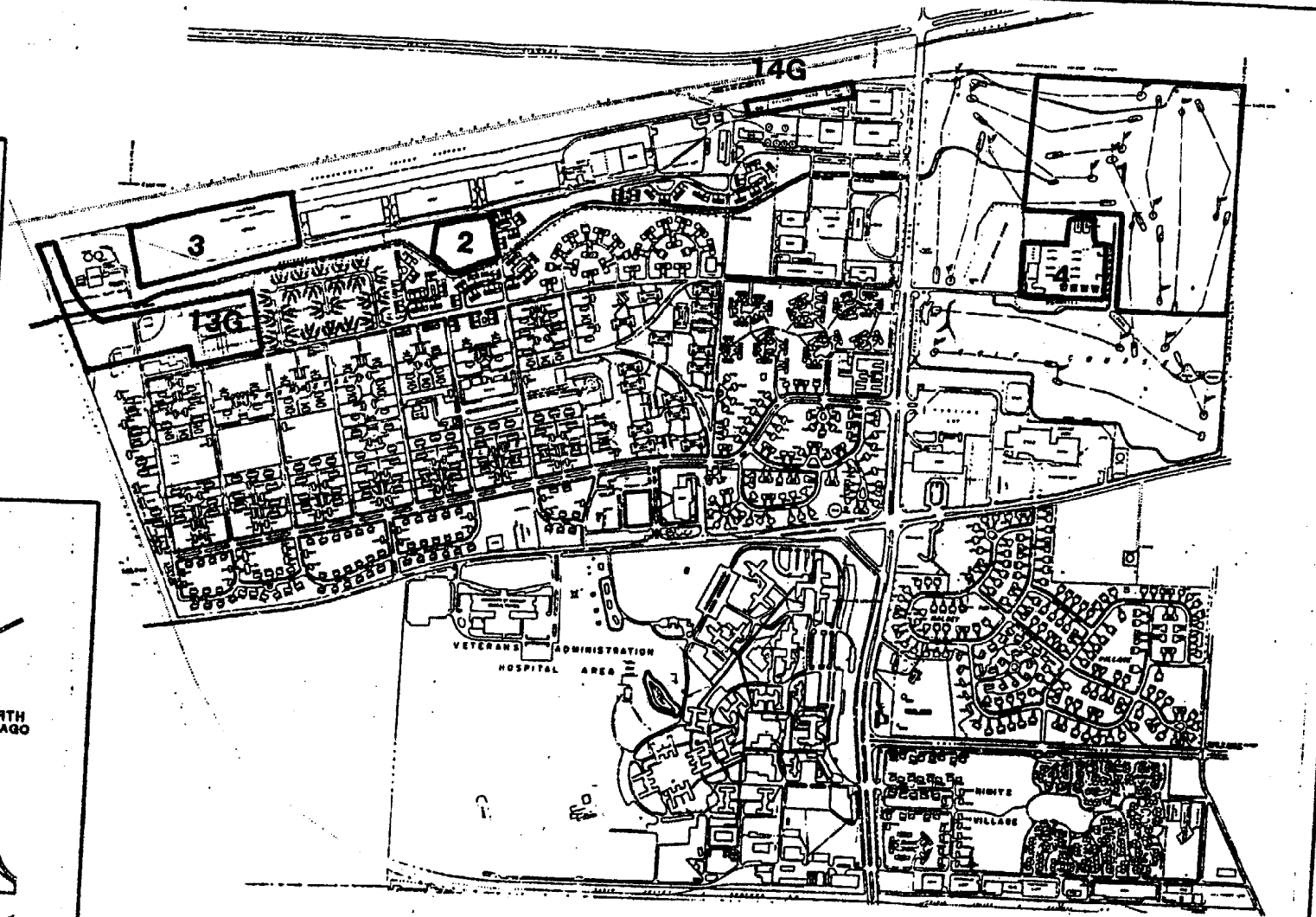


Figure 2-1b

Sites Recommended for Confirmation Studies and Other Disposal Sites

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

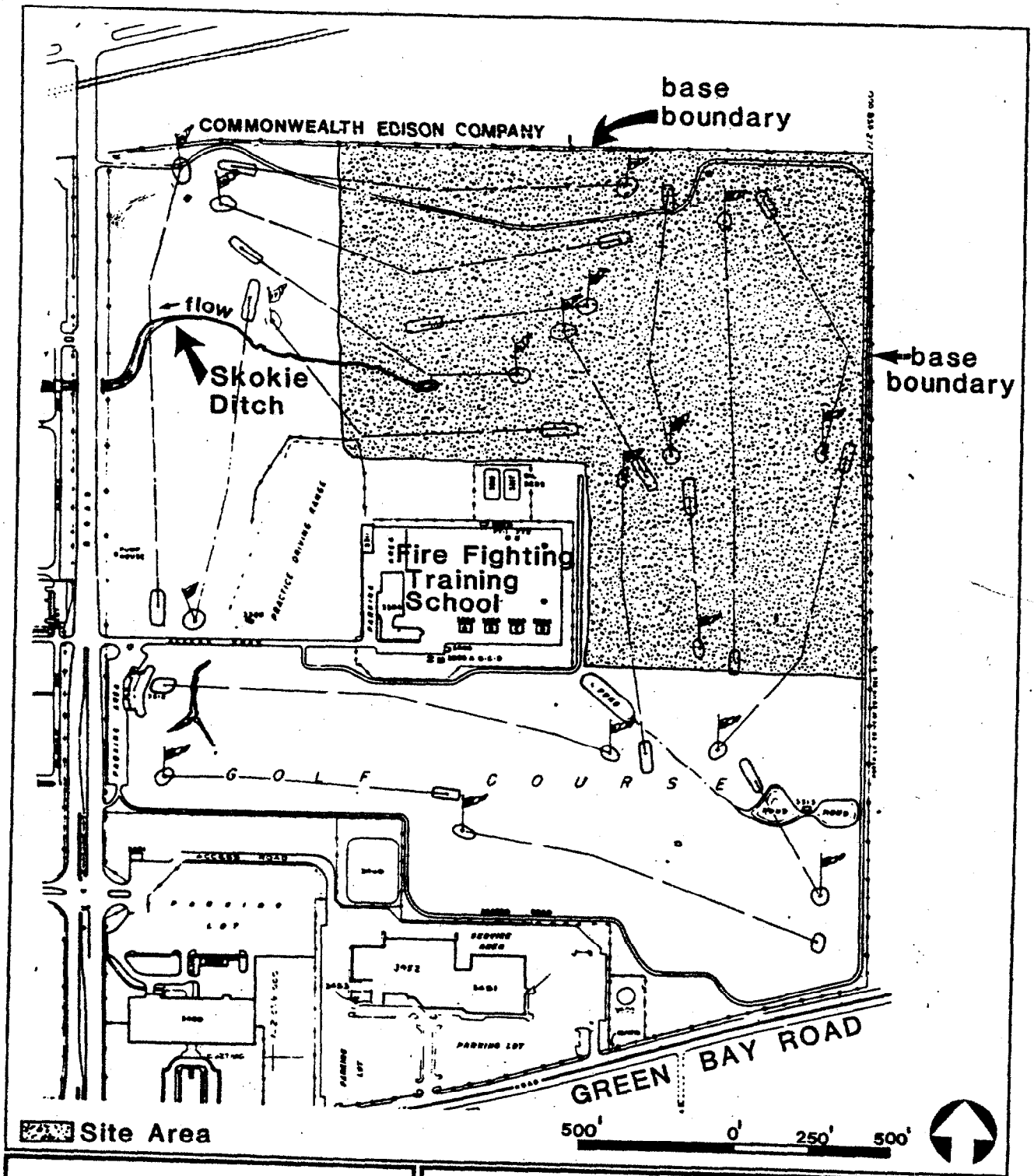


Figure 2-2

Site 1, Golf Course Landfill

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Great Lakes, Illinois

completion. Proceeding in this manner, the trenches were progressively filled and covered from west to east and north to south.

Coal ash from the activity was also disposed of at this site. Reportedly, ash was encountered for the first several feet when holes were being dug for trees within the disposal area. Other chemicals which may have been disposed of at this site include perchloroethylene (PCE), transformer oils containing polychlorinated biphenyls (PCB's), and solvents including carbon tetrachloride, Solvent 144, and motor crankcase oil. Small volumes of other solvents and household hazardous wastes are also known to have been disposed of into the landfill.

The shallow subsurface at NC Great Lakes is composed of glacial till which has few, if any, continuous sand stringers which could carry ground water to a remote location. The primary pathway is by way of Skokie Ditch, a perennial stream which rises on the disposal site. Skokie Ditch flows in a southerly direction from the site, passing the Supplyside area of the activity and exiting from Navy property after passing the Green Bay Sewage Treatment Plant in Forrestal Village. From there, Skokie Ditch, which has become the Skokie River, discharges into the Chicago River and finally into the Mississippi River. Skokie Ditch is a sluggish, almost stagnant stream in this area, except immediately after a storm. No fishing has been reported in close proximity to the activity. After leaving the activity, Skokie Ditch passes several industrial plants and drains into the Skokie River. These plants are also potential contributors to the stream flow.

Although there is no demonstrable migration of contaminants from this landfill to Skokie Ditch, such contamination is very plausible. Potential receptors of contaminants would include fish taken from Skokie Ditch downstream of the activity and other industrial land uses, and any person entering the area; it is noteworthy that the area is fenced off to prevent people from wandering into it. Because of the variety of toxic materials which may have been disposed of there, and the close proximity of human receptors, Site 1, Golf Course Landfill, is recommended for a Confirmation Study.

2.3.2 **Site 4, Fire Fighting Training Area.** The Fire Fighting Training Area (Figure 2-3) has been in constant use since 1942. This 10-acre training area is used to train all recruits in fire fighting techniques by letting them fight practice fires in open steel tanks and in smoke practice buildings. These fires are set with #2 fuel oil which is floated on water. Gasoline is used to ignite the fuel oil.

In about 1979, a centrifugal oil/water separator was installed in the waste line between the training areas and the lagoons (located west of the training area) to which the wastes generated by the training exercises are directed. Oil removed from the separator and residual oil skimmed manually from the lagoons was drummed and the 55-gallon drums were stored along the western fence line of the training area.

From 1942 to 1979, waste petroleum, oils, and lubricants (POL's) and waste solvents from other NC Great Lakes activities were also collected in this

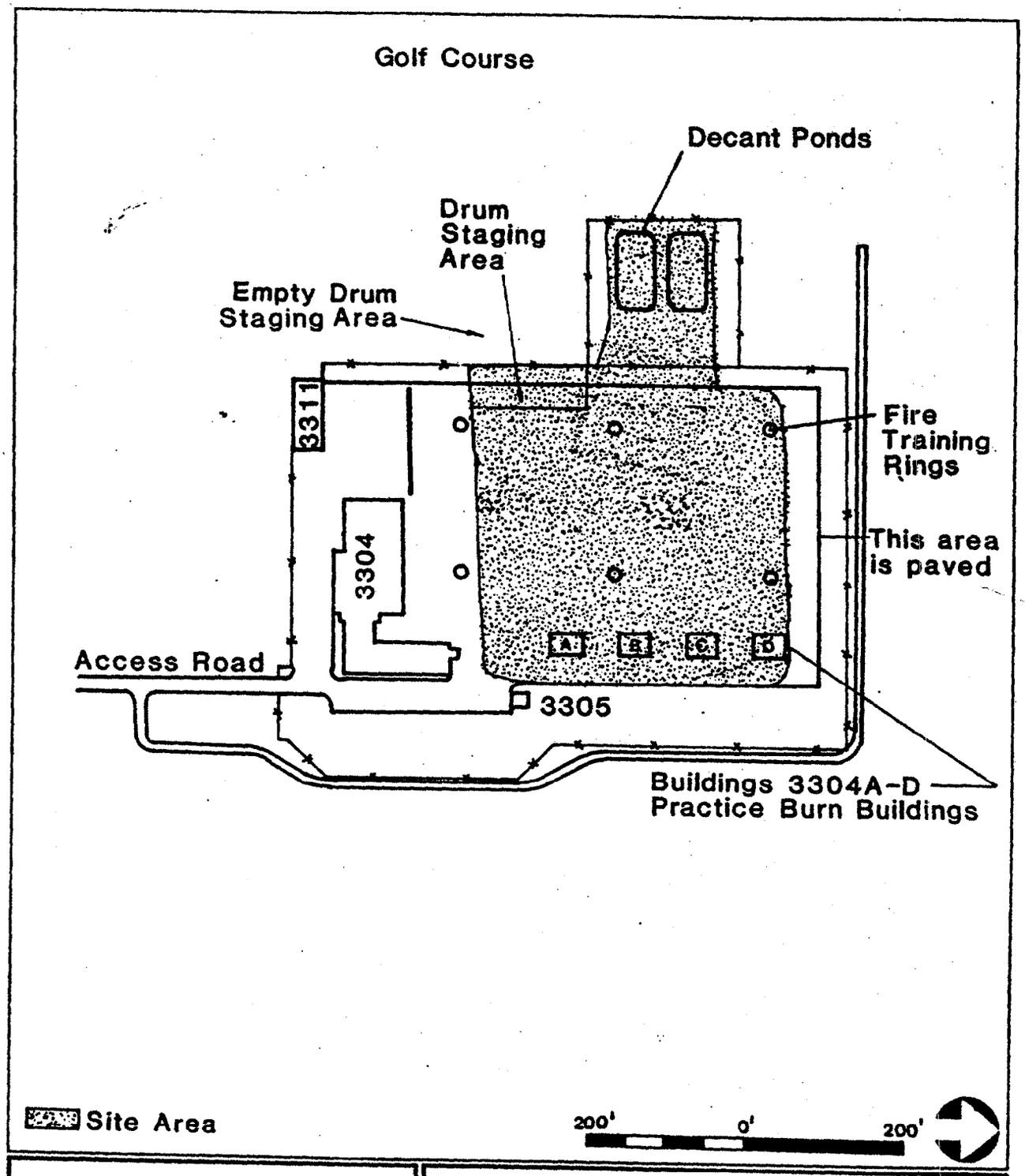

Figure 2-3

Site 4, Fire Fighting Training Area

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area. Some of this material was burned in the training exercises on an as-available basis. The remainder, also in 55-gallon drums, was allowed to accumulate along with the oil that had been skimmed from the lagoons and removed from the separator. The practice of accepting these materials was discontinued in 1979; however, the storage of the approximately 300 drums that had accumulated continued until 1983, when the first of a series of contracts were let with waste disposal firms to haul away the liquid wastes which were stored in these drums. All of the drums had been emptied by the spring of 1985, and the empty drums were awaiting disposal as scrap by the Defense Reutilization and Marketing Office (DRMO), formerly the Defense Property Disposal Office (DPDO).

The area where the 300 drums were stored is a soil pad and is heavily soaked with residual oil from spillage. The area is not diked, and runoff could reach the Skokie Ditch during heavy rains.

Specific chemicals which may have been stored in the drums include Solvent 144, turpentine, gasoline, #2 diesel fuel, crankcase motor oil, and antifreeze. Degradation of some of this material before it entered the soil and limited evaporation of the more volatile components of gasoline and solvents before they got below the top 6 inches of soil are likely.

Given the possibility of contamination from the solvents and gasoline used in the liquid waste-burning episodes of the past, and the potential migration of any contaminants lost to the environment into Skokie Ditch, the pathways and potential receptors are the same as those described for the Golf Course Landfill. Individuals entering the fenced area and the wildlife (fish) in Skokie River are the main receptors identified. Site 4, Fire Fighting Training Area, is recommended for a Confirmation Study.

2.3.3 <u>Site 5, Transformer Storage "Boneyard"</u>. Located in the northern end of Camp Moffett, the Transformer Storage "Boneyard" area (Figure 2-4) is southwest of Building 1517, east of the Elgin, Joliet & Eastern Railroad right-of-way. From 1945 to 1985, this location was the primary storage area for out-of-service transformers, including those filled with PCB oils. Prior to 1985, stored transformers were moved about within the entire storage area and, at one time or another, could have been anywhere within the area. In 1985, the PCB transformers were moved into a storage facility specifically designed to hold them (Building 1405). There are currently about 40 non-PCB transformers and capacitors in storage in the area.

Waste materials in the Transformer Storage "Boneyard" included transformer oils, PCB transformer oils, and lead insulation from high voltage cables. Four surface soil samples collected in the Transformer Storage "Boneyard" in 1984 had PCB levels of between 50 and 100 parts per million (ppm). These wastes are for the most part tied up in the shallow soils; the most likely migration pathway is being tracked out on vehicular tires or the shoes of employees who walk in that area. Receptors would thus include those employees who frequently work in the Transformer Storage "Boneyard" and those who work in nearby areas to which "Boneyard" employees may track the contaminated soils. Site 5, Transformer Storage "Boneyard," is recommended for a Confirmation Study.

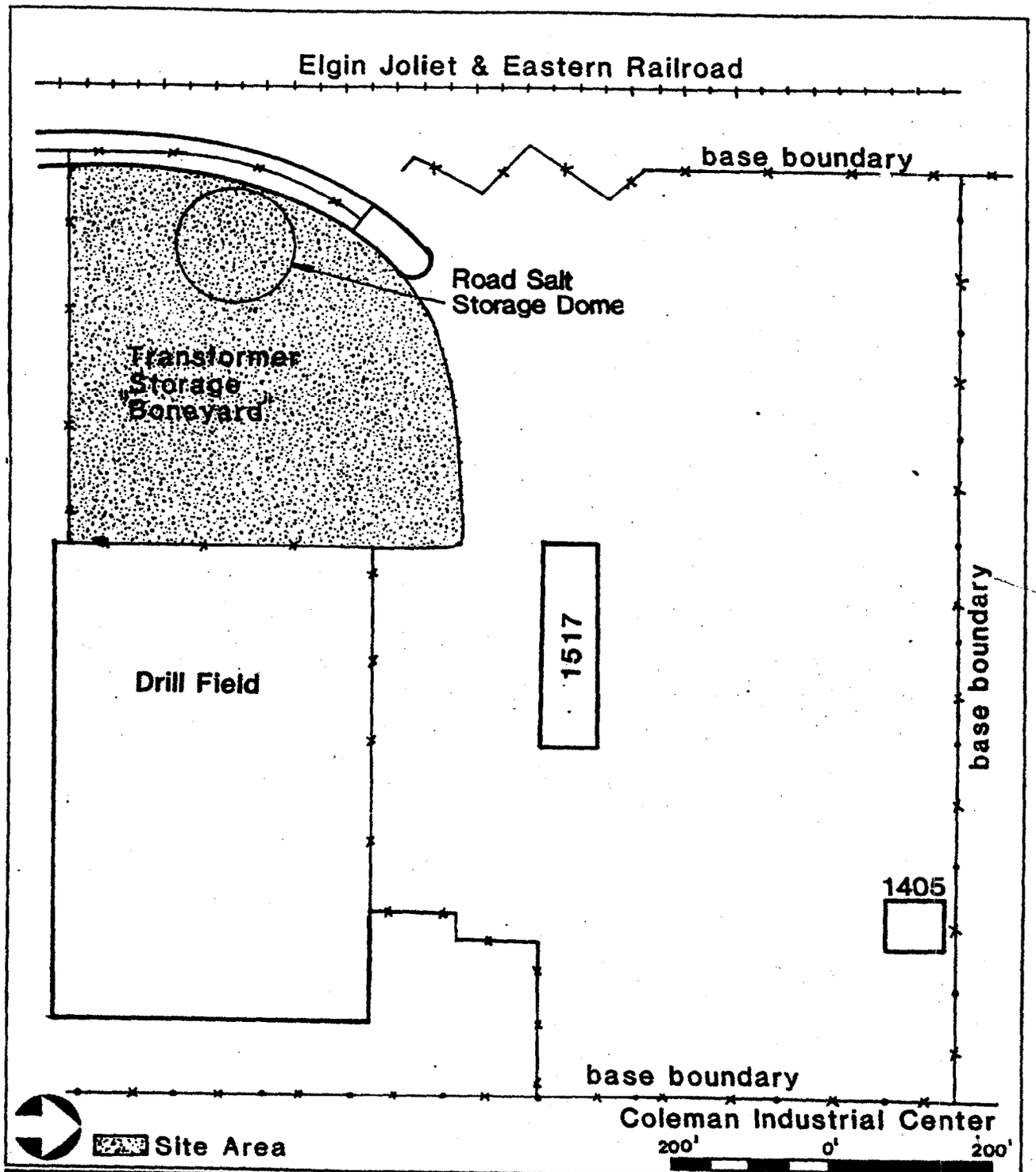

Figure 2-4

Site 5, Transformer Storage "Boneyard"

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2.3.4 Site 6, Mainside Transformer Storage Area. Six transformers containing PCB oils were stored from 1979 to 1981 on the basement floor (a dirt floor) of Building 226 (Figure 2-5). The basement floor is at grade with the ground surface immediately west of the building. The building has since been razed to the foundation level. These foundation walls remain standing, and act as bulkheads to maintain the higher ground elevations found on the east side of the building.

While the transformers were stored there, vandals removed the tops of six of them and spilled the contents out on the ground prior to stripping out the copper. The entire liquid contents of the transformers (totaling approximately 132 gallons of PCB oil) was lost. No cleanup of the site was made.

During the on-site visit, a tour of the disposal site was made. The soils inside the foundation wall were stained with oil, especially in the southeast corner of the foundation area. This was the only area of the foundation without a thick stand of weeds.

Pathways include possible erosion of the contaminated soils into a nearby storm sewer inlet which discharges into Pettibone Creek; contaminants could also be picked up by the shoes of casual visitors who may wander into the area. The area is not secured, but is substantially off the beaten track, even of the jogging trail which passes nearby. Potential receptors include the fish and organisms of Pettibone Creek, the harbor, and Lake Michigan, into which Pettibone Creek discharges. Some sport fishermen take fish from the shore and nearshore areas of Lake Michigan, possibly introducing the contamination into the human food chain. Site 6, Mainside Transformer Storage Area, is recommended for a Confirmation Study.

2.3.5 Site 7, RTC Silk-Screening Shop. The Recruit Training Center (RTC) Silk-Screening Shop (Figure 2-6) is located in the RTC Training Aids Branch in Building 1212. This shop has been in its present location since at least 1965. The various flags and banners used by the recruits during parades, graduations, etc., are made in this shop. The screens are painted or dyed with ink during their preparation. Materials used include water- and oil-based lacquers and enamels, mineral spirits, acetone, thinner, direct photographic emulsions, and ink products. The specific materials used have reportedly changed over the years.

As of August 1985, wastes generated by the RTC Silk-Screening Shop were no longer disposed of on the ground; they are now disposed of in a 55-gallon drum that is emptied by a private contractor hired through DRMO.

Upon completion, the finished silk screens are washed with water in a booth located in the northeast corner of Building 1212. This wash booth had a 2-inch drain in the bottom that penetrated the exterior wall and ended in mid-air. Any material passing through the drain emptied onto the unpaved ground immediately outside the building. This practice continued from 1965 to 1985. The ground surrounding the outlet (an area of approximately 3 feet by 15 feet) is obviously stained. Upon closer examination it can be seen that

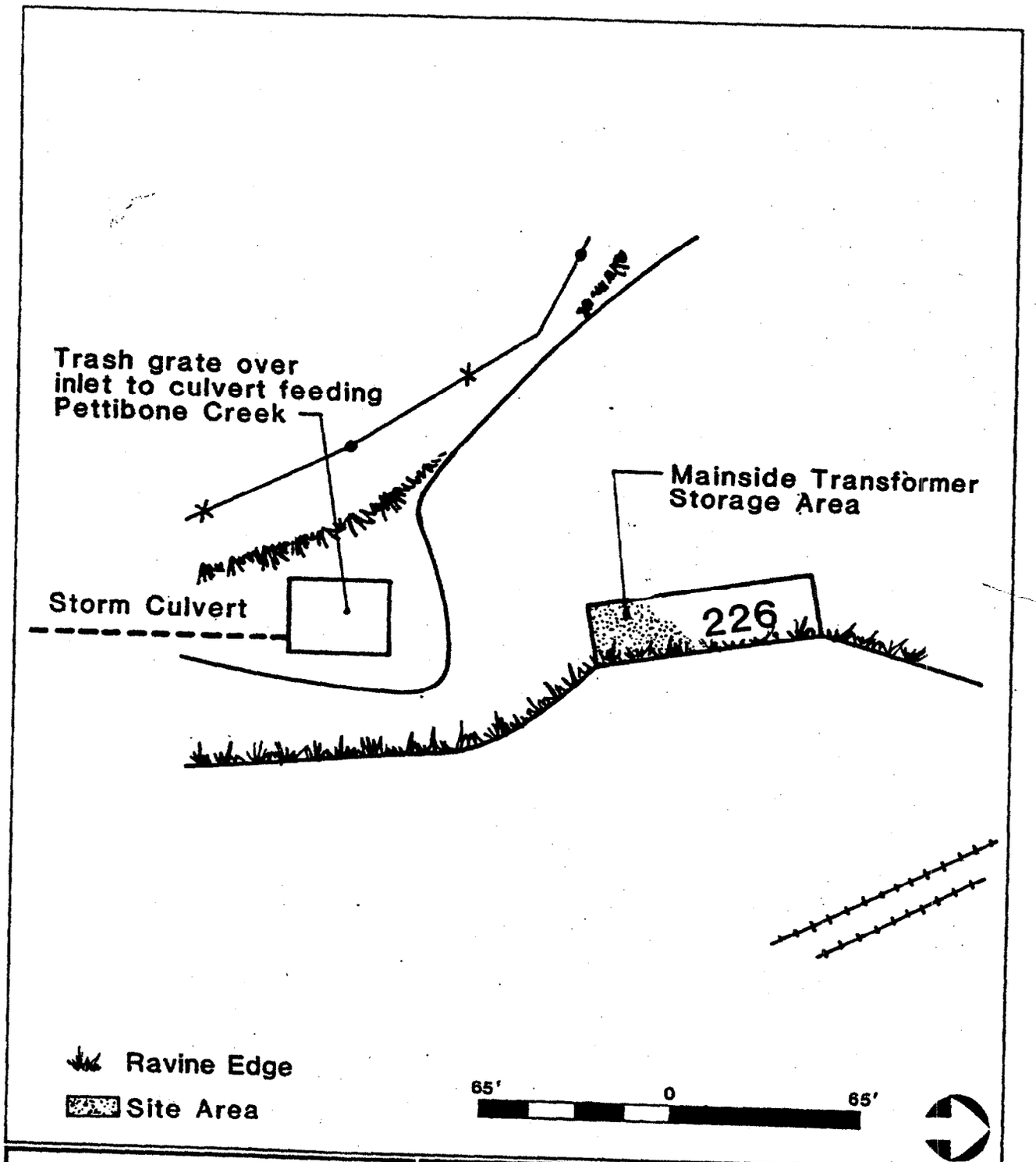

Figure 2-5

Site 6, Mainside Transformer Storage Area

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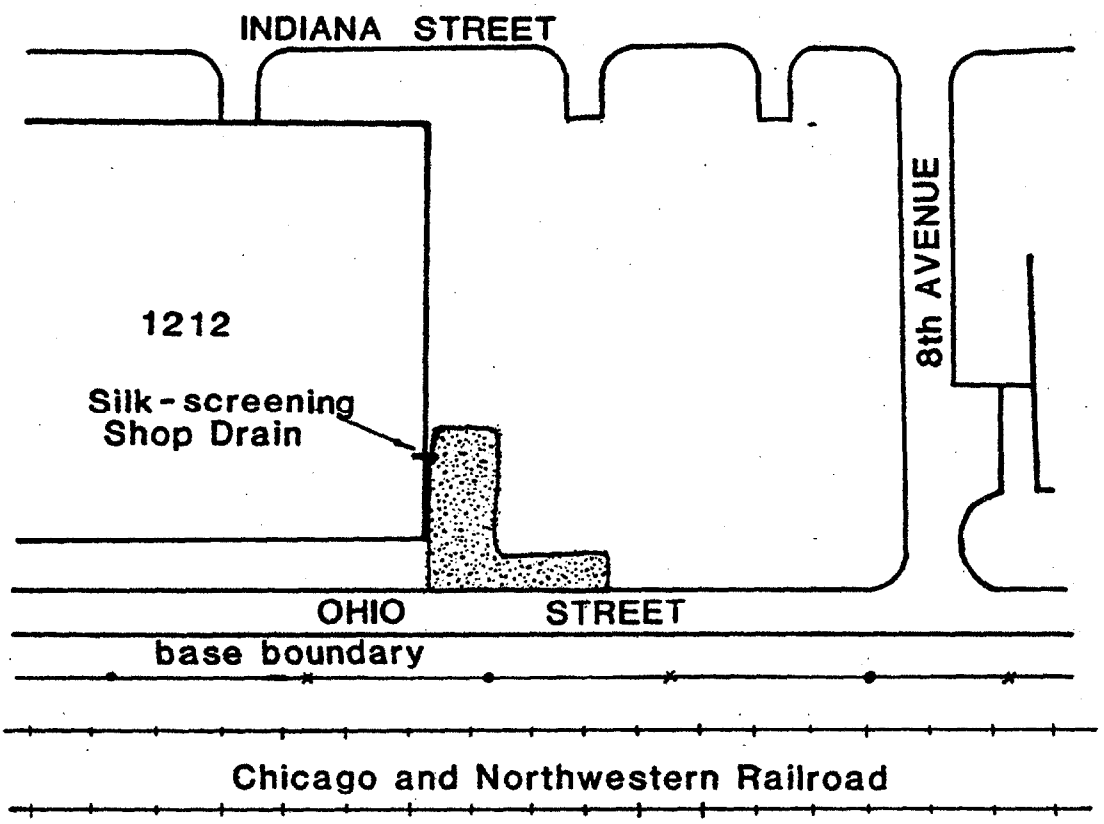

Site Area

100' 0' 100'

Figure 2-6

Site 7, RTC Silk-Screening Shop

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the staining continues north and east into the dirt road behind the building where, reportedly, the effluent often formed pools during periods of heavy discharge.

The pools remained until they either infiltrated the soil, were flushed away by precipitation, or evaporated. It is unlikely that waste which infiltrated the surface entered the buried sand-and-gravel glacial aquifers that underlie the activity. In the vicinity of this site, the water-bearing zones which could be considered to be aquifers lie at a depth of approximately 15 to 50 feet below the ground surface. The tight nature of the surface materials here would restrict the migration of contaminants into these deeper layers. A more likely pathway would be via storm water runoff, which may have carried the contamination directly into Pettibone Creek via overland flow or through the storm sewers. Once in the creek, the contamination would be free to flow directly into Lake Michigan (although upon entering Pettibone Creek the wash waste would be diluted by a factor of several orders of magnitude).

Possible receptors include the fish and other organisms living in Pettibone Creek, the harbor, and Lake Michigan. Direct exposure of personnel living in the RTC camps is likely to be limited because of the relative inaccessibility of the area within RTC, and the lack of idle time allocated to personnel in the area. Site 7, RTC Silk-Screening Shop, is recommended for a Confirmation Study.

2.3.6 **Site 8, Exchange Service Station.** In 1983, 3,000 gallons of leaded gasoline leaked at the Navy Exchange service station (Figure 2-7) on the Mainside area of the activity (Building 144). Approximately 3,000 gallons of gasoline were released when a line leading to the station's underground storage tanks ruptured. Wells were installed by an outside contractor to pump out the contaminated ground water and gasoline. The recovered fuel was delivered to the Fire Fighting Training Area (Site 4). Contaminated water was removed from the activity by an outside contractor. After the recoverable gasoline was removed from the ground, contaminated soil was also removed for off-base disposal. A 24-hour fire watch was put in effect, and the area was monitored by the Fire Department for a month following the spill.

Despite the cleanup at the spill site, the odor of gasoline can still be detected in the basement of the Post Office (Building 112), which is within 100 feet of the spill site, after a heavy rain (residual gasoline remaining in the subsurface is displaced by percolating rainwater). This area is underlain by a sand-and-gravel aquifer at a depth of less than 15 feet below the surface. Gasoline may have entered this aquifer and been carried to Pettibone Creek or Lake Michigan. At the very least, residual gasoline contamination remains in the soils underlying the service station.

Pathways include migration in the shallow subsurface sorted sand aquifer which could ultimately discharge into Pettibone Creek, several hundred feet west of the spill site. Receptors include employees in the Post Office (Building 112) and the organisms in Pettibone Creek, the harbor, and Lake Michigan. Sport fishermen eating their catches from the nearby areas of the

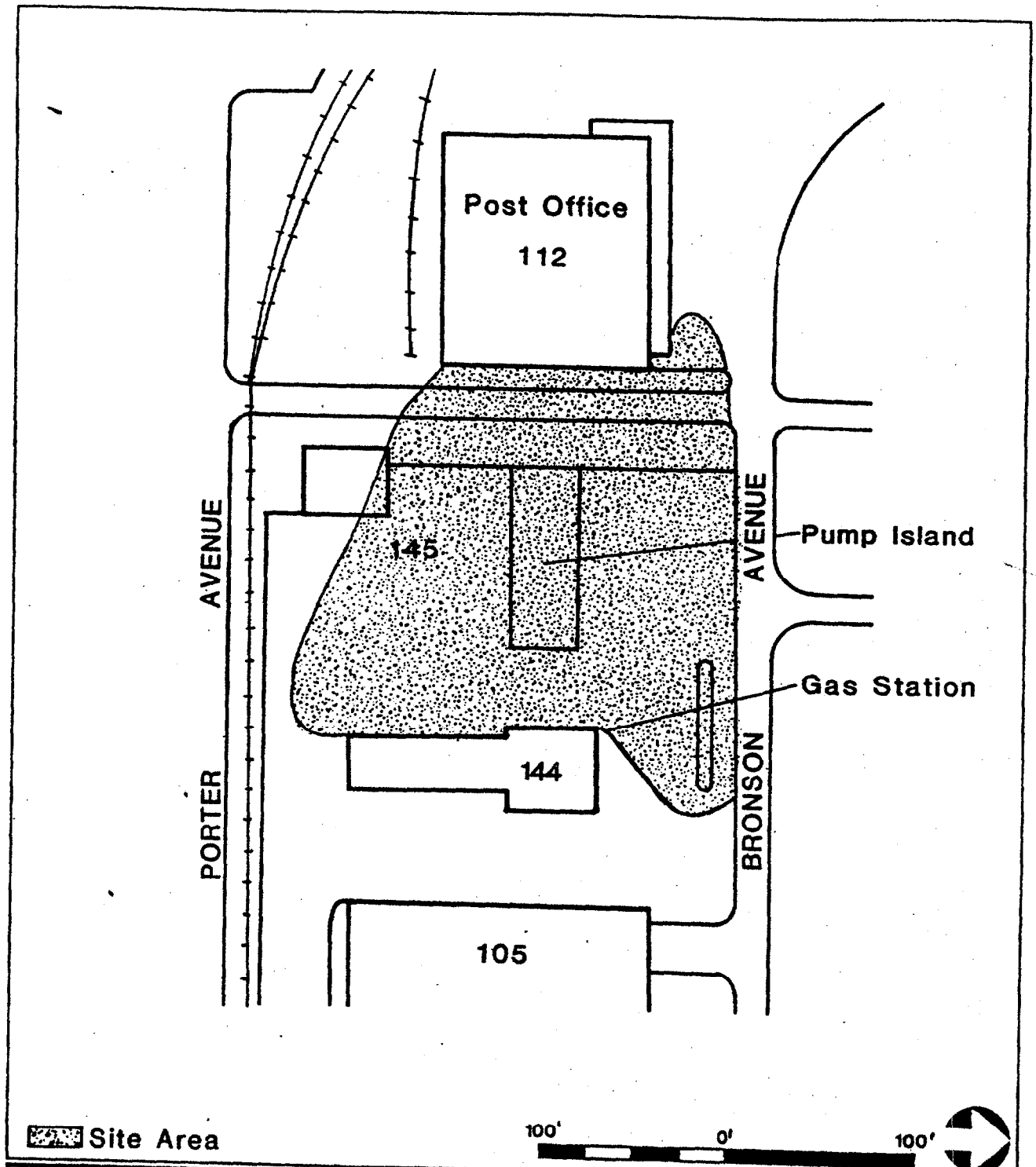

Figure 2-7

Site 8, Exchange Service Station

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lake could ingest fractions of the gasoline from this source. Site 8, Exchange Service Station, is recommended for a Confirmation Study.

2.3.7 Site 12, Harbor Dredge Spoil Area. The harbor has been dredged twice in the history of NC Great Lakes, in 1952 and 1970. Dredge spoils were disposed of in the area outlined in Figure 2-8.

Recent analysis of the in-place harbor sediment by the IEPA indicated a sludge worm population of 10,000 worms per square foot (NORTHNAVFACENGCOM, 1984). Populations of 100 worms per square foot are considered to represent contaminated conditions. Such a worm population is indicative of sediments that are extremely rich in organic matter. Moreover, the organic-rich sediments may reflect conditions of poor water circulation within the harbor area.

The dredge spoils taken from the harbor in 1952 and 1970 would also be expected to be organically rich, although exposure to the air would have resulted in oxidation and accelerated decomposition of the organics.

Contaminants entering the harbor area are highly diluted by harbor water and the waters of Lake Michigan. The IEPA has determined, in fact, that the waters of Pettibone Creek transport some quantities of pesticides into the lake and harbor (NORTHNAVCFACENGCOM, 1984). However, according to the IEPA these quantities do not represent a threat to humans or to the environment due to dilution by lake waters (NORTHNAVFACENGCOM, 1984).

The NC Great Lakes Master Plan cites contaminantion of the Inner Harbor sediments with heavy metals, PCB, and oils. The source of these contaminants is apparently the industries located upstream from the activity. Some of these industries are identified in the land use section of Chapter 4 of this report. The Inner Harbor is not Navy property; however, Site 12, the Harbor Dredge Spoil Area, is Navy property.

Hazardous wastes generated by private industry upstream of the activity may have entered the harbor, and these wastes may pose a threat to the environment, even though there is no history of direct dumping in the harbor. Similarly, the sediments dredged from the harbor in 1952 and 1970 may contain concentrations of hazardous materials high enough to warrant further study. Hence, Site 12, Harbor Dredge Spoil Area, is recommended for a Confirmation Study.

2.4 SITES NOT RECOMMENDED FOR CONFIRMATION STUDY. Seven of the 14 potentially contaminated sites found at NC Great Lakes are not recommended for Confirmation Studies. The locations of these sites are shown in Figures 2-1a and 2-1b.

2.4.1 Site 2, Forrestal Landfill. The Forrestal Landfill (Figure 2-9) was the first controlled disposal area used by NC Great Lakes. This operation started in 1967 and ended in 1969. The 4-acre area is located between Superior Street and Skokie Ditch, south of Virginia Court. The site was operated as a trench-type landfill with no burning. This site represented a transition step from the largely uncontrolled operation of the Golf Course

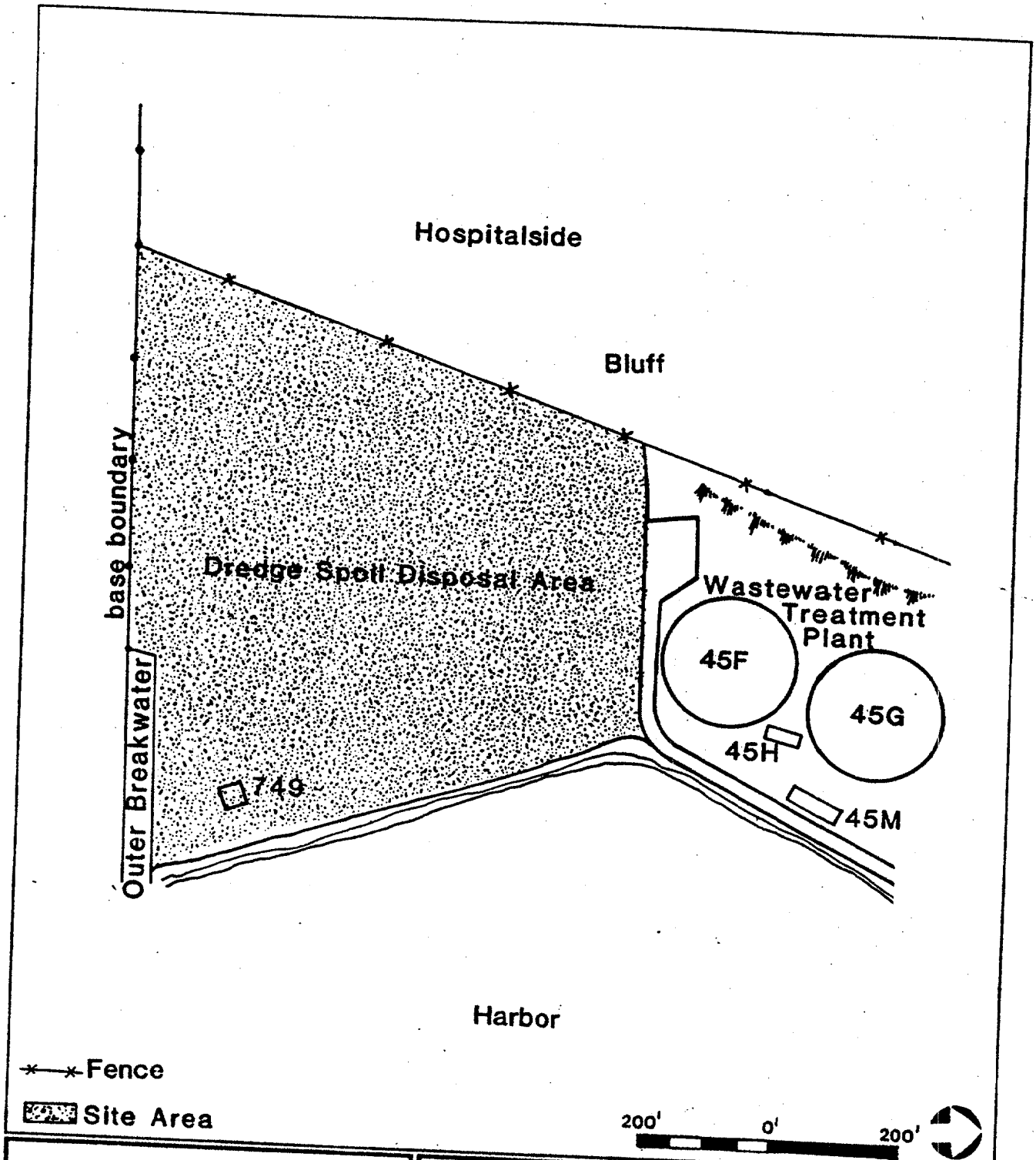

Figure 2-8

Site 12, Habor Dredge Spoil Area

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Great Lakes, Illinois

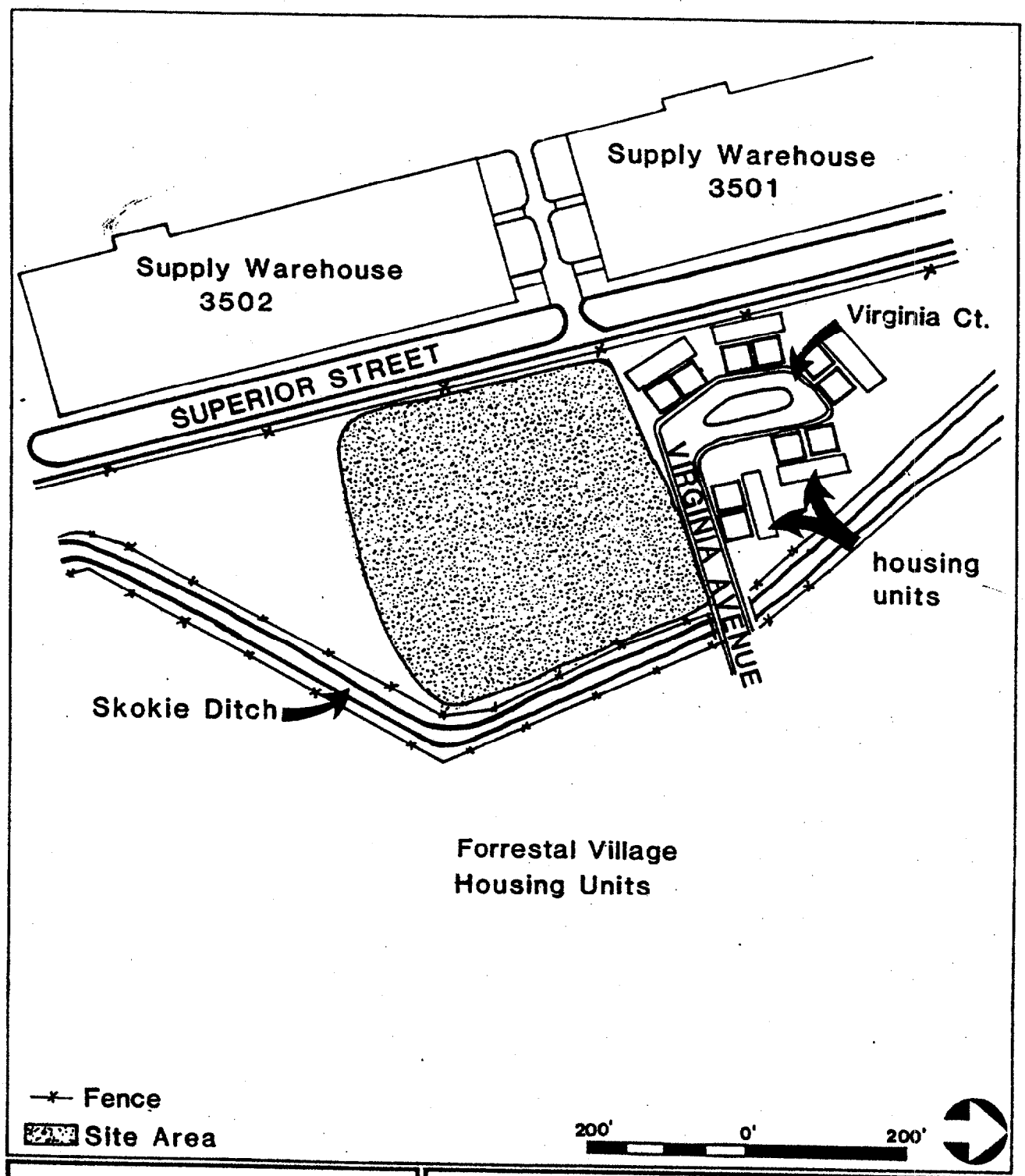

Figure 2-9

Site 2, Forrestal Landfill

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Naval Complex
Great Lakes, Illinois

Landfill (Site 1) to the fully controlled operation of the Supplyside Landfill (Site 3). A guard shack was constructed to limit access to the Forrestal Landfill.

The total volume of material disposed of in the Forrestal Landfill was limited by the size of the parcel involved and the fact that the material disposed of there was not burned. In addition, the period during which the site was operated coincided with the period during which responsibility for waste collection from most activity housing switched from Navy personnel to private contractor, with disposal off Navy property. It is estimated that the site contains approximately 76,000 cubic yards of refuse. No hazardous wastes were disposed of in this landfill.

Degradation products from a site like this include alcohols and methane gas (from degradation of organic wastes). Skokie Ditch is the eastern border of the site and, as described for the Golf Course Landfill, is the most likely pathway for waterborne materials leaving the site. Ground water pathways are not likely since the glacial till material in the shallow subsurface does not permit migration of water. Because some of the housing units in Forrestal Village are within 100 feet of the landfill, gas migration through soil should be considered as a possible pathway.

Receptors of waste products which migrate off the landfill site could include residents of the housing units on Virginia Court, provided that gas migration could be documented, and users of the waters of Skokie River and the streams into which Skokie Ditch empties. However, because gas migration has not been documented in the first 10 years since the closure of the landfill, when it would most likely have occurred, and no hazardous wastes were disposed of at this site, Site 2, Forrestal Landfill, is not recommended for a Confirmation Study.

2.4.2 <u>Site 3, Supplyside Landfill</u>. Supplyside Landfill (Figure 2-10) is the disposal area shown in the General Development Map in the southwest corner of NC Great Lakes and labeled "Closed Sanitary Landfill Area." It is adjacent to the activity boundary and south of the Supply Department warehouse (Building 3503), and extends almost to the westward extension of Alabama Avenue.

Supplyside Landfill has recently (1985) been regraded with final cover which was to be seeded for the first time during the 1985 growing season. The grading was performed by Naval Construction Batallion 401, a tenant command on the activity. The landfill surface rises 15 to 20 feet above the surrounding grade on the east and the west. Skokie Ditch drains the surface water from the area and lies adjacent to the landfill on the east. On the west, an area of poorly drained land begins at the fence marking the activity boundary and occupies several acres of the Commonwealth Edison Company right-of-way.

This landfill operated during the period 1969 to 1983, at which time it was closed; since then, all refuse has been sent off-base for disposal. The period of operation was concurrent with the institution of additional

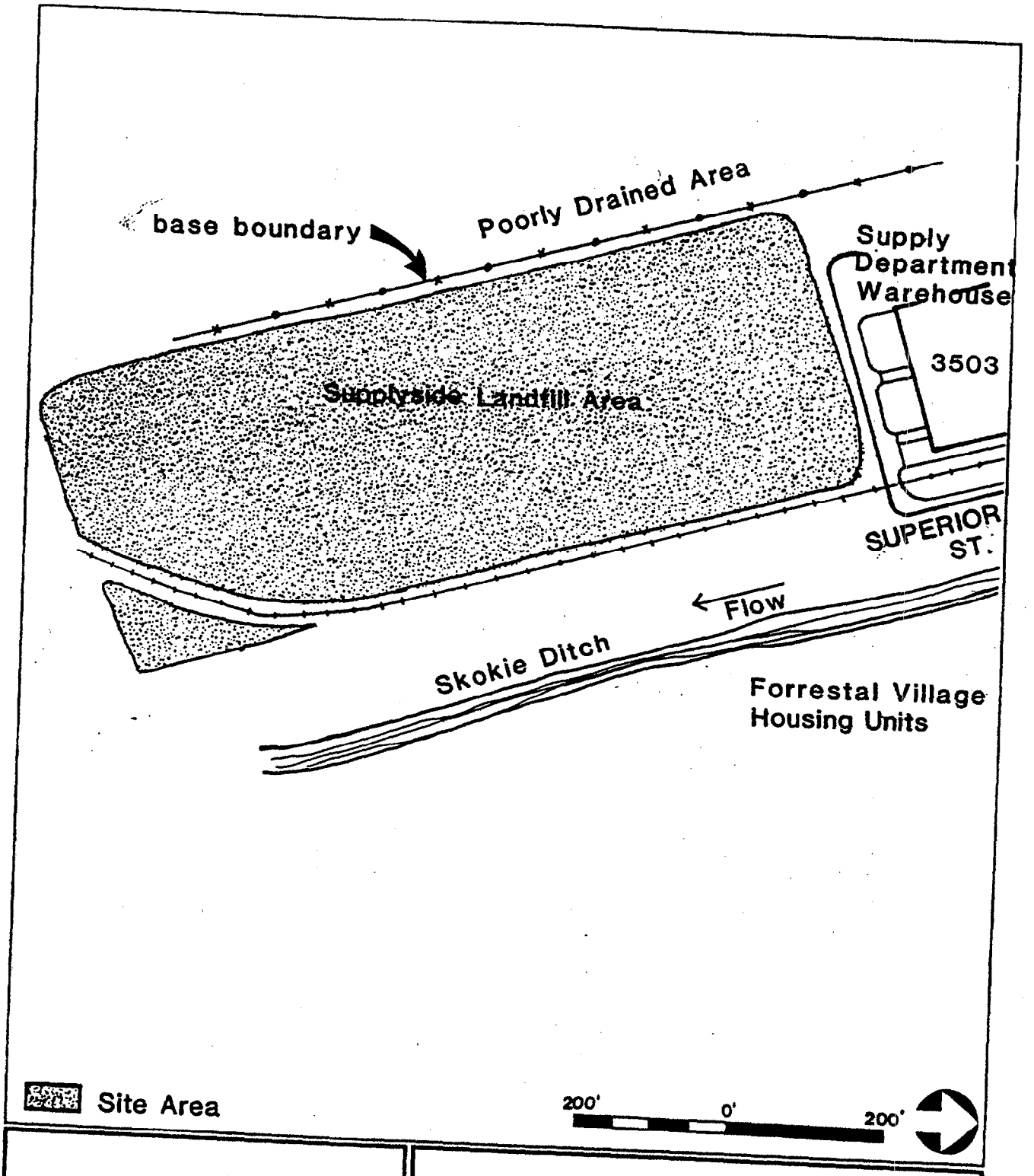


Figure 2-10

Site 3, Supplyside Landfill

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

controls and monitoring of landfill operations. These actions resulted in the additional control necessary to ensure that proper disposal of hazardous materials would be carried out. The landfill was operated as a trench-type landfill, with four parallel trenches on this particular site, which covers an area about 400 feet by 1,000 feet. Landfilling was conducted on both sides of the rail spur. There was never any intentional burning of refuse on this site.

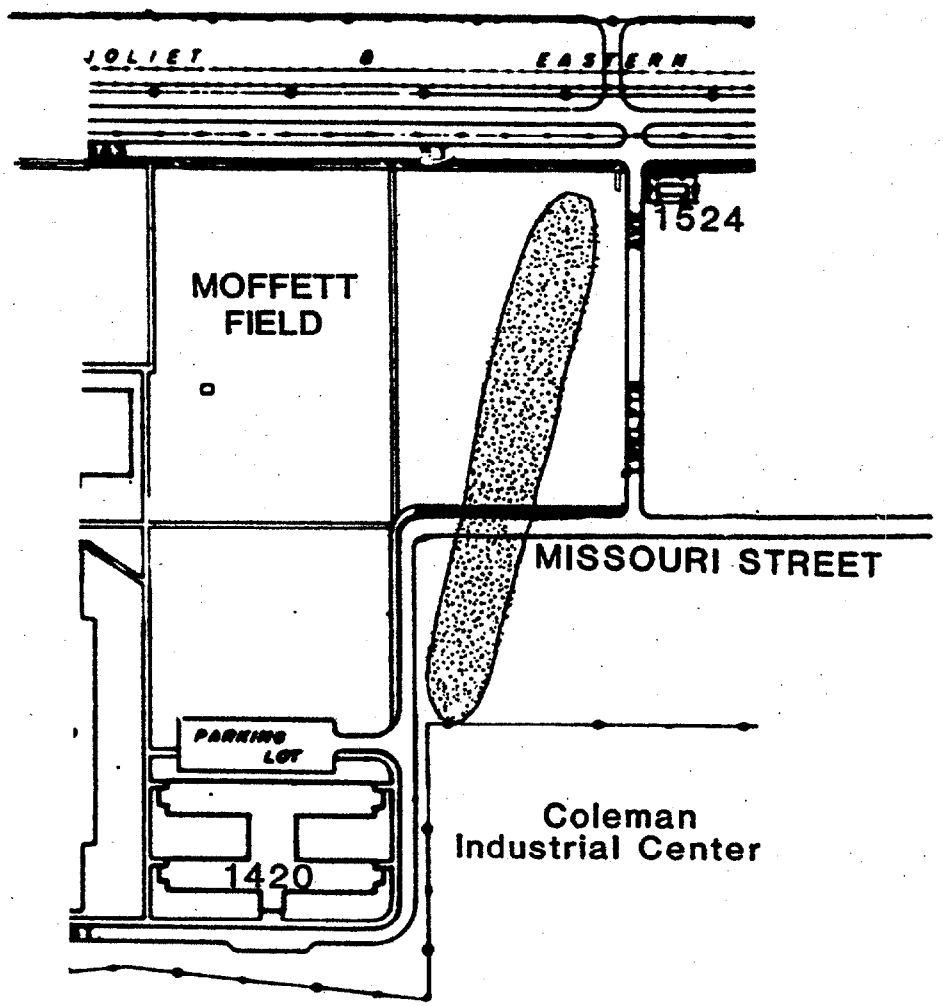
The main components of disposed material at the Supplyside Landfill site were mixed office waste and some galley waste. All household wastes were disposed of off-base by contract collectors/haulers. No liquids were accepted for disposal at the Supplyside Landfill, nor were metals or sanitary wastes. Chemical wastes likely to have been disposed of in the landfill include residues of spent chemical cleaners, solvents, and oils on waste building materials or rags used for cleanup. Specific cleaners like Solvent 144 and trichloroethane, formica glue (contact cement), and cement grout for tiling jobs are likely to have been components of this category. Other wastes typical of an office source like typewriter ribbons, paper, and ink are thought to have been major constituents of the landfill waste.

Skokie Ditch, on the eastern margin of the Supplyside Landfill, is the most likely pathway for migration of any landfill-generated contaminants. Even in the unlikely event that ground water pathways exist, discharge to this gaining segment of Skokie Ditch is the most likely discharge point for the ground water and any dissolved constituents. Sites 1, 2, and 3 lie within a 1-mile reach of Skokie Ditch. Site 3 is the farthest downstream of these three sites. From the farthest downstream point where the landfill borders the Skokie Ditch to the point where the ditch crosses the activity boundary is a distance of 1,000 feet.

The site is currently being monitored under the terms of a 3-year post-closure monitoring agreement with the State of Illinois. Both surface and ground water monitoring are being conducted. IEPA has approved the activity's monitoring program for the Supplyside Landfill. Site 3, Supplyside Landfill, is not recommended for a Confirmation Study.

2.4.3 Site 9, Camp Moffett Disposal Area. A 1980 excavation to repair a portion of the roadway in Camp Moffett which had collapsed uncovered a variety of galley-type wastes. These wastes included stainless steel serving trays and food wastes. The excavation went to the limit of reach of the backhoe which was available (approximately 8 feet below the surface) and did not reach the bottom of the fill. No effort was made to determine the lateral extent of the fill; however examination of older aerial photographs and topographic maps of the area suggests that the area was once a narrow, V-shaped ravine, a former tributary of Pettibone Creek (Figure 2-11). No other information is available about the Camp Moffett Disposal Area.

There is no information to suggest that any hazardous waste disposal occured at the Camp Moffett Disposal Area. Therefore, Site 9, Camp Moffett Disposal Area, is not recommended for a Confirmation Study.



Site Area

500' 0 500'

Figure 2-11

Site 9, Camp Moffett
Disposal Area

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

2.4.4 **Site 11, BE/E School Gyro Compass Room.** On the third floor of Building 2B, rooms 329, 330, 330A, and 330B (Figure 2-12) housed 15 gyro compasses from 1942 until 1976. Each mechanism contained 10 to 15 pounds of elemental mercury. Reserve mercury was stored in a locker located in room 330C. The gyromechanisms were dismantled in 1976 and sent via Supply to DRMO (then DPDO).

A large puddle of mercury was discovered under the storage locker in room 330C in 1979 during conversion of the rooms from laboratories into classrooms. Further investigation revealed the presence of mercury in between the floor tiles and the baseboard edging in the room. School personnel called the Public Works Center (PWC), which apparently contacted Preventative Medicine and the Fire Department. Preventative Medicine personnel vacuumed the area for mercury. Personnel report no problems with mercury since 1979. The four rooms have been used as classrooms since 1979.

Because all of the mercury was cleaned up and disposed of, and the rooms have tested within acceptable limits for mercury vapor, Site 11, BE/E School Gyro Compass Room, is not recommended for a Confirmation Study.

2.4.5 **Site 13, Demolition Debris Disposal Areas.** During the course of the on-site visit by the IAS team, several areas which were used for the disposal of inert demolition debris were discovered. Each of the demolition debris areas discovered is described in this section, and is illustrated in Figures 2-13a and 2-13b.

Demolition Debris Disposal Sites 13A, 13B, and 13C are located along the shoreline of Lake Michigan. These sites include the entire shoreline, exclusive of the immediate vicinity of the Inner Harbor and Boat Basin. The sites include areas where fill was placed both behind and in front of bulkheads and piers that were constructed to protect the bluffs from coastal erosion. Most of this fill material was comprised of bricks, concrete, and other building materials large enough to provide protection for the receding shoreline. These materials may be examined in the actual shore zone, and especially in the vicinity of the Skeet Range (Building 743), where typical building demolition debris material is clearly visible. On-ground inspection revealed that only inert materials had been disposed of there.

Some of the material was placed by the Naval Construction Batallion Unit 401, some by the Public Works Center, and some by contractors working on the activity. Between 1981 and 1984, Naval Construction Batallion Unit 401 placed fill at the Rifle Range shoreline (Site 13C) to restore the bluff after particularly severe erosion. No active disposal was evidenced during the on-site visit.

Site 13D included the area along the western and southern sides of Zeigemeier Street as it rises from the shoreline onto the Mainside campus. The disposal site is bounded by the bluff to the east, Zeigemeier Street on the north and Paul Jones Street on the west, and ends north of Cluverius Street. Disposal there ended prior to the development and construction of Building 621, the ET A-School, in 1969. PWC personnel also noted problems with installing portable building anchor systems in the area east of

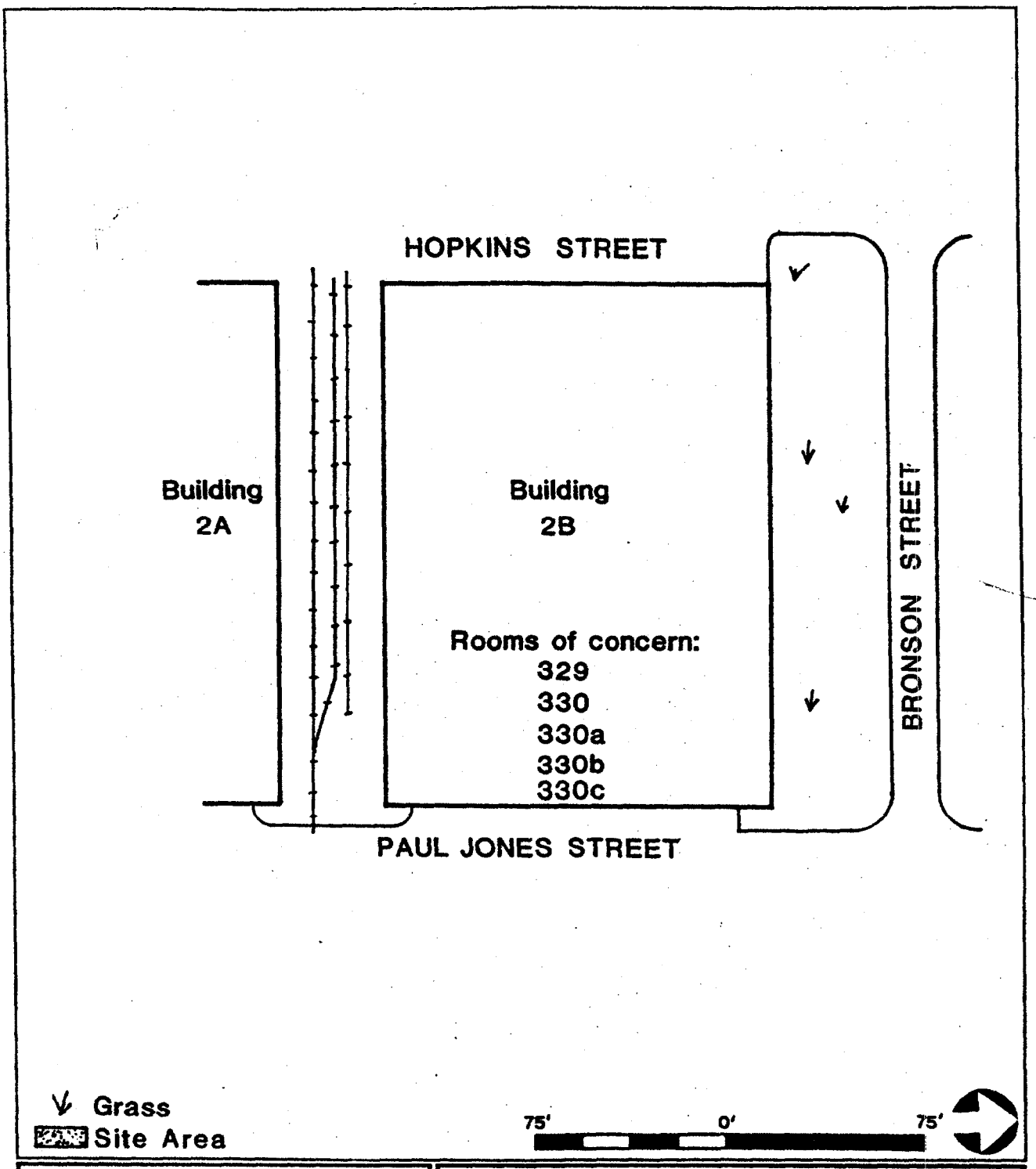
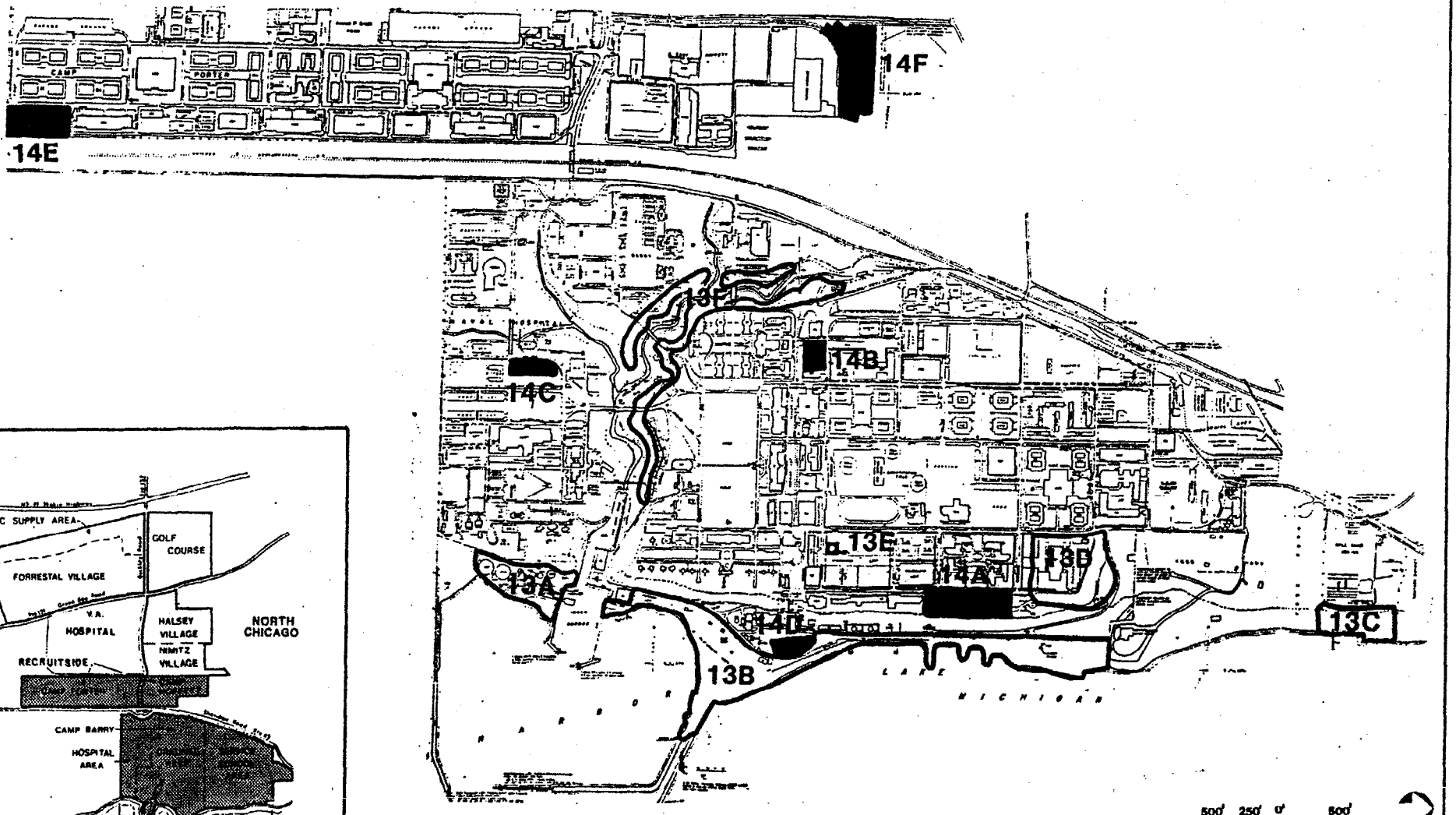
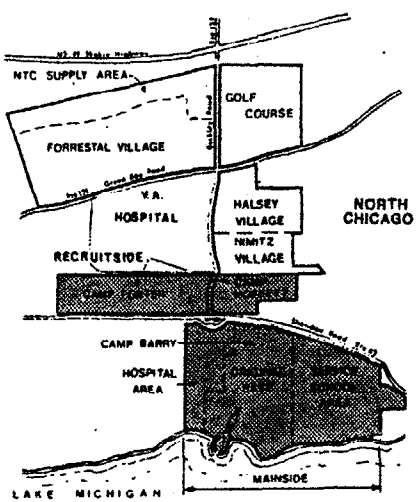


Figure 2-12

Site 11, BE/E School
Gyro Compass Room

Initial Assessment Study
Naval Complex
Great Lakes, Illinois





Not to Scale

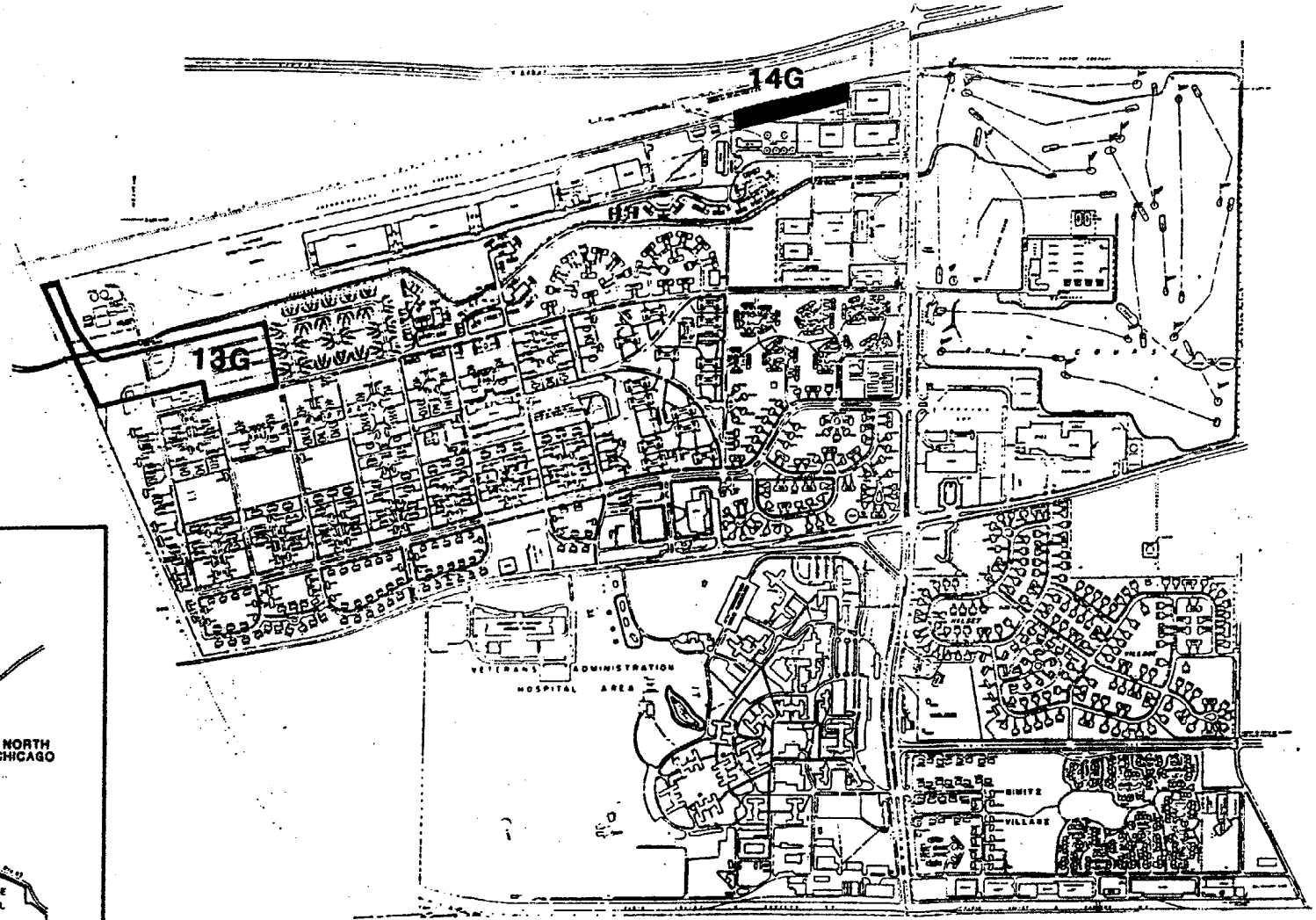
Former Demolition Debris Disposal Areas

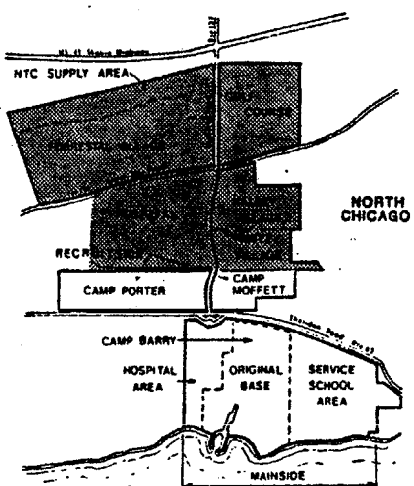
Former Coal Storage Areas

Figure 2-13a

Site 13, Demolition Debris Disposal Areas, and Site 14, Former Coal Storage Areas

Initial Assessment Study
Naval Complex
Great Lakes, Illinois





Not to Scale

Former Demolition Debris Disposal Areas

Former Coal Storage Areas

Figure 2-13b

Site 13, Demolition Debris Disposal Areas, and Site 14, Former Coal Storage Areas

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

Building 621, on top of the bluff. The present appearance of the area provides no clue to the existence of the demolition debris and no seepage was observed on the bluff.

Site 13E was a former swimming pool facility located on the north side of Bronson Avenue, opposite Building 122. The facility had been out of service due to leakage of the concrete walls and was filled during the period 1984 to 1985 by the Naval Construction Battalion Unit 401. Completion of this project preceded the 1985 on-site visit of the IAS team by several weeks.

Site 13F is along the banks of Pettibone Creek. Based upon examination of topographic maps, archive photographs, and general development maps, the location of the top of these banks has moved up to 100 feet toward the stream bed. This is consistent with the observations of many activity personnel who related that coal ash had been disposed of almost anywhere on the activity where fill was required for grading purposes.

The final demolition debris disposal site (Site 13G) is in the area of the present Auto Hobby Shop (Building 2110). Prior to the construction of the new trailer court area along Great Lakes Drive, Arkansas Road, and Georgia Road, this area was used for demolition debris disposal. Disposal of this inert material proceeded south from Delaware Avenue, around Building 2110, and across Alabama Avenue to the southern activity boundary. The area along the southern activity boundary and south of Sewage Disposal Plant No. 2 was filled along a 50- to 100-foot swath from the vicinity of Building 2262 to the southwest corner of the activity. Some of the evidence supporting this observation includes the difficulty experienced by PWC personnel in installing tiedown facilities in the trailer court area, the general lay of the land in that area, and the surface appearance of the grounds in the playing fields south of Alabama Avenue. No sign of material other than demolition debris was encountered in these areas. No outcroppings of these materials were found in Skokie Ditch.

Since no leachates are expected from these disposal areas, they are provided for purposes of documentation only, and Site 13, Demolition Debris Disposal Areas, is not recommended for a Confirmation Study.

2.4.6 <u>Site 14, Former Coal Storage Areas</u>. Coal was used as the primary source of fuel for space heating and power at NC Great Lakes from the activity's inception until coal was phased out in favor of oil at the Mainside power station. Coal was stored at various locations throughout the activity during the period of its use. These locations are identified in this section because of the potential concern about leachates developing from coal residues which may remain at these locations.

Each of the sites that once were used to store coal is described elsewhere in this report (Chapter 8); these sites are discussed here for documentation purposes. None of these sites poses a likely threat via the development of leachates, primarily because most or all of the coal which would be the potential source of contamination has been removed. The only coal pile presently remaining at the activity is located at Site 14D, where some fine-grained high sulfur coal used to fire the experimental fluidized bed

combustor is still stored. A contract is expected to be let soon to have an off-base contractor remove the coal which remains there (NAVFACENGCOM, personal communication, 1985).

2.5 SITES RECOMMENDED FOR REMEDIAL MEASURES. One of the 14 sites examined by the IAS team is recognized by the Navy as being contaminated with hazardous wastes. The site is the NTC Rifle Range; it is shown in Figure 2-14.

2.5.1 Site 10, NTC Rifle Range. The NTC Rifle Range (Figure 2-14) is located on a 14.2-acre plot at the extreme northeastern corner of NC Great Lakes. The Rifle Range has been located at this site since the land was purchased in 1918. In the past, this had been the primary firearms training and practice facility for the activity. No Navy training takes place there at the present time; it is currently being used by the Department of Justice, Federal Bureau of Investigation as a training and practice facility.

In August 1984, NORTHNAVFACENGCOM conducted a preliminary investigation to determine the amount of environmental contamination at the site. Unfired rounds of old ammunition were found in the uppermost soil layer throughout the site, and may extend down to 8 feet below the surface. It appeared that these items had been buried in the soil and had surfaced due to erosion. NORTHNAVFACENGCOM investigators concluded that a serious safety hazard would exist were the Navy to access the land without first sweeping the entire site for ordnance.

The cost for demilitarizing the site has been estimated at approximately $554,000, which is close to the fair market value of the site (NORTHNAVFACENGCOM ESR #21-696-250, September, 1984). Because of the documented site contamination, Site 10, NTC Rifle Range, is not recommended for a Confirmation Study; however, it is recommended for cleanup under this program, if and when the site ceases to be used as a rifle range.

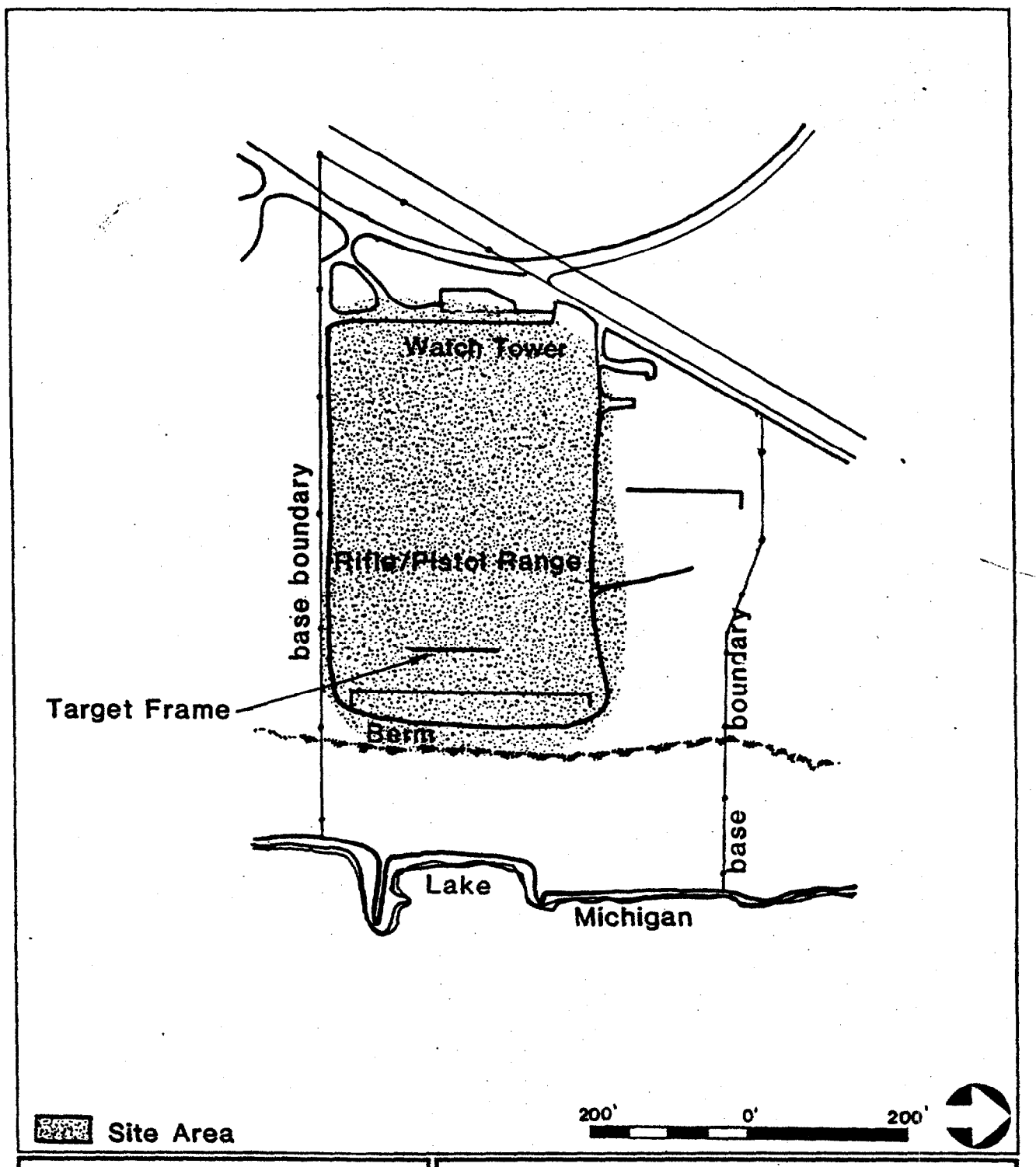


Figure 2-14

Site 10, NTC Rifle Range

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

CHAPTER 3. RECOMMENDATIONS

3.1 INTRODUCTION. This chapter provides recommended courses of action for the eight potentially contaminated sites identified at NC Great Lakes. These sites may pose a potential threat to human health or to the environment. Confirmation Studies, phase II of the NACIP program, are recommended for seven of these sites (Table 3-1):

- Site 1, Golf Course Landfill
- Site 4, Fire Fighting Training Area
- Site 5, Transformer Storage "Boneyard"
- Site 6, Mainside Transformer Storage Area
- Site 7, RTC Silk-Screening Shop
- Site 8, Exchange Service Station
- Site 12, Harbor Dredge Spoil Area

The eighth site that poses a potential hazard to human health is Site 10, the NTC Rifle Range. This site is recommended for Remedial Measures only if and when the site is no longer being used as a target range.

The field investigation programs presented address only the verification phase of the confirmation program. Design of a characterization investigation will, in general, be dependent upon the results of the verification study. The technical elements utilized in the recommended field programs include soil borings, surface water sampling, and construction of monitoring wells. Data collected from the field programs will be sufficient to:

- determine if migration of toxic materials away from a specific site is occurring;
- establish the direction of ground water movement in the shallow water table aquifer; and
- in instances where spillage of toxic materials is suspected, establish whether these materials have been retained in the shallow subsurface.

3.2 CONFIRMATION STUDY RECOMMENDATIONS.

3.2.1 Site 1, Golf Course Landfill. (Figure 3-1)

Ground water monitoring wells:	Install 6 wells at locations shown in Figure 3-1
Types of samples:	Ground water: One sample taken quarterly from each well, 24 samples annually. Surface water: One sample quarterly from sampling point on Buckley Road (see Figure 3-1 and Remarks).

Table 3-1

Summary of Confirmation Study Recommendation,
NC Great Lakes, Illinois

Site No.	Site Name	Map Coordinates	CSRS Score	Number of Wells	Number and Type of Samples	Frequency of Sampling	Parameters
1	Golf Course	Most of Area E	4.14	6	24 ground water samples annually	quarterly	TDS, pH, TOC, volatile organics, chloride, zinc, iron, lead, mercury
					4 surface water samples annually	quarterly	
4	Fire Fighting Training Area	FF-22 and FF-23	7.70	3	12 ground water annually;	quarterly	Oil, grease, tetraethyl lead, xylene, volatile organics
					14 soil samples		
5	Transformer Storage "Boneyard"	S-24	4.85	-	32 soil samples	one time	PCB
6	Mainside Transformer Storage Area	M-26	8.05	-	10 soil samples	one time	PCB
7	RTC Silk-Screening Shop	Q-16	13.2	-	10 soil samples	one time	Volatile organics
8	Exchange Service Station	L-23 L-24	7.58	3	12 ground water samples	quarterly	Tetraethyl lead, xylene, volatile organics
12	Harbor Dredge Spoil Area	G-16	12.0	-	30 sludge samples	one time	PCB, lead, zinc, chromium, volatile organics

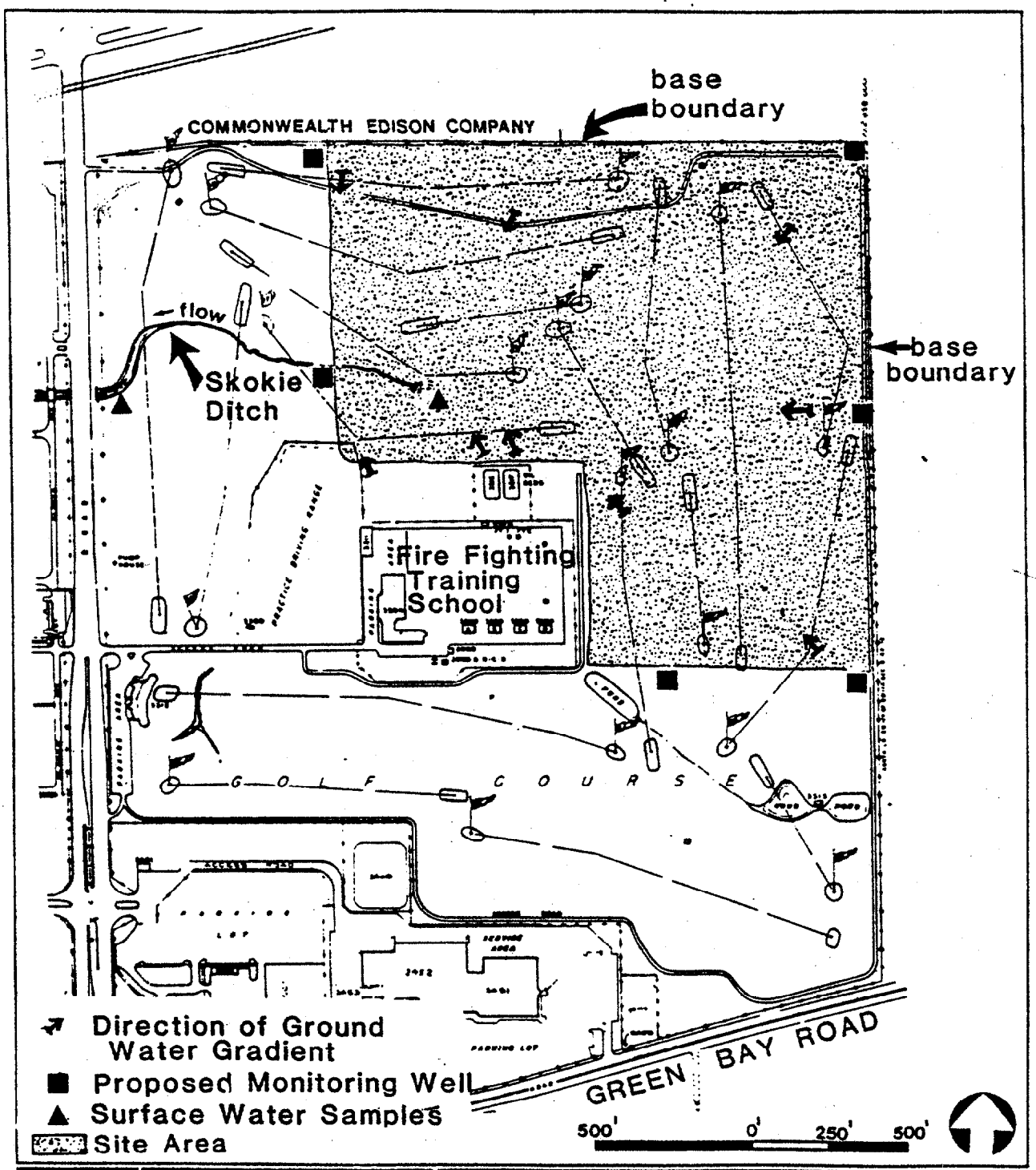


Figure 3-1

Site 1, Golf Course Landfill Monitoring Wells and Sampling Locations

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

Test parameters:	Total dissolved solids (TDS), pH, total organic carbon (TOC), volatile organics, chloride, zinc, iron, lead, mercury, water level

In northernmost surface water location: Evaluate water table level only.

Remarks: Stilling wells to measure surface water stage (elevation) should be placed at the Skokie Ditch surface monitoring points shown in Figure 3-1. Ground water monitoring wells should be screened so that top of water table intercepts screens throughout seasonal water level fluctuations. It is assumed that a 10-foot screen length is used.

3.2.2 Site 4. Fire Fighting Training Area. (Figure 3-2)

Ground water monitoring wells:	Install three; two downgradient and one upgradient of site as shown in Figure 3-2.
Types of samples:	Ground water: one sample from each well, taken quarterly; 12 samples annually.
	Soil samples: one sample from each location, 14 samples total.
Test parameters:	oil, grease, tetraethyl lead, xylene, volatile organics, pH, water level

Remarks: Ground water monitoring wells should be screened so that top of seasonal high water table intercepts the screen throughout water table level fluctuations. It is assumed that a 10-foot screen length is used.

3.2.3 Site 5. Transformer Storage "Boneyard". (Figure 3-3)

Type of sample:	Soil samples.
Number of samples:	32, taken one time.
Test parameter:	PCB

Remarks: Take 22 samples at designated points in grid pattern, as shown in Figure 3-3. Take 10 samples at discretionary locations where there is evidence of spillage. Soil samples should represent a composite of top 6 inches of soil at each location. Deeper compositing is necessary if visual signs of contamination (staining) go deeper.

3.2.4 Site 6. Mainside Transformer Storage Area. (Figure 3-4)

Types of sample:	Soil samples.
Number of samples:	10, taken one time.
Test parameter:	PCB.

Remarks: Samples should be taken at designated points in grid pattern, as shown in Figure 3-4. Samples should be representative of top 6 inches of soil; deeper sampling is recommended if deeper staining appears.

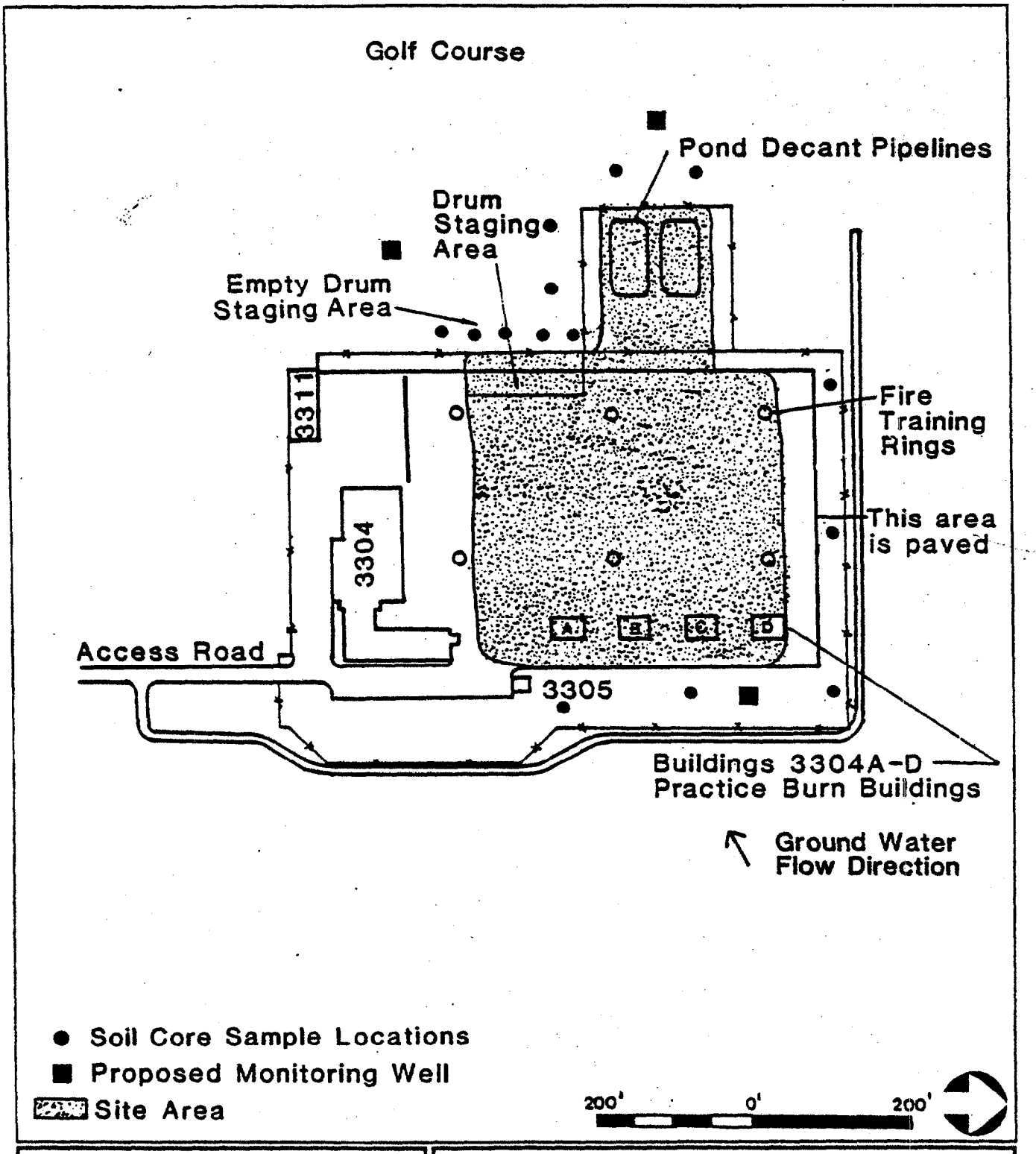


Figure 3-2

Site 4, Fire Fighting Training Area Monitoring Wells and Sampling Locations

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

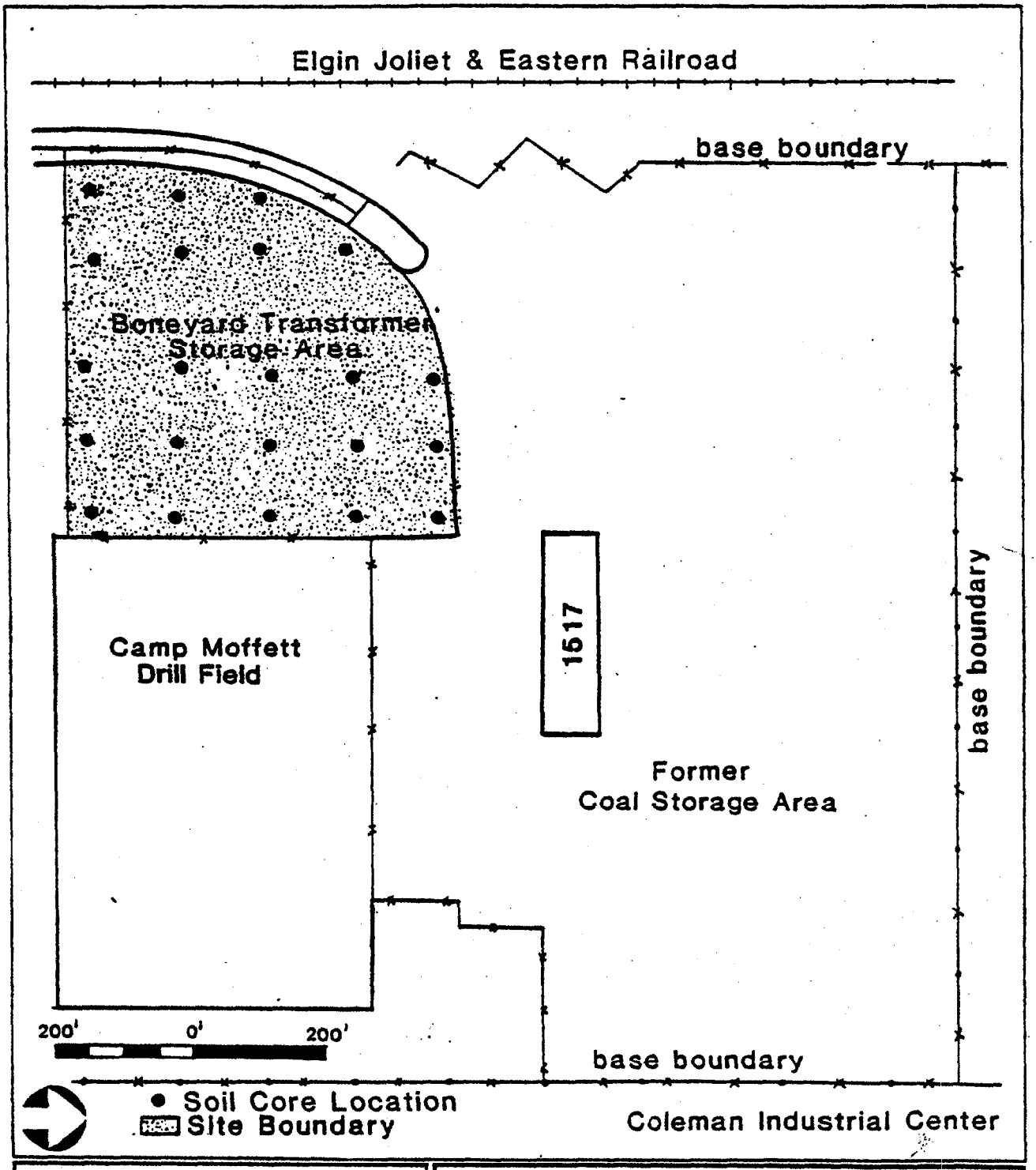


Figure 3-3

Site 5, Transformer Storage "Boneyard" Sampling Locations

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

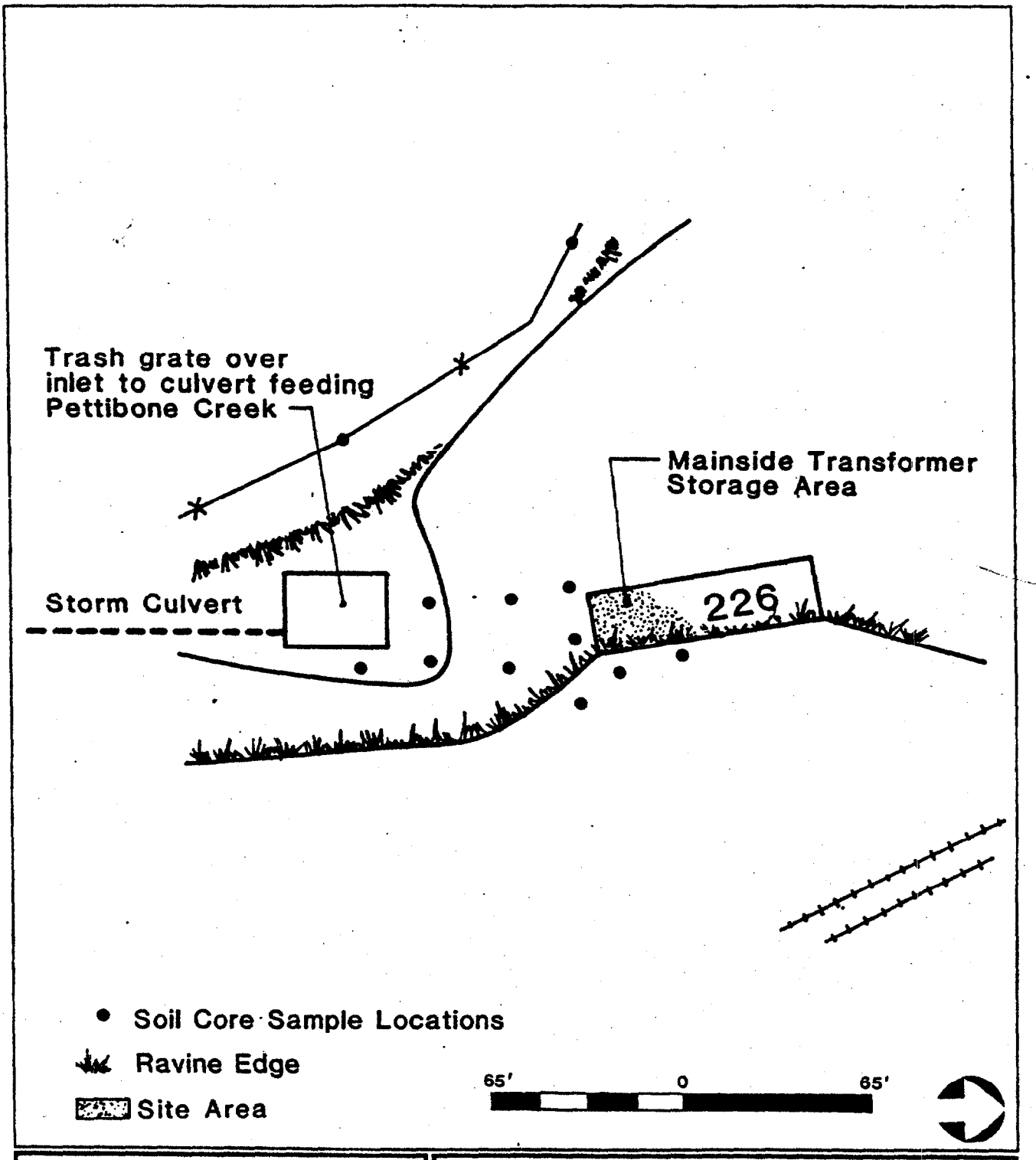


Figure 3-4

Site 6, Mainside Transformer Storage Area Sampling Locations

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

3.2.5 Site 7. RTC Silk-Screening Shop. (Figure 3-5)

Type of samples:	Soil cores.
Number of samples:	10, taken one time.
Test parameter:	Volatile organics.

Remarks: Take 10 samples, 5 in the locations shown in Figure 3-5 and 5 at discretionary locations where there is evidence of spillage. Samples should be representative composite of top 6 inches of soil; deeper samples should be taken if deeper staining appears.

3.2.6 Site 8. Exchange Service Station. (Figure 3-6)

Ground water monitoring wells:	Install 3 wells at locations shown in Figure 3-5.
Type of sample:	Ground water.
Number of samples:	12; one sample from each well, quarterly, for one year.
Test parameters:	Tetraethyl lead, xylene, volatile organics, water level.

Remarks: Ground water monitoring wells should be screened so that the top of the water table intercepts the screen throughout seasonal water table fluctuatiuons. It is assumed that a 10-foot screen length is used.

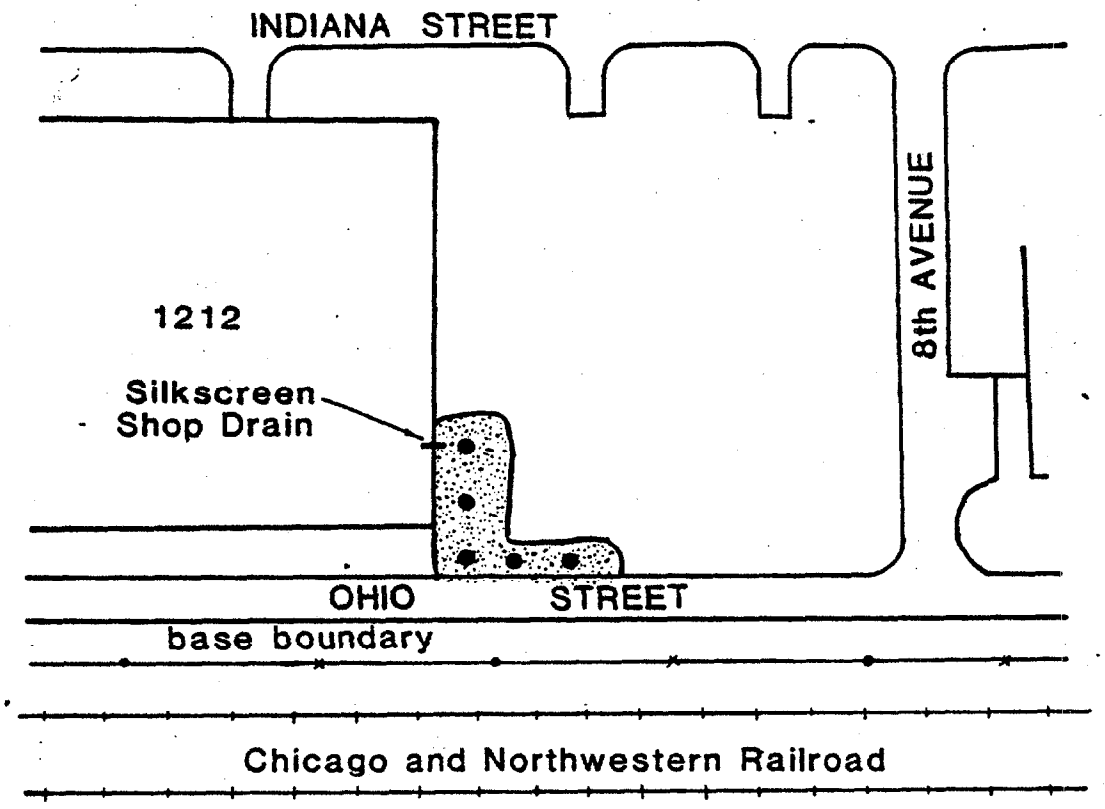
3.2.7 Site 12. Harbor Dredge Spoil Area. (Figure 3-7)

Types of sample:	Soil cores.
Number of samples:	30; taken one time.
Test parameters:	PCB, lead, zinc, chromium, volatile organics.

Remarks: Cores should penetrate to the bottom of the sludge deposits. Take samples from top, middle, and bottom of core at each location shown in Figure 3-7, so that samples are representative of sludge composition throughout the deposit.

3.3 RECOMMENDATIONS OTHER THAN CONFIRMATION STUDIES.

3.3.1 Site 10. NTC Rifle Range. The Navy has confirmed that lead-containing ordnance is present under the surface of the NTC Rifle Range (Figure 3-8). For this reason, tests to reconfirm this fact are unnecessary. It is the recommendation of the Initial Assessment Study (IAS) team that operations to remove the lead and unspent ordnance be initiated, if and when the site ceases to be used as a target range.



• Soil Core Sample Locations

Site Area

100' 0' 100'

Figure 3-5

Site 7, RTC Silk-Screening Shop Sampling Locations

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

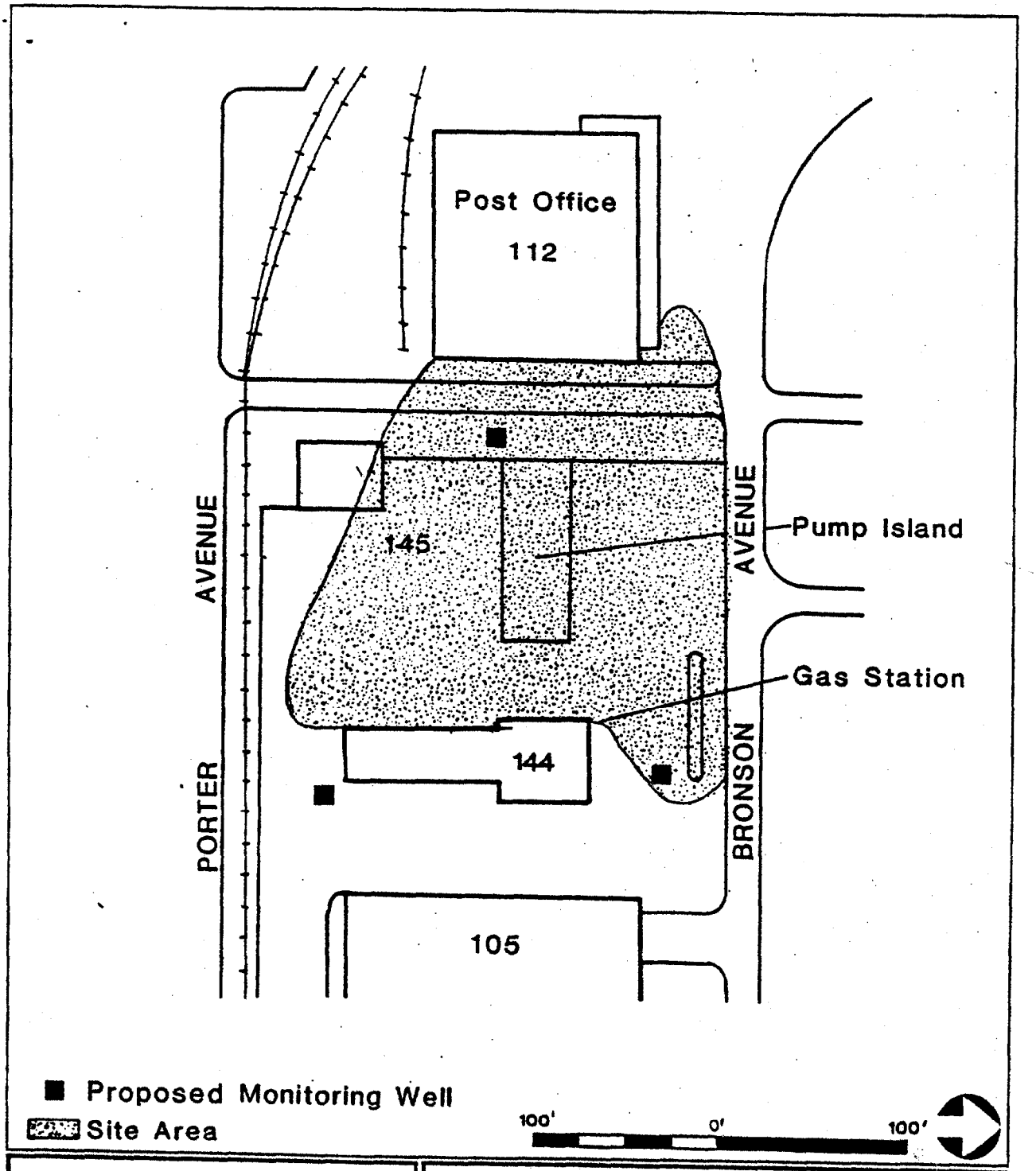
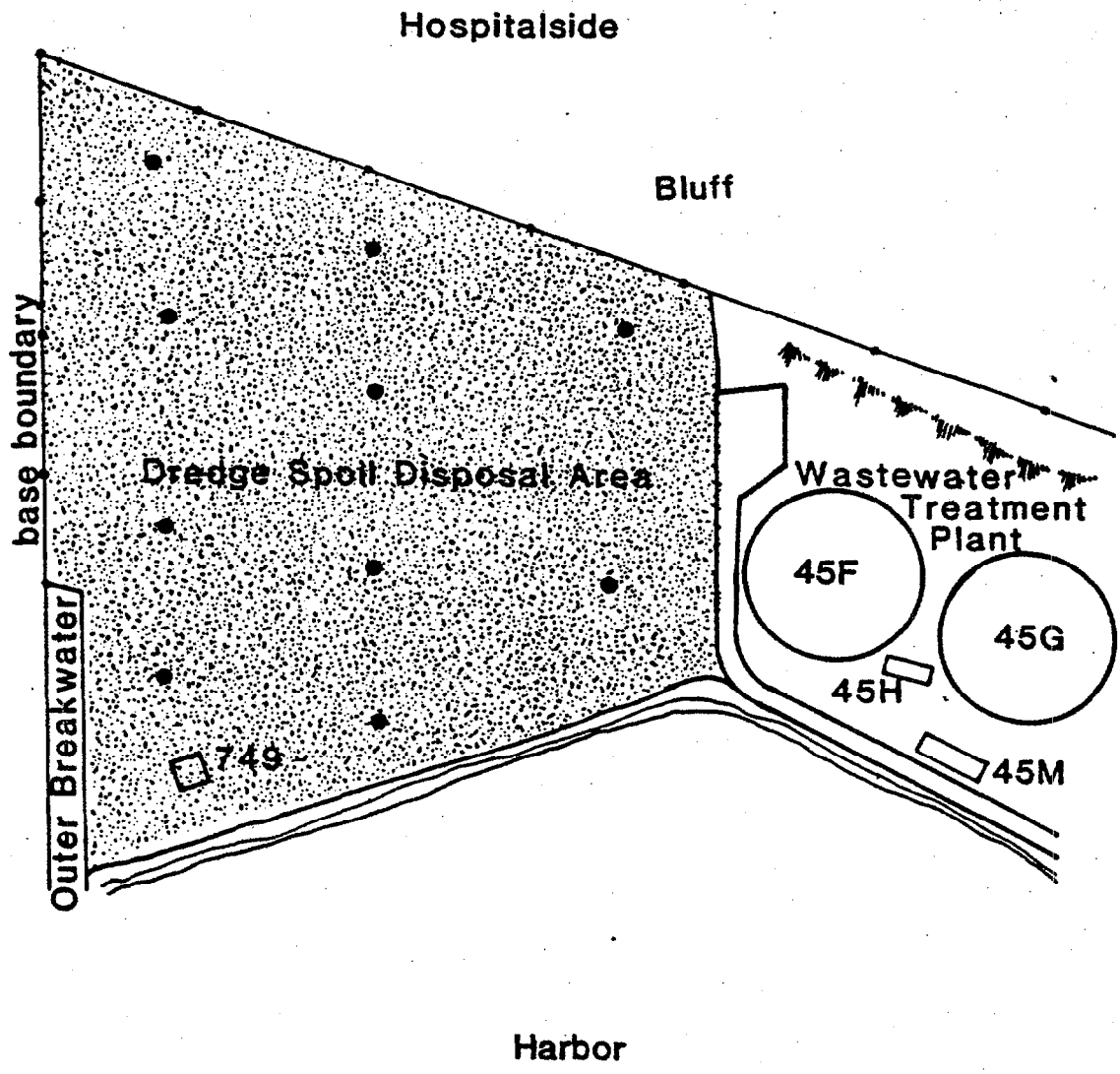


Figure 3-6

Site 8, Exchange Service Station Sampling Locations

Initial Assessment Study
Naval Complex
Great Lakes, Illinois



• Soil Core Locations
Site Area

200' 0' 200'

Figure 3-7

Site 12, Harbor Dredge Spoil Area Sampling Locations

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

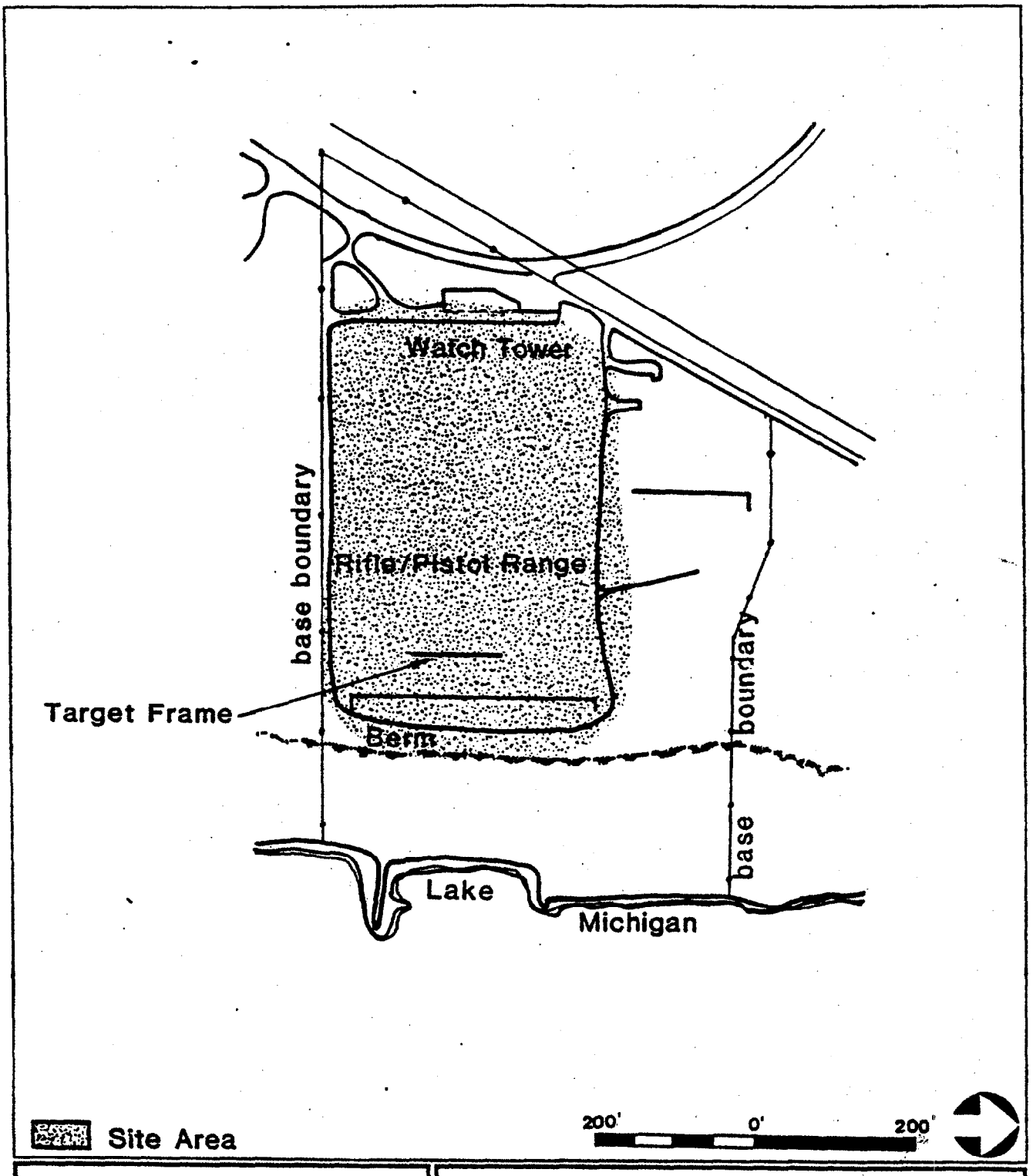


Figure 3-8

Site 10, NTC Rifle Range

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

3.3.2 **All Remaining Sites.** The remainder of the sites discussed by the IAS team have been judged to pose no threat to human health or to the environment. Nevertheless, it is recommended that a permanent record of these sites be maintained so that any future development plans can incorporate pertinent information about these sites.

CHAPTER 4. BACKGROUND

4.1 GENERAL. Naval Complex (NC) Great Lakes is located in Shields Township, Lake County, Illinois, on the shore of Lake Michigan (Figure 4-1). Dedicated in 1911, it is the largest naval training center (1,650 acres) in the United States and possibly in the world (NORTHNAVFACENGCOM, 1980). It is bounded on the west by U.S. 41 (Skokie Highway), on the north by the City of North Chicago, and on the south by the Veterans' Administration Hospital and Golf Course and by the Shore Acres Country Club. Lake Michigan lies to the east (Figure 4-2).

4.1.1 Mission of the Activity. The mission of NC Great Lakes is "to exercise command over, and coordinate the efforts of the assigned subordinate activities in effecting basic indoctrination (recruit training) for enlisted personnel, and initial skill, advanced, and/or other specialized training for officer and enlisted personnel of the regular Navy and the Navy Reserve, and to support other activities as directed by higher authority" (NORTHNAVFACENGCOM, 1980).

The full complement of host, tenant, and support operations personnel at NC Great Lakes consists of 22,883 military (529 officers, 22,354 enlisted men and recruits) and 3,087 others (American civilians and foreign nationals).

The Naval Training Center is the major activity; it consists of the Administrative Command, the Recruit Training Command, and the Service School Command. Supporting roles are performed by the Public Works Center and the Naval Regional Medical Center.

Of the 30 tenant commands, only the following were found to generate significant quantities of hazardous waste: the Hospital Corps School, the Naval Regional Dental Center, the Naval Dental Research Institute, and the Navy Publication and Printing Service Office. The remaining tenant commands generate only paper. Additional quantities of hazardous waste were generated by the two support organizations, the Naval Regional Medical Center and the Public Works Center.

4.1.2 Adjacent Land Use. A variety of land uses presently surround NC Great Lakes. The most highly urbanized land uses abut the activity's northern boundary where North Chicago's industrial zone is located. Some of the surrounding industry in the drainage area of Pettibone Creek includes Fansteel Company (North), Tantalum Place, North Chicago; Fansteel Company (South), Tantalum Place, North Chicago; Lavin & Sons, N. Chicago Refiners, Sheridan Street, North Chicago; Ammco Tools, Inc., Commonwealth Avenue, North Chicago; and Car Shop, Elgin, Joliet & Eastern RR, North Chicago (this facility was reported to be in operation at some point in the past).

At least one of these industries was responsible for a fuel oil spill within the past 2 years. The spill affected Pettibone Creek, and the industry paid an outside contractor to clean up the creek, including that part of it that is on Navy property.

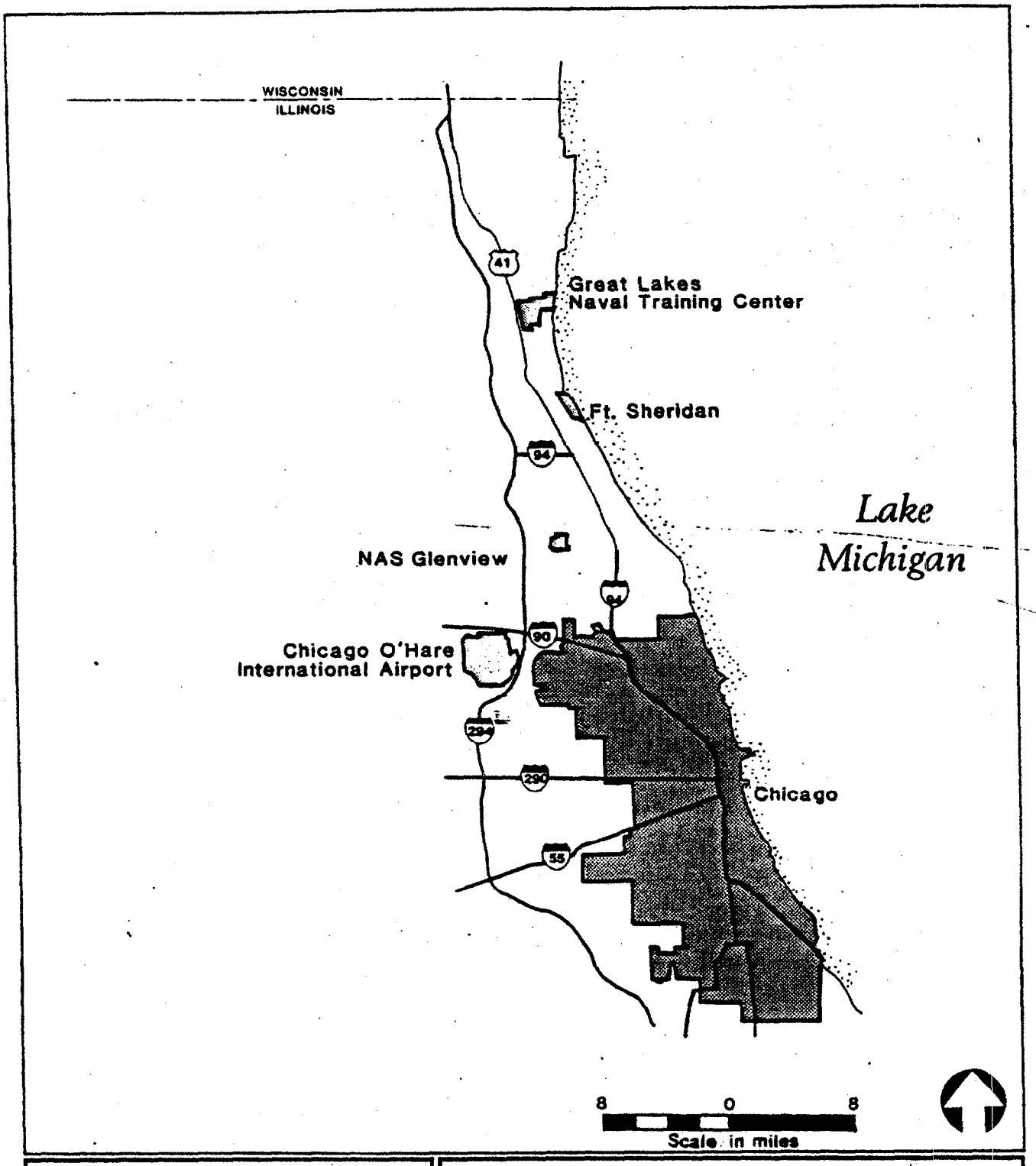


Figure 4-1

General Location Map,
NC Great Lakes

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

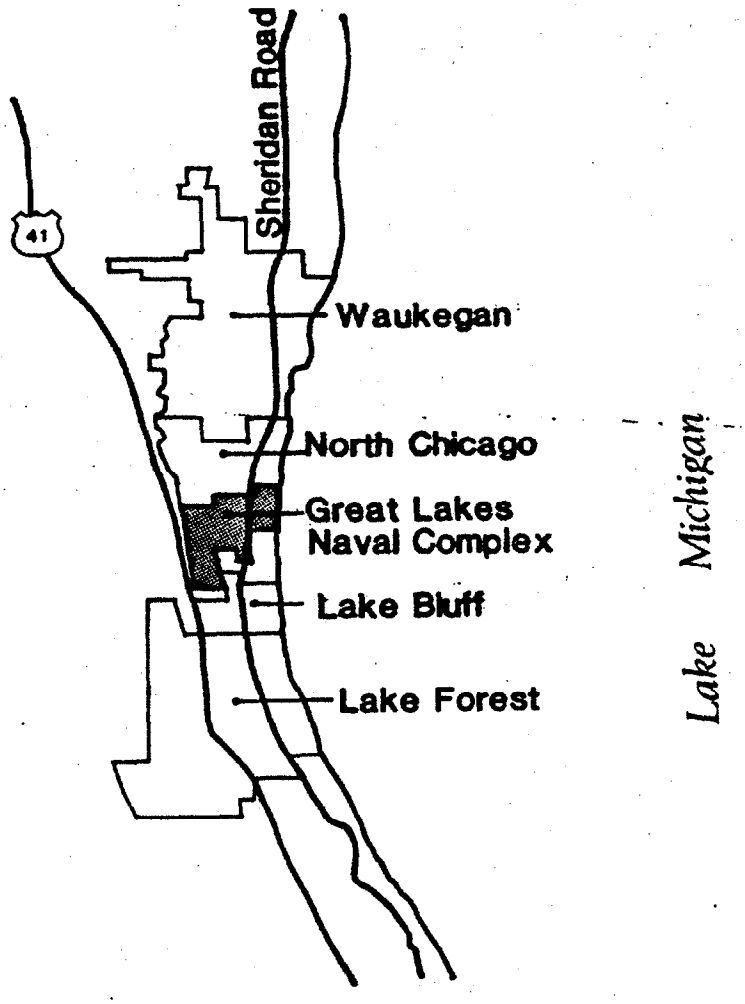


Figure 4-2

Immediate Area
Surrounding
NC Great Lakes

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

Much of the area beyond the northwest boundary of the activity comprises unincorporated lands of the County and lies vacant except for scattered retail and residential uses. Primarily industrial uses are found adjacent to the activity's western boundary, while the land adjacent to the southern boundary is a mixture of public open space and residential land use.

4.2 HISTORY. In 1902, Congress appropriated $5,000 to investigate sites in the Midwest on which to establish a naval training station. After considering 37 Great Lakes' sites, a board of officers recommended the present Lake Bluff location, a 167-acre tract overlooking Lake Michigan. Advantages of this site included its proximity to Chicago and its excellent rail transportation via the Chicago and Northwestern Railroad and the now-defunct Chicago North Shore and Milwaukee Railroad.

The location presented two major drawbacks, however. The first drawback to the location was the bitter opposition generated in Congress by the suggestion that Lake Bluff be developed as a naval training station. Congressman George E. Foss, representative of the 13th Illinois Congressional District and chairman of the Committee on Naval Affairs, maneuvered to overcome this obstacle by pressing for the Naval Appropriations Act of 1904. When the legislation was enacted, the President appointed a board that consisted of one officer and two civilians. The Board subsequently gave Lake Bluff the highest recommendation. The second drawback to the site was cost; even at the turn of the century lakefront property in this area was selling for over $1,000 per acre. To overcome this drawback, Congressman Foss persuaded the Merchant's Club of Chicago to establish a fund through which private donations could be accepted toward purchase of the land. The club raised $175,000 for the required 167 acres and offered the property to the Navy for a $1.00 fee, with the stipulation that the training station be built there.

In April 1904, the Naval Appropriations Act empowered the President to approve the Board's report and authorized purchase of the site. Previously, Congress had authorized $250,000 for the purchase of the land in its Naval Appropriations Act, thereby giving Congressional approval to the purchase.

Captain A. A. Ross, first Commandant of NC Great Lakes, accepted command of the activity on behalf of the government on July 1, 1905. Six years later, the activity was ready to accept its first recruit for training. Ross presided at commissioning ceremonies on July 1, 1911, and the activity was officially dedicated by President Taft on October 28, 1911. The original activity, which consisted of 39 permanent buildings, was bounded on the west by Sheridan Road, on the north by Bronson Avenue, on the east by Lake Michigan, and on the south by an irregular line through what is now Hospitalside (Figure 4-3). Expansion to the present boundaries was accomplished by various land acquisitions from 1917 to 1942.

When the United States entered World War I, the population at NC Great Lakes expanded quickly. Immediately prior to the war (April 1, 1917), 50 buildings served a complement of 2,500 men. At the peak of the war, the

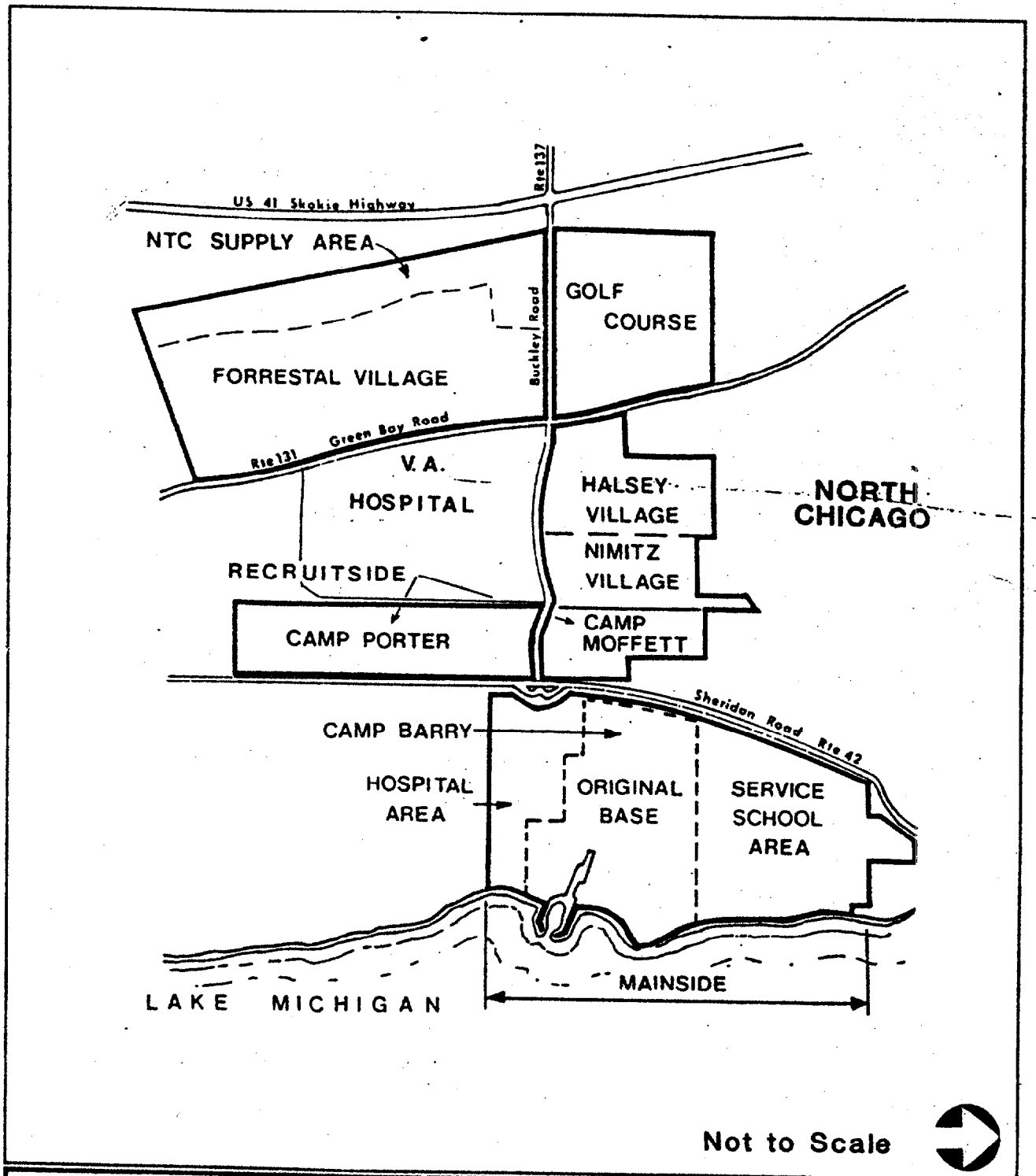


Figure 4-3

NC Great Lakes

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

activity expanded to 1,200 acres, 775 buildings, and 47,721 men (as of August 27, 1918), thus becoming the largest naval station in the United States.

To accommodate the huge influx of personnel, the original Instruction Building and Drill Hall facing the parade ground on Mainside were converted to barracks, and thousands of tents were erected in vacant areas of the activity. The Service School Command expanded from 4 schools to 17, and under the direction of Captain W.A. Moffett, seven completely self-contained regimental units were designed and constructed. Each unit housed 1,726 men and included an administration building, an instruction building, a drill hall, a galley and mess hall, a dispensary, and a steam heating plant. By October 1917, all personnel were moved out of tents and into temporary frame buildings. Most of these temporary buildings were demolished upon cessation of hostilities in 1918, although some stood through World War II.

By 1922, the Navy had stopped training recruits at NC Great Lakes, and consideration was being given to closing the activity. Through the efforts of the Union League Club of Chicago and the Chicago, Waukegan, and North Chicago Chambers of Commerce, Congress was persuaded to restore NC Great Lakes to its prewar training status.

By 1932 all of the land west of Sheridan Road had been transferred to the Veterans' Administration Hospital. The activity was then composed of 102 buildings on 507 acres. Only one of the 17 service schools that had been in operation during World War I remained in active status; however, by July 1933 no training activities were conducted and the entire complement authorized for manning the activity consisted of a Marine Guard detachment of 40 men, a Fire Department of eight men, and a small public works force. The only regular maintenance activity consisted of mowing Ross Field.

The activity was reopened for training in 1935. The limited national emergency declared by President Roosevelt in 1939 marked the beginning of the second period of major growth for NC Great Lakes. Service schools were reopened in 1940, and, just prior to Pearl Harbor, authorization was given for the construction of temporary frame barracks. By 1942, eight camps, each housing a regimental unit of 4,500 recruits, had been constructed, bringing the activity's population to 44,000 men. By September of the same year, six more of these camps were constructed in the Green Bay Road area, and the population of NC Great Lakes grew to 68,000 men. By March 1944 the activity had reached an all-time peak strength of 100,156 men.

Though hostilities ended in 1945, NC Great Lakes did not again revert to its prewar status as it had after World War I. The Navy retained many of the temporary World War II buildings in order to meet commitments relating to the Korean and Vietnam conflicts. Since the Vietnam conflict, training requirements at NC Great Lakes have remained at a high peacetime level. A complement of approximately 9,000 officers and men is stationed at the activity, maintaining facilities and conducting the training of the 80,000 recruits and students graduated annually. Today, NC Great Lakes consists of some 1,060 buildings on approximately 1,650 acres of land, with a replacement value of more than $1 billion.

4.3 LEGAL ACTIONS. There have been no legal actions taken against NC Great Lakes for violations of environmental laws.

4.4 BIOLOGICAL FEATURES.

4.4.1 Ecosystems. The natural environment of NC Great Lakes can be characterized as a relatively flat glacial drift deposit bordered by steep lake-facing bluffs cut with steeply sloping ravines. The most distinctive characteristic of this bluff-ravine complex is the continual erosion of the unconsolidated glacial material that makes up the bluff faces and ravine walls (United States Department of Agriculture (USDA), 1970; NORTHNAVFACENGCOM, 1980).

Intensive development of NC Great Lakes since 1911 has removed most of the natural vegetation of oak, hickory, maple, and other hardwoods. The only native woodlands present occur primarily on the steeply sloped ravine of Pettibone Creek, running across the Mainside part of the activity, and the bluffs facing Lake Michigan. Ecosystems of note on the base are the Pettibone Creek ravine; the Skokie Ditch area (which is the headwater region of the Skokie River); the Golf Course; and the narrow lakeshore/dune/steep coastal bluffs area.

The bank of Pettibone Creek is forested with white oak (*Quercus alba*), red oak (*Quercus falcata*), European larch (*Larix decidua*), white (*Pinus strobus*) and Scotch pine (*Pinus sylvestris*), and maple (genus *Acer*). Shrubs include raspberry (genus *Rubus*), and blackberry bushes (also genus *Rubus*). Wild grape (genus *Vitis*) and numerous perennial weeds cover the slopes.

The principal mammal found in this area is the rat (*Rattus norvegicus*), which burrows in the soft Hennepin loam and scrounges for refuse from nearby homes. Presently there are programs aimed at rodent control in operation at NC Great Lakes. Groundhog (*Marmota monax*), raccoon (*Procyon lotor*), squirrel (family Sciuridae), opossum (*Didelphis virginiana*), rabbit (*Oryctolagus cuniculus*), and chipmunk (genus *Tamias*) may also be found here.

Children and pets from nearby houses play in Pettibone Creek, which supports minnows (family Cyprinidae), aquatic insects, frogs (order Salientia), and salamanders (order Caudata). The water is slow moving due to low gradients, and is prone to stagnation during dry spells.

Skokie Ditch, an upgraded ditch with intermittent flow, comprises a second ecosystem. There is less vegetation along the ditch than occurs along Pettibone Creek, although a few willow trees (genus *Salix*) are close to the ditch in some areas. Some mammals (such as groundhogs, squirrels, rats, opossum, rabbits) may inhabit this area, although in lesser numbers than are found in the Pettibone Creek area. Frogs, salamanders, mosquitos (family Culicidae), and various aquatic insects inhabit the ditch on a seasonal basis.

Flat grassy areas such as the Golf Course comprise another type of undeveloped area at NC Great Lakes that may be viewed as an ecosystem.

Vegetation includes planted grasses and various planted exotic and native trees and shrubs. Squirrels and rabbits are the principal mammals found in the flat grassy areas; occasionally wild animals (such as those listed above) enter the area from farmland at the western margin of the activity.

The activity's shoreline along Lake Michigan comprises another ecosystem. It stretches about 2 miles along the lake and varies in width from approximately 100 feet at its northern end to a maximum of approximately 1,500 feet in the recreation area. The shore has been built out all along the activity boundary, and is lined with construction debris to impede erosion by the lake waters. The small foredune area along the shore is planted with American beachgrass (Ammophila arenaria). The area behind the beach is planted with bluegrass (genus Poa) and fescue (genus Festuca). Outside of these planted areas some natural vegetation can be found, including sedges (genus Carex), tall reed grass (genus Phragmites), and other herbaceous species.

This shoreline plant community is important to the integrity of the adjacent bluffs, but it has been disappearing as development of the lakefront continues. Numerous studies have shown that high lake levels which remove the narrow protective beaches result in accelerated erosion of the shore bluffs.

The steeply sloping bluff area adjacent to the shoreline rises approximately 70 feet above the water level and extends 1.25 miles along the activity's shoreline. The slope is heavily vegetated with a mixture of central and northern hardwood species, principally elm (genus Ulmus), mixed oak, sugar maple (Acer saccharum), soft maple, and ash (genus Fraxinus). Also present is a dense cover of shrubby species, including blueberry (genus Vaccinium), huckleberry (genus Gaylussacia), blackberry, willow, osier, and sassafras (S. albidum).

As previously mentioned the bluff face is composed of unconsolidated material deposited by glacial advances. While the dense cover of trees and shrubs on the shore bluff helps to stabilize the bluff face, it is still subject to erosion and slumping.

The shallow water near the shore of Lake Michigan supports abundant aquatic life. Aquatic insects, crustaceans such as crayfish (genus Cambarus), mollusks such as freshwater clams (genera Unio or Anodanta), and aquatic plants live in sandy and muddy substrates along the shore. Panfish, including sunnies (Lepomis gibbosus), bluegills (Lepomis machrochirus), crappies (Pomoxis annularis and Pomoxis nigro-masculatus), and white (Morone americana) and yellow perch (Perca flavescens), are fairly common in these shallow, warm waters. The panfish feed on the insects, minnows, and algae that thrive in the nearshore environment.

Coho salmon (Oncorhynchus kisutch), largemouth (Micropterus salmoides) and smallmouth bass (Micropterus dolomieu), lake trout (Salvelinus namaycush), pike (Esox lucius), and pickerel (genus Esox) are among the more common game fish in the lake. Lake whitefish (Coregonus clupeaformis), muskelunge (Esox

masquinongy), and trout (family Salmonidae) are occasionally caught by fishermen outside the harbor area. These gamefish typically feed on smelt (genus Osmerus) and panfish.

Especially common fish in the activity's harbor complex include the various types of panfish listed above and largemouth bass. These fish provide sportfishing opportunities in the harbor complex and should be considered as potential receptors of hazardous wastes that may enter the harbor via Pettibone Creek. Filter-feeding freshwater clams are also considered primary receptors of any hazardous wastes that exist in the water as particulate matter.

The bird population on the activity consists mostly of pigeons (family Columbidae), starlings (Sturnus vulgaris), and English sparrows (Passer domesticus). These birds are currently the focus of pest control programs. Various songbirds also inhabit the base, and seagulls (family Laridae) are always seen along the shore, along with a smaller number of ducks (family Anatidae).

4.4.2 Rare, Threatened, and Endangered Species. Under the Endangered Species Act of 1973 the Federal Government has designated for protection a number of plant and animal species that are in danger of extinction, or are likely to become endangered, throughout all or a significant part of their range (50 CFR 17.11 and 17.12). The State of Illinois passed an Endangered Species Act in 1972 to strengthen protection for plants and animals endangered or threatened with extinction by the State.

Currently, the Federal Government recognizes seven endangered animal species and one endangered plant species with ranges that include Illinois. The Illinois Department of Conservation recognizes an additional 65 animal species and 364 plant species that are either threatened or endangered as breeding populations in Illinois. Appendix B contains lists of all threatened and endangered plant, fish, bird, and terrestrial mammal species found in Illinois.

As of 1984 there were no known threatened or endangered plant species occurring on or near NC Great Lakes (NORTHNAVFACENGCOM, 1984a). However, the shoreline plant community found on the activity has been recognized as a dwindling natural resource worthy of protection (Illinois State Geological Survey (ISGS), 1977).

There are no terrestrial animal species native to the Great Lakes area that are considered threatened or endangered by the State or the Federal Government (NORTHNAVFACENGCOM, 1984). However, the State does consider a number of fish species to be threatened, including the lake whitefish and the lake sturgeon (Acipenser fulvescens). It is possible that individuals of these species periodically enter waters in close proximity to NC Great Lakes.

4.5 PHYSICAL FEATURES.

4.5.1 Climatology. NC Great Lakes is located in a region characterized by frequent changes in temperature, humidity, cloudiness, and wind

direction. The climate type is continental with warm summers and very cold winters. Prolonged warm spells and major droughts are infrequent but long spells of dry weather may occur during the growing season.

The normal daily average temperature for January is 25 degrees F., and for July is 75 degrees F. The lowest recorded temperature was -24 degrees F.; the highest recorded temperature was 105 degrees F. The average growing season lasts from April 30 through October 20. The mean annual precipitation is 34 inches, which peaks in June and is lowest in February. Mean annual snowfall ranges from 40 to 60 inches. Average winds are westerly at 11 miles per hour in winter, shifting to south-southwesterly at 9 miles per hour in summer (National Oceanic and Atmospheric Administration (NOAA), 1970).

Seasonal climate conditions have been shown to have a direct relationship to the bluff recession rate, a continuing problem in many lakeshore areas. The most severe rate occurs in late winter (February-March) when the first major thaw occurs (with many subsequent freeze-thaw cycles), precipitation is higher, and there is a higher frequency of onshore wave attacks. Data suggest that the synergistic effect of these four factors is primarily responsible for severe bluff recession.

4.5.2 **Topography.** Lake County is in the Wheaton Morainal Country of the Great Lakes section of the Central Lowland Province. This province is gently sloping and poorly drained, with many streams ending in depressions and marshes.

There are three topographic subcomplexes in Lake County, whose characteristics are influenced by the region's morainal geology. These are the Beach-Dune Complex, the Upland-Moraine Complex, and the Bluff-Ravine Complex. NC Great Lakes lies atop the Bluff-Ravine Complex.

The Bluff-Ravine Complex occurs within the narrow Lake Michigan watershed and consists of level tablelands which are typically bordered by steep lake-facing bluffs and a network of interior ravines. The most distinctive feature of this complex is its continual degradation by erosion. The two most damaging erosive forces are the pounding of waves from the lake and the surface runoff over the ravine walls. Numerous studies have shown that high lake levels which remove the narrow protective beaches result in accelerated rates of bluff erosion. Bluff and beach erosion may also result from such factors as loss of vegetation, natural weakness of bluff material, oversteep slopes, ground water seeps and springs in the bluffs, and deprivation of littoral drift sediments along the shore by shore structures farther north (ISGS, 1977).

Ravines have also formed in this unstratified glacial till, making the bluff area extremely erodible and prone to slumping. Ravines are particularly sensitive to increases in surface runoff, which intensifies the water erosion over and through the ravine walls. At NC Great Lakes there are 1.25 miles of lake bluffs and 1.5 miles of ravine carrying the activity's major stream, Pettibone Creek (NORTHNAVFACENGCOM, 1980).

Almost all of the land on which NC Great Lakes is situated has a constant elevation of 650 feet above mean sea level, plus or minus 10 feet. The exceptions to this rule are found in the Pettibone Creek area (600 feet) and the east end of the activity along Lake Michigan (590 feet).

4.5.3 Geology. NC Great Lakes is part of the glaciated Central Lowland region. Before glaciation, the land surface in the vicinity of what is now NC Great Lakes was formed by consolidated sedimentary rocks. These layers of much older limestones and shales are the result of ancient marine deposition by seas that periodically covered the area. In general, these bedrock layers are horizontal or dip gently eastward. The bedrock is presently covered with a superficial layer of glacial till that averages a depth of 170 feet (NORTHNAVFACENGCOM, 1980; Flint, 1971). This till was laid down by several periods of glacial activity during the last 600,000 years (Flint, 1971). It is usually traceable as a continuous blanket-like unit, due to the horizontal character of the underlying bedrock.

Silurian bedrock (Niagran and Alexandrian limestone) lies beneath the till layer at minimum depths of 170 feet. The limestone is impervious to water, and all water-bearing strata that could possibly serve as pathways for the migration of contaminants occur in the overlying layers of glacial till. To a large degree, the till material is derived from the limestone (Flint, 1971). Frequently, the till layer is 200 or more feet thick (Flint, 1971; Illinois Department of Public Health, miscellaneous dates, 1971 to present). Figure 4-4 shows a geologic cross section of the shallow till layers underlying NC Great Lakes.

The thick layer of glacial material, the only geologic unit that underlies the activity, is important for controlling development. The predominant glacial deposit in Lake County is the Wadsworth till member (clayey phase and sandy phase), an unsorted material consisting of elements ranging from clay to large boulders. Because this till is unsorted, i.e., it has not been exposed to the sorting action of water or wind, interstices between rocks in the till are filled with fine clay-sized particles. Consequently, the till can be practically impermeable to water.

Hydraulic conductivities for clayey tills may be 10 to the minus 12 centimeters per second (cm/sec), meaning that water may only migrate 10 meters through the till in 10,000 years (Freeze and Cherry, 1979).

Well logs from Lake Bluff addresses all show till extending to a minimum depth of 170 feet and frequently extending 210 feet or more. Although till is the dominant type of glacial deposit in the NC Great Lakes area, well logs show localized sorted volumes of glacial material throughout the till. These discontinuous stringers and lenses may serve as aquifers. A representative well log from Lake Bluff (Figure 4-5) shows 10 feet of brown clay, followed by 148 feet of blue clay, 13 feet of broken rock-gravel, and limestone, which begins at 171 feet in this case. Fill, or 2 to 3 feet of topsoil, may occur (Hoover Water Well Company well logs, 1968 to 1985).

Surface expression of till is flat, consisting of low ridges and hills interspersed with depressions and lakes. A sandy facies crops out along the lakeshore at the foot of the bluffs along Lake Michigan.

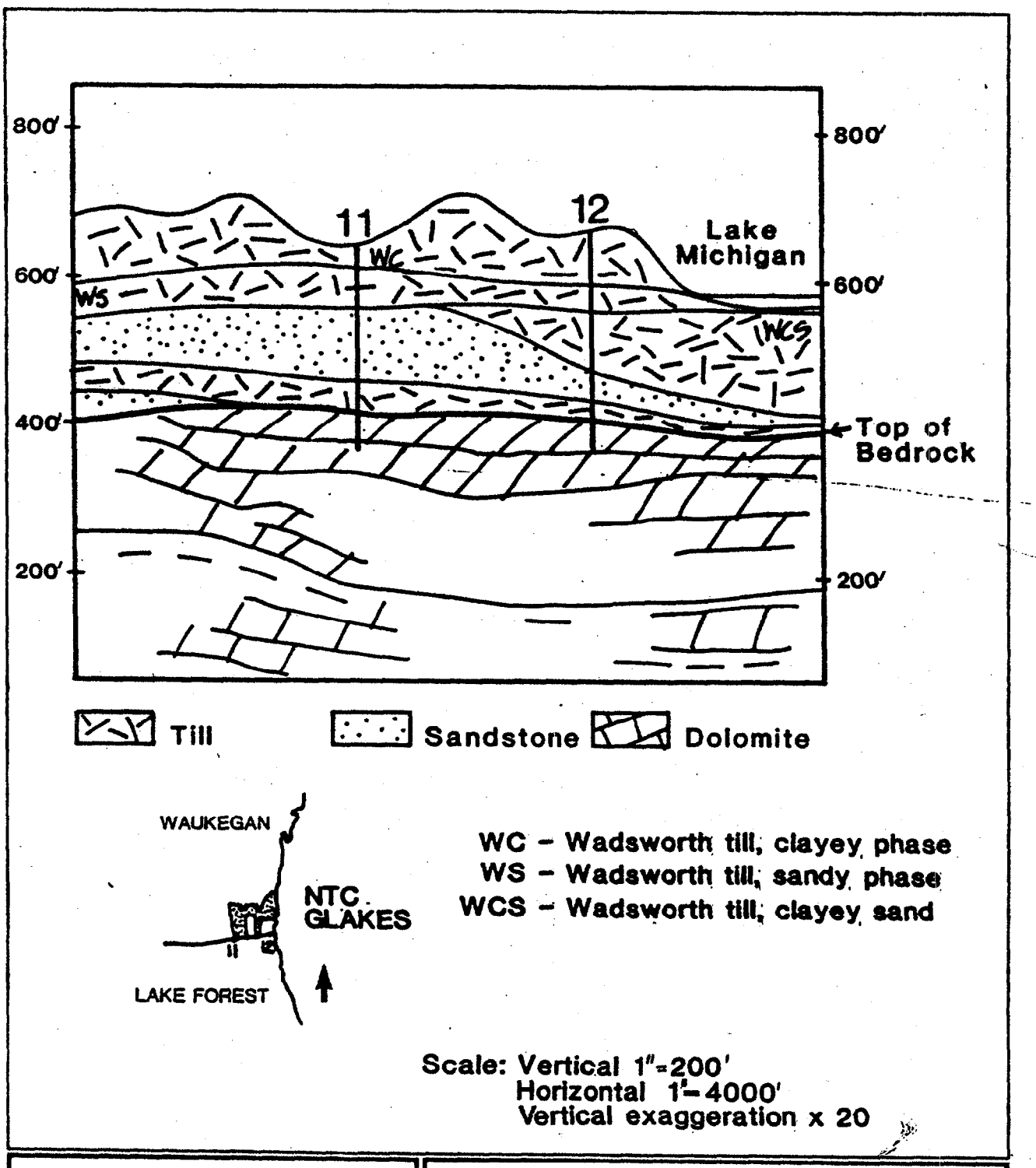


Figure 4-4

Geologic Cross Section, NC Great Lakes

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

White Copy – Ill. Dept. of Public Health
Yellow Copy – Well Contractor
Blue Copy – Well Owner

INSTRUCTIONS TO DR ERS

FILL IN ALL PERTINENT INFORMATION REQUESTED AND MAIL ORIGINAL TO STATE DEPARTMENT OF PUBLIC HEALTH, CONSUMER HEALTH PROTECTION, 535 WEST JEFFERSON, SPRINGFIELD, ILLINOIS, 62761. DO NOT DETACH GEOLOGICAL/WATER SURVEYS SECTION. BE SURE TO PROVIDE PROPER WELL LOCATION.

ILLINOIS DEPARTMENT OF PUBLIC HEALTH WELL CONSTRUCTION REPORT

1. Type of Well
   a. Dug ____. Bored ____. Hole Diam. 6 in. Depth 198 ft.
   Curb material ____. Buried Slab: Yes ____ No ____
   b. Driven ____. Drive Pipe Diam. ____ in. Depth ____ ft.
   c. Drilled X. Finished in Drift X. In Rock ____.
   Tubular ____. Gravel Packed ____.
   d. Grout:

(KIND)	FROM (Ft.)	TO (Ft.)

2. Distance to Nearest:
   Building ____ Ft. Seepage Tile Field ____
   Cess Pool ____ Sewer (non Cast iron) ____
   Privy ____ Sewer (Cast iron) ____
   Septic Tank ____ Barnyard ____
   Leaching Pit ____ Manure Pile ____
3. Well furnishes water for human consumption? Yes X No ____
4. Date well completed 3/23/79
5. Permanent Pump Installed? Yes ____ Date ____ No X
   Manufacturer ____ Type ____ Location ____
   Capacity ____ gpm. Depth of Setting ____ Ft.
6. Well Top Sealed? Yes X No ____ Type ____
7. Pitless Adapter Installed? Yes ____ No ____
   Manufacturer ____ Model Number ____
   How attached to casing? ____
8. Well Disinfected? Yes X No ____
9. Pump and Equipment Disinfected? Yes ____ No ____
10. Pressure Tank Size ____ gal. Type ____
    Location ____
11. Water Sample Submitted? Yes X No ____

REMARKS:

IDPH 4.065
1/74 – KNB-1

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner LA SALLE DEVELOPMENT Well No. Armour Estates, Lake Bluff
    Address P.O. Box 827, Palatine, Il
    Driller John P Lichter License No. 102-6
11. Permit No. 70191 Date 12/14/78
12. Water from Limestone & Gravel County Lake
    at depth 171 to 198 ft.
14. Screen: Diam. 5 in.
    Length: 3 ft. Slot 10
    Sec. 16.
    Twp. 44N
    Rge. 12E
    Elev. ____

SHOW LOCATION IN SECTION PLAT
NE 1/4 SEC, NW/4 NE

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
6	Black	grade	168

16. Size Hole below casing: 6 in.
17. Static level 93 ft. below casing top which is 1 ft. above ground level. Pumping level ____ ft. when pumping at 15 gpm for ____ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
Brown Clay	10	10
BlueClay	148	158
Broken rock-gravel	13	171
Limestone	27	198

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED [signature] DATE 6/19/79

Figure 4-5
Representative Well Log, Vicinity of NC Great Lakes

Initial Assessment Study
Naval Complex
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The ISGS has evaluated the engineering properties of the geologic material underlying the activity in Circular 481 (1973) and found the subsurface material to be generally favorable for most construction. The major problem that may be expected is poor drainage; often the low permeability of the till creates a water table near the surface, causing construction difficulties as well as inefficient operation of facilities such as septic systems.

4.5.4 Soils. The native soils of the area have been classified into the Morley-Beecher-Hennepin Association, a grouping of soil types that characteristically occur together. This association occurs as a long, narrow belt extending along the shore of Lake Michigan from below Waukegan to the southern border of Lake County (USDA, 1970).

In general, most soils in the area of NC Great Lakes have properties suitable for development with few limitations. However, one limitation of these soils is their high shrink-swell potential due to the high clay content in the soil and underlying till. Additionally, where drainage is a problem in these silty soils, frost heave is a common limiting factor. According to Naval Facilities Design Manual 2, frost penetration depth in this area is 40 inches. These soil problems can be overcome without much difficulty through the use of suitable engineering and construction practices.

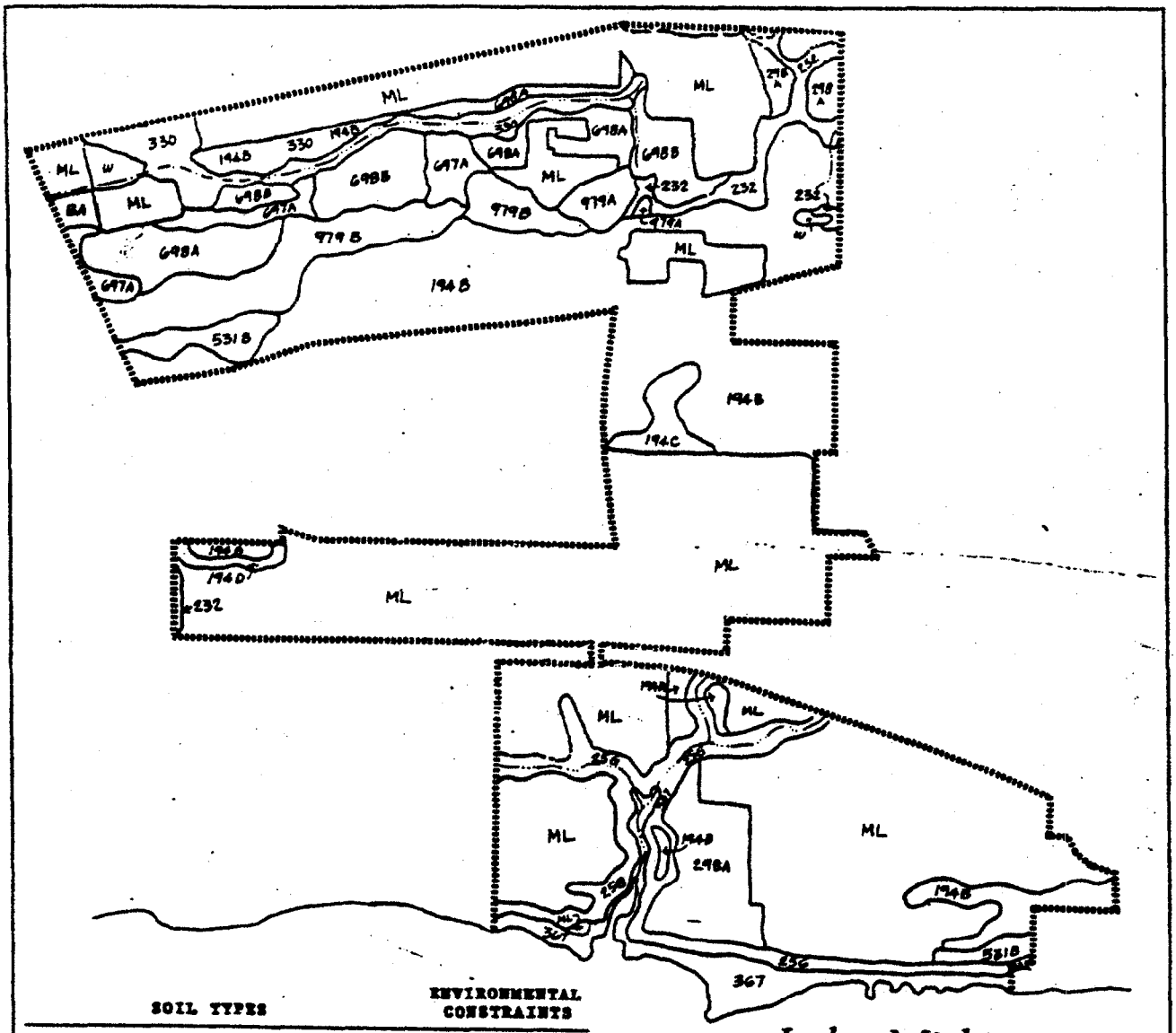
The following discussion enumerates and briefly describes the soil types that occur at NC Great Lakes (NORTHNAVFACENGCOM, 1980; USDA, 1970). Figure 4-6 accompanies the discussion and shows locations and potential uses of soils at NC Great Lakes.

The Morley series consists of deep soils that range from well-drained to moderately well-drained. These soils have arisen in thin, silty deposits of silty clay loam texture. Permeability is low because the subsoil is clayey; the underlying material is calcareous, silty clay derived from glacial till. Moisture capacity is high and the water table is 3 feet or more from the surface.

Three Morley soil types occur on NC Great Lakes: Morley silt loam 194B, with 2 to 4 percent slopes; Morley silt loam 194C, with 4 to 7 percent slopes; and Morley silt loam 194D, with 7 to 12 percent slopes. Each soil typically occurs at the top of morainic ridges, has moderately slow drainage, is farmed infrequently off the activity, and is prone to erosion.

The Beecher series soil type at NC Great Lakes is Beecher silt loam 298B. The soil is gently sloping and poorly drained, and formed from thin deposits of silty clay. Large areas of the soil are farmed off the activity. Seasonal water table levels are high.

Hennepin soils occur on steep, well-drained slopes. Hennepin loam 25G has 30 to 60 percent slopes, making it unsuitable for uses other than recreation.



SOIL TYPES		ENVIRONMENTAL CONSTRAINTS
MADELAND	ML	
HENNEPIN LOAM	256-G	STEEP
MORLEY SILT LOAM	194-B	
MORLEY SILT LOAM	194-C	
MORLEY SILT LOAM	194-D	
ASHKUM SILTY CLAY LOAM	232	WET
BEECHER SILT LOAM	298-A	
PEOTONE SILTY CLAY LOAM	330	WET
BEACH SAND	367	COASTAL BEACH
MARKHAM SILT LOAM	531-B	
WAUCONDA SILT LOAM	697-A	
GRAYS SILT LOAM	698-A	
GRAYS SILT LOAM	698-B	
GRAYS AND MARKHAM SILT LOAMS	979-A/B	
BARROW AREA	BA	

Figure 4-6

Soils Map,
NC Great Lakes

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

Ashkum silty clay loam 232 is level, is found in low-lying areas, and is subject to ponding. Tile drainage is common, and almost all soil of this type occurring in the NC Great Lakes area is farmed. Poor drainage limits development.

Peotone silty clay loam is level, is subject to ponding, and is generally artificially drained. The soil is farmed off the activity, but a high water table limits construction.

Markham silt loam 531B has 4 percent slopes, and lies atop morainic ridges. The soil derives from glacial till, and drainage is poor.

Wauconda silt loam 697A is deep soil with moderate permeability and a slope of 0 to 2 percent. The soil is frequently cultivated off the activity. Limitations derive from a seasonal high water table level.

Grays series soils are deep soils that range from well-drained to moderately well-drained and are derived from calcareous silt and sand. Permeability is moderate. Grays silt loam 698A has 0 to 2 percent slopes, has no farming limitations, and is suitable for development. Grays silt loam 698B has 2 to 4 percent slopes, and has few limitations save a tendency to erode due to the underlying gravelly substratum.

Grays and Markham silt loams 979A and 979B are low permeability soils that occur between glacial moraines in Lake County. These soils are poorly drained and are used primarily for farming off the activity.

Borrow Areas (BA) have had soil removed; in some cases only shallow layers are removed, although in other cases several feet of soil may have been removed, exposing the underlying glacial till. Borrow Areas support little vegetation.

Beach sand occurs along the shore of Lake Michigan. It is suitable for recreational use.

Madeland (ML) consists of areas of manmade cuts and fill, and is generally covered with roads and buildings. Fill material is not necessarily soil.

Beach sand is unstable and subject to wave action from the lake; Hennepin loam with extreme slopes poses a severe erosion hazard; and Ashkum and Peotone soils in low-lying areas are subject to ponding, high water table, and high shrink-swell. Some of the properties of the site soils are listed in Table 4-1.

4.5.5 <u>Surface Water</u>. NC Great Lakes is located within two major drainage basins: Lake Michigan North Drainage Basin (St. Lawrence River) and the North Branch Chicago River Drainage Basin (Mississippi River). The drainage divide separating these two watersheds occurs along Green Bay Road. Areas east of the road drain into the lake, and areas west of the road drain into the Skokie River, called the Skokie Ditch where it originates on the activity.

Table 4-1

Major Soil Types at NC Great Lakes
(Source: USDA, 1970)

Soil Unit	Symbol	Percent Slope	Drainage Class	Depth to High Water Table(feet)	Subsoil Texture	Underlying Material	Designated Prime Agricul. Soil	Agricul. Limitations	Development Limitations
Hennepin loam	25G	30-60	2	3 +	silt loam	calc. silt loam	No	E	ST, E, FH
Del Rey silt loam	192A	0-2	4	1 - 3	s.c.l.	lake sediments	Yes	SHWT, SP	SHWT, FH
Morley silt loam	194B	2-4	2-3	3 +	s.c.l.	calc. glac. till	Yes	SP	FH, CS
Morley silt loam	194C	4-7	2-3	3 +	s.c.l.	calc.glac. till	No	SP	FH, CS
Morley silt loam	194D	7-12	2-3	3 +	s.c.l.	calc. glac. till	No	SP, E	FH, CS
Ashkum silty clay loam	232		5	0 - 1	s.c.l.	glac. till	Yes	HWT	HWT, P, S, F
Beecher silt loam	298A	0-2	4	1 - 3	s.c.l.	calc. glac. till	Yes	SP	SHWT, FH
Beecher silt loam	298B	2-4	4	1 - 3	s.c.l.	calc. glac. till	Yes		SHWT, FH
Peotone silty clay loam	330		6	0 - 1	s.c.l.	calc. s.c.l.	Yes	SH, WT	HWT, S, FH,
Beach sand	367			0 - 1			No	U	U, GW
Markham silt loam	531B	1-4	2-3	3 +	s.c.l.	calc. glac. till	Yes	SP	FH
Wauconda silt loam	697A	0-2	4	1 - 3	s.c.l.	calc. silt & sand	Yes		SHWT, FH, S
Grays silt loam	698A	0-2	2-3	3 +	s.c.l.	calc. outwash sed.	Yes		FH
Grays silt loam	698B	2-4	2-3	3 +	s.c.l.	calc. outwash sed.	Yes		FH
Wauconda & Beecher silt loams	978A	0-2		1 - 3			Yes	SP	SHWT
Grays and Markham silt loams	979A	0-2		3 +	s.c.l.	s.c.l.	Yes	SP	
Grays and Markham silt loams	979B	2-4		3 +	s.c.l.	calc. glac. till	Yes	SP	
Borrow area	BA		Variable	Variable			No		
Madeland	ML		Variable	Variable			No		

Usage Limitation Codes

U	Unstable	S	Seepage
FH	Frost Heave	SP	Slow Percolation
CS	Clayey Subsoil	GW	Groundwater Contamination Potential
P	Ponding	E	Erosion
HWT	High Water Table	ST	Steep Slopes
SHWT	Seasonal High Water Table		

Drainage Classes

1. excessively drained
2. well drained
3. moderately well drained
4. somewhat poorly drained
5. poorly drained
6. very poorly drained

Stream patterns in the area are irregular, and the streams carry small volumes of water. The two major streams that drain NC Great Lakes are Pettibone Creek, a narrow stream with a steeper overall gradient than the other area streams, and the Skokie River, which rises on the activity and has been channelized between Buckley Road and Alabama Avenue (Figure 4-7). Some of the hydrologic characteristics of area streams are presented in Table 4-2.

The Illinois Environmental Protection Agency (IEPA) has classified both drainage basins within which NC Great Lakes lies as water quality limited; that is, the water quality does not meet established standards and/or is not expected to do so, even after the prescribed 1983 effluent limitations are in effect.

Sampling by IEPA has indicated some violation of water quality standards in all tributary streams of both watersheds. In the Lake Michigan North Drainage Basin, Pettibone Creek has had the highest number of parameters violated and the highest number of violations. However, due to the relatively miniscule amount of water that flows through Pettibone Creek into Lake Michigan, the potential for significant impact on the lake's pollution load is minimal.

In the Skokie River (i.e., downstream from NC Great Lakes), Illinois water quality standards for ammonia-nitrogen, fecal coliform, and dissolved oxygen are commonly violated. This condition is typical of the poor water quality of the entire North Branch Chicago River Drainage Basin; it results from high pollution loads, and is further aggravated by very sluggish flows (NORTHNAVFACENGCOM, 1980). In the vicinity of NC Great Lakes, Skokie Ditch/River is a depression that may intersect the water table as it rises following periods of heavy precipitation. At present, Skokie Ditch receives storm water runoff from storm sewers that serve Forrestal Village. Since this runoff is the only known discharge from NC Great Lakes into Skokie Ditch, the activity's contribution to ammonia-nitrogen and fecal coliform violations in Skokie River would be minimal, if not insignificant.

4.5.6 **Ground Water.** Due to the proximity and acceptable water quality of Lake Michigan, NC Great Lakes does not rely on ground water wells for drinking water. However, both the glacial till and the underlying bedrock were used in the past as sources of ground water. Presently, water from the hydrologically isolated region of the till-bedrock interface is used as a source of ground water (Illinois Department of Public Health, 1978; Hoover Water Well Source, 1968; see also following discussion). Water for the activity is supplied from Lake Michigan.

The water table is usually within 10 feet of the ground surface and may intersect the surface in low-lying depressions. The water table intersects Pettibone Creek, and it intersects Skokie Ditch infrequently, following periods of heavy rain. Ground water movement is predominantly horizontal through the till, and rates of movement are slow due to the very low hydraulic conductivities. There is also a vertical component to ground water flow as a result of fracturing in the till. However, compaction of the till at increasing depth, and infilling of interstices and fractures

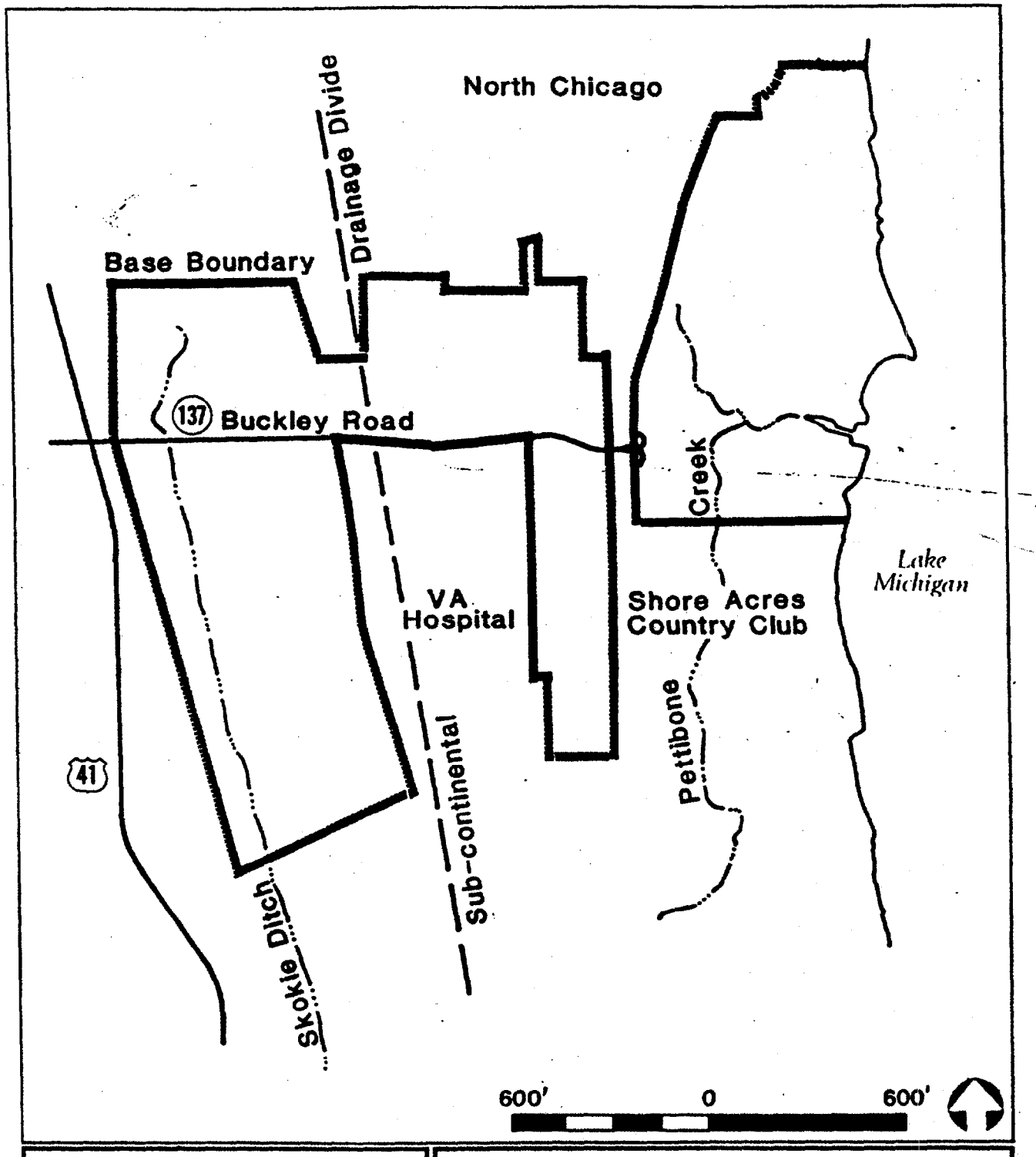


Figure 4-7

Site Features Map, NC Great Lakes

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

Table 4-2

Area Stream Characteristics,
Vicinity of NC Great Lakes

Stream	Length (Miles)	Average Width (Ft.)	Water Surface (Acres)	Gradient (Ft/Mile)	Drainage Area (Sq.Miles)
Bull Creek	.9	4.0	.4	NA	NA
Dead Rober	1.5	105.0	27.2	9.3	6.0
Kellogg Ravine	9.5	6.0	6.9	3.1	6.2
Pettibone Creek	3.7	3.0	1.3	40.0	5.4
Lake Michigan Tributary	4.0	6.0	2.9	30.0	1.5
Waukegan River	8.5	4.0	4.1	21.8	9.0
No. Branch Chic. River	50.6	69.0	432.2	2.5	200.0
Skokie River	22.0	20	NA	4.0	32.9
West Fork No. Branch of Chicago River	8.3	8.3	18.4	2.0	30.0

NA: Not Available

Source: Sheaffer, J.R., and Zeizel, A.J., 1966.

with calcareous cement, hydrologically isolate the deep-lying limestones from the overlying till by preventing vertical flow at depth.

The consolidated sedimentary bedrock underlying NC Great Lakes forms a ground water reservoir. Many private and commercial wells are drilled into the Niagran and Alexandrian limestone, with typical yields of 25 to 40 gallons per minute. The consolidated rocks are hydraulically isolated from the overlying till.

Sand and gravel lenses, stringers, and beds located throughout the till sheet may serve as localized aquifers. At the bedrock-till interface (170 feet) is a sand-and-gravel aquifer which is a comparatively undeveloped source of potable water. Provided that these lenses and the sand-and-gravel aquifer are not overpumped, they may be reliable, long-term providers of ground water. Figure 4-8 shows the location and depth of some of these aquifers beneath the activity.

Where unfractured, the finer silty phase of the till is relatively impervious to water. In-place hydraulic conductivities are commonly on the order of 10 to the minus 12 cm/sec. Due to the extremely low hydraulic conductivities, coupled with the relatively low gradients common to the area, it may take ground water 10,000 years to travel 10 meters through the till.

4.6 MIGRATION POTENTIAL. Two pathways for the migration of contaminants exist at NC Great Lakes. These pathways are ground water transport in the shallow till and sand-and-gravel aquifers, and surface water runoff to Skokie Ditch or Pettibone Creek.

4.6.1 Ground Water. NC Great Lakes is underlain by a sheet of glacial material up to 250 feet thick. This material ranges from completely unsorted to well sorted. Where unsorted, the glacial till commonly forms aquitards; sorted materials comprise local aquifers.

There are three main aquifers at NC Great Lakes that may serve as migration pathways for contaminants. (The deep-lying sand-and-gravel aquifer located at the interface of the till and the limestone bedrock will not be considered as a pathway because it is hydrologically isolated from the shallower till layers, and will therefore neither receive nor transmit contaminants.) The area north of Buckley Road is underlain by a shallow aquifer less than 15 feet from the surface. Forrestal Village and the southern half of Camp Porter are underlain by an aquifer that rests at a minimum depth of 50 feet. The remaining area between these two aquifers lies at depths ranging from 15 to 50 feet (Figure 4-8).

Hydraulic conductivities in till are typically very low, with values in the range of 10 to the minus 12 cm/sec. The generally flat nature of these sheet-like deposits results in very low hydraulic gradients, and this fact combines with the low conductivities to severely restrict ground water flow through these materials. Given a gradient of 0.5 and a hydraulic conductivity of 10 to the minus 12 cm/sec, ground water would require nearly 10,000 years to travel 10 meters through this material.

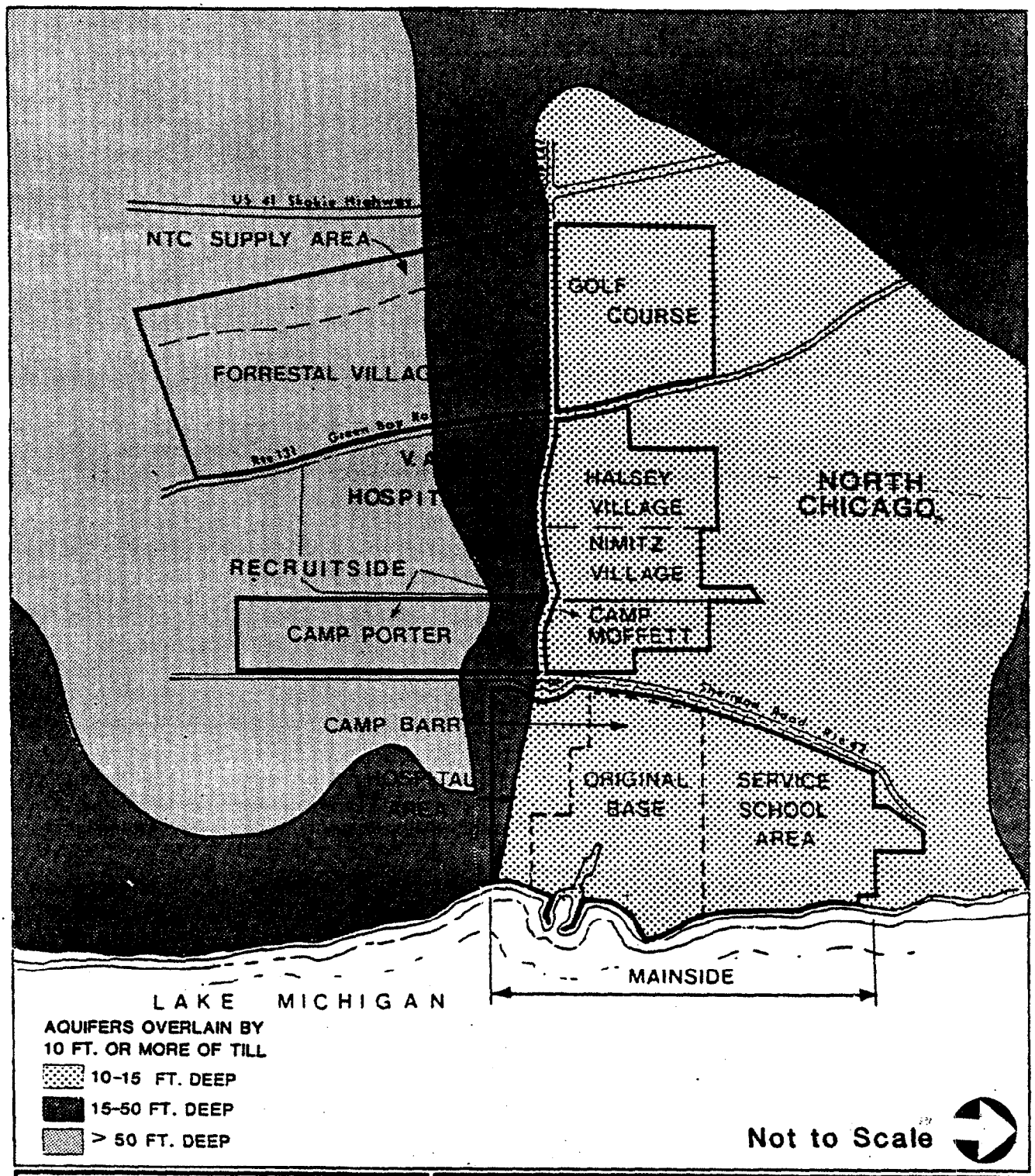


Figure 4-8

Buried Aquifers, NC Great Lakes

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

The well sorted sand-and-gravel sheets and lenses that are interspersed throughout the glacial till represent potential pathways for the migration of pollutants. Hydraulic conductivities in this material are several orders of magnitude higher than those found in the surrounding glacial till. These deposits are often of sufficient areal extent to provide reliable sources of ground water. Well logs from NC Great Lakes show that one sand-and-gravel aquifer is used (infrequently) as a source of potable or agricultural water; this aquifer is at the interface between the glacial till and the underlying limestone, and consists of limestone rubble. Well logs from the area indicate that this aquifer lies at a minimum depth of about 170 feet.

It has been observed that glacial materials of high clayey content in parts of the Midwest have networks of hairline fractures. These fissures are predominantly vertical and may serve as conduits for ground water movement. In general, however, hydraulic conductivity in such fractured tills decreases with depth as a result of compression from overburden loading. Moreover, fissures are frequently cemented shut in tills with a high calcareous component; the glacial till in the area of NC Great Lakes is highly calcareous (USDA, 1970; Flint, 1971).

For practical purposes, then, the plus 200-foot-thick till at NC Great Lakes has very little potential for vertical ground water migration. Furthermore, the clayey soils at the surface would inhibit penetration and migration of polluted waters.

Finally it must be said that hydraulically connected aquifers at very shallow depths could possibly transmit contaminated ground water to Skokie Ditch, Pettibone Creek, or Lake Michigan, if they were located below contaminated sites (although this is unlikely to occur).

4.6.2 Surface Water. NC Great Lakes lies within two drainage basins - the North Branch Chicago River and Lake Michigan North. The divide between these two basins lies approximately along Green Bay Road. Precipitation which does not infiltrate into the relatively impervious surficial material will travel as overland flow into either Skokie Ditch or Pettibone Creek.

The water in Skokie Ditch is not used as a source of potable or agricultural water in the immediate vicinity of NC Great Lakes. Illinois water quality standards for ammonia-nitrogen, fecal coliform, and dissolved oxygen are commonly violated in Skokie Ditch downstream from NC Great Lakes and the other industries which lie within the ditch's drainage area. This condition is fairly typical of the generally poor water quality in the entire North Branch Chicago River Drainage Basin (NORTHNAVFACENGCOM, 1980; see also section 4.5.5).

Pettibone Creek drains the Mainside area of NC Great Lakes and industrialized areas to the north of the activity, and receives discharge from storm sewers in North Chicago. The creek empties into Lake Michigan at the NC Great Lakes harbor. According to activity personnel, Pettibone Creek has on occasion been a conduit for spilled chemicals generated by industries located immediately off the activity. According to IEPA, Pettibone Creek has had the highest number of violations of water quality parameters and the

highest number of separate violations in the Lake Michigan North Drainage Basin. Parameters violated include those for PCB's and heavy metals. The receptors of this contaminant load are the sediments of the boat basin. These sediments support a huge population of sludge worms, indicative of severe contamination. Another potential receptor of contamination from Pettibone Creek is the potable water intake serving the activity. This is not considered a serious problem, however, due to the intake's remote location (8,000 feet offshore) and the dilution of contamination by the waters of Lake Michigan.

CHAPTER 5. WASTE GENERATION

5.1 GENERAL. Naval Complex (NC) Great Lakes is primarily a training facility; large-scale maintenance operations are not conducted on the activity. The generation of hazardous waste is confined mainly to the Public Works Center (PWC), the Hospital Command, and the Service School Command. Minor quantities are also generated by the other commands and tenant operations. Within this section, past operations are described as completely as possible; however, due to the frequent complete turnover of military personnel at the activity, it is often extremely difficult to find any personnel with tenure greater than 1 or 2 years. For this reason, current operations are discussed to enhance understanding of past waste generation practices.

Past and present operations at NC Great Lakes are discussed by command, branch, and shop. Whenever possible, waste types, quantities, and disposal practices have been identified for each operation or shop. If applicable, past locations where particular operations were quartered are also identified.

A summary of waste generation from all waste-generating activities at NC Great Lakes is presented in Table 5-1. In most cases current annual generation rates were used to develop a total waste generation quantity based on the duration of the operation and the population of the activity during the relevant time period.

5.2 NAVAL ADMINISTRATIVE COMMAND.

5.2.1 Fire Stations. Three fire stations have served NC Great Lakes since the 1950's, although the fire station in Mainside has existed since the activity became operative in 1904. The fire stations are located in Buildings 106, 108H, and 2912. Each fire station has a complement of 12 men. Workload has decreased significantly within the last 5 years, due primarily to fire inspections and information dissemination. The fire stations used to respond to seven calls per day; today the average has decreased to less than one call per day.

The fire stations generate no wastes. Aqueous Film Forming Foam (AFFF) has been in use since 1980 for fighting petroleum fires. Prior to 1980, a high protein foam was used; however, use of this compound was discontinued due to its highly corrosive nature.

The Fire Department has been called upon often in the past to clean up gasoline spills at the various service stations on the activity. Department personnel have used an absorbent, Absorball, to soak up spilled gasoline since 1975. The gasoline-soaked Absorball is placed in plastic bags by the firemen and then is picked up by PWC for off-base disposal. Prior to 1975 gasoline spills were treated by washing the gasoline down the storm sewers.

5.2.2 Photo Lab. The ADCOM (Administrative Command, a subordinate command of NC Great Lakes) Photo Lab can develop black-and-white, color, and

Table 5-1

Summary of Waste Generation, NC Great Lakes

Operation	Waste Material	Disposal Rate (gallons/year)	Disposal Practice 1	Duration of Practice
Naval Administrative Command:				
Photo Lab	Photographic chemicals: bromides, acetic acid, formaldehyde, bleach, acetone, alcohols; paper, film (black-and-white and color)	360, plus waste paper	Sanitary drains at previous location	1942-1973
			Sanitary drains	1973-1985
Navy Exchange:				
Service Station	Waste oil	1,000's gallons	Off-base recycling	1958-1985
	Antifreeze	100's gallons	Storm sewer drains	1958-1985
Laundry and Dry Cleaning	Perchlorethylene	recycled	Off-base	1973-1983
Photo Lab	Photographic chemicals: bromides, acetic acid, formaldehyde, bleach, acetone, alcohols; paper, film	1,300	Sanitary drains	before 1981
			Fixer recycled at previous location	1981-1985
			Sanitary drains	1973-1985
Recreational Services Department:				
Auto Hobby Shop	POL's	4,000	Private contractor	1958-1983
		5,400	Private contractor	1983-1985
	Stoddard solvent	undetermined	Storm sewer	1958-1973
	Stoddard solvent	recycled	Off-base	1973-1975

Table 5-1 (contd.)

Summary of Waste Generation, NC Great Lakes

Operation	Waste Material	Disposal Rate (gallons/year)	Disposal Practice 1	Duration of Practice
Ceramic Hobby Shop	Paint	2 (consumed)	Dumpster *	
Golf Course	POL	110	Burned at Fire Training Ctr.	pre-1968-1982
	POL	110	Private Contractor	1982-1985
	Stoddard Solvent	20	Burned at Fire Training Ctr.	pre-1968
	Stoddard Solvent	recycled	Off-base contractor	1968-1985
	12 v. batteries	30	Exchanged for deposit	1968-1985
	Pesticide containers	12	Dumpster	1967-1985
Recruit Training Command:				
RTC Rifle Range	Lead, brass	340,000 rounds	Recycled	1981-1985
	Lead, brass	¼340,000 rounds	Recycled	1967-1981
	Lead, brass,	¼340,000 rounds	Taken to landfill	1942-1967
	CLP = Clean, Lube Protect gun oil	0.095 gal/yr.	Dumpster *	1942-1985
	Bore cleaner - #6850-00-224-6663	0.095 gal/yr.	Dumpster *	1942-1985
Airman Laboratory	PD 680	0.150	Dumpster *	1981-1985
	Paint thinner	0.150	DRMO	1981-1985
	Paint	0.025	Dumpster *	1981-1985
	Varnish	0.025	Dumpster *	1981-1985
	Hydraulic fluid	0.025	Dumpster *	1981-1985

Table 5-1 (contd.)

Summary of Waste Generation, NC Great Lakes

Operation	Waste Material	Disposal Rate (gallons/year)	Disposal Practice 1	Duration of Practice
Building and Equipment Maintenance	POL's	110	DRMO	1943-1985
	Paint thinner	0.05	Dumpster	1943-1985
	Floor wax and stripper	0.05	Dumpster	1943-1985
	Spray lacquer	0.05	Dumpster	1975-1985
	RV batteries	10	DRMO	1943-1985
Motor Pool	Batteries	10 units/year	DRMO	1965-1985
RTC Silk-Screening Shop	Wash waste: alcohol, turpentine, linseed oil, latex paint, inks, acetone, gasoline	1,400	Onto ground	1972-1985
Public Works Department:				
Motor Vehicle Maintenance	POL's	5,200	DRMO	1942-1985
	Batteries	1,460	DRMO	1942-1985
	Paint	2	Sanitary sewer	1942-1985
Paint and Sign Shop	Paint: latex	0.05	Dumpster	1980-1985
	oil	0.05	Dumpster	pre-1970-1980
	Saf Peel surfactant	0.05	Dumpster	1982-1985
	Solution waste: mineral spirits, latex, oil varnish, oil-based stains, and acetone	2,200	Sanitary sewer	pre-1970-1985

Table 5-1 (contd.)

Summary of Waste Generation, NC Great Lakes

Operation	Waste Material	Disposal Rate (gallons/year)	Disposal Practice 1	Duration of Practice
Carpentry Shop	asbestos	undetermined	Dumpster	1947-1980
	Latex and oil paints	3 quarts	Dumpster *	1947-1985
	Latex primers	3 quarts	Dumpster *	1980-1985
	Solvent 144	11	Dumpster *	1978-1985
High Voltage Shop	1,1,1-trichloroethane	0.5	Dumpster *	1978-1985
HVAC Shop	Latex and oil primer	1	Dumpster *	1954-1985
	WD-40 Lubricant	1	Dumpster *	
Machine Shop	Solvent 144	110	DRMO	1942-1985
Tool Room	Solvent 144	30	DRMO	1983-1985
Cement Finishing Shop	"Lance" brand sealers	0.25	Dumpster *	1968-1985
	Form oil	0.25	Dumpster *	1968-1985
	Cement epoxy	1	Dumpster *	1968-1985
	Spray paint	1	Dumpster *	1968-1985
Welding and Sheet Metal Shop	Water soluble cutting oil	0.075	Dumpster *	1934-1985
	Scrap metal	undetermined	DRMO	1982-1985
Pipe Shop	Water soluble cutting oil	0.175	Dumpster *	1983-1985
	Uranine dye	2 pounds	Sanitary sewer	1973-1985
	OXOFF acid cleaner	200	Sanitary sewer	1973-1985
	COMMAND caustic cleaner	50	Sanitary sewer	1973-1985
Bricklayers Shop	18% muriatic acid solution	¼125	Sprayed on location	pre-1968
	18% muriatic acid solution	125	Sprayed on location	1968-1983
	18% muriatic acid solution	500	Sprayed on location	1983-1985

Table 5-1 (contd.)

Summary of Waste Generation, NC Great Lakes

Operation	Waste Material	Disposal Rate (gallons/year)	Disposal Practice 1	Duration of Practice
Roofers Shop	Roof coating and sealant	275 (consumed)	Dumpster *	1968-1985
	Gasoline	1 (consumed)	Dumpster *	1968-1985
Sandblasters Shop	Black Beauty grit	750 pounds	Left on-site	1968-1985
Service School Command:				
EM/IC School	Stoddard solvent	0.050	Dumpster *	1942-1985
	Paints	0.175	Dumpster *	1942-1985
	Glass cleaner	0.050	Dumpster *	1942-1985
	Tric spray	0.005	Dumpster *	1942-1985
	Saf-Peel	0.325	Dumpster *	1942-1985
	"Bostic" thinner	0.400	Dumpster *	1942-1985
	WD-40 lubricant	0.008	Dumpster *	1942-1985
	Isopropyl alcohol	0.030	Dumpster *	1942-1985
Fire Control Technician, Opticalman, and Instrument Control	Alcohols	0.060	Dumpster *	1954-1985
	Acetone	0.025	Dumpster *	1954-1985
	Penetrating oil	0.010	Dumpster *	1954-1985
	Paint	5	Dumpster	1954-1985
	Thinner	8	DRMO	1954-1985
	PD 680	48	DRMO	1954-1985
	Glass cleaner	6	Sanitary sewer	1954-1985
	Gear oil	48	DRMO	1954-1985
NTC Rifle Range	lead, brass, live ordnance	undetermined	Left on ground, or sent to landfill	1918-1981

Table 5-1 (contd.)

Summary of Waste Generation, NC Great Lakes

Operation	Waste Material	Disposal Rate (gallons/year)	Disposal Practice 1	Duration of Practice
Gunnery School	PD 680	1.75	DRMO	1954-1985
	Hydraulic/transmission fluid	3,500	DRMO	1954-1985
	Grease	120	DRMO	1954-1985
	Mineral oil	0.025	Dumpster *	1954-1985
	Corrosion inhibitor	1.5	Dumpster *	1954-1985
	Thinner	0.06	Dumpster *	1954-1985
Steam Propulsion School	POL's	1,200	Outside contractor	1961-1985
	Acetone	1 (consumed)	Dumpster *	1961-1985
	Ammonium molybdate	1.5	Sanitary sewer	1961-1985
	Nitric acid	4	Sanitary sewer	1961-1985
	Chloride indicator tablets	3,000 units/year	Sanitary sewer	1961-1985
	Mercuric nitrate solution	4	DRMO	1961-1985
	Trisodium phosphate	6	Sanitary sewer	1961-1985
	Disodium phosphate	5	Sanitary sewer	1961-1985
	Morpholine	18	Sanitary sewer	1961-1985
	Lubricating oil	1	Outside contractor	1961-1985
	Cutting oil	0.010	Dumpster *	1961-1985
	Diesel fuel	5	Outside contractor	1961-1985
	Paint	3.25	Dumpster *	1961-1985
	PD 680 - Stoddard solvent	0.025	Dumpster *	1961-1985
	Spray solvent	0.035	Dumpster *	1961-1985

Table 5-1 (contd.)

Summary of Waste Generation, NC Great Lakes

Operation	Waste Material	Disposal Rate (gallons/year)	Disposal Practice 1	Duration of Practice
Hospital Command:				
Nuclear Medicine	Iodine 125	200 milliCuries/yr.	All disposed in dumpster after 10 half-lives (declared non-radioactive)	1970-1985
	Iodine 123	10,400 milliCuries/yr.		
	Iodine 131	1,200 milliCuries/yr.		
	TC 99M	78 milliCuries/yr.		
	Ga 67	260 milliCuries/yr.		
	Th 201	260 milliCuries/yr.		
	Cobalt 51	120 milliCuries/yr.		
	Cobalt 58	10 milliCuries/yr.		
	Iodine 131 waste (urine)		Incinerated	1970-1985
	Cobalt 58 waste (urine)		Incinerated	
	Acetone		Dumpster *	
X-ray	Photographic fixer and developers: alcohols, bleaches, bromides, acetoness	2650	Sanitary sewer after silver recovery	1981-1985
	Photographic fixer and developers: alcohols, bleaches, bromides, acetones	2650	Sanitary sewer after silver recovery	1961-1981

Table 5-1 (contd.)

Summary of Waste Generation, NC Great Lakes

Operation	Waste Material	Disposal Rate (gallons/year)	Disposal Practice 1	Duration of Practice
Photo Lab	Photographic chemicals: alcohol, bromides, acetic acid, acetone, bleaches, formaldehyde, film, paper	14	Sanitary sewer after silver recovery	1967-1985
	Photographic chemicals: alcohol, bromides, acetic acid, acetone, bleaches, formaldehyde, film, paper	14	Sanitary sewer	pre-1967
Incinerator	Ash	36 cu. yards/year	Off-base landfill	1967-1975
	Ash	36 cu. yards/year	Activity landfills	pre-1967
Naval Regional Dental Clinic	Waste compressor oil	9	PWC disposal	1976-1985
	Waste amalgam	100 lbs/year	DRMO	1983-1985
	Waste amalgam	300 lbs/year	DRMO	1976-1983
	X-ray solution: bromides, alcohols, acetate, formaldehyde	1800 lbs/year	DRMO	1975-1985
	X-ray solution: bromides, alcohols, acetate, formaldehyde	1800 lbs/year	Sanitary sewer	pre-1975
	Scrap lead	100 lbs/year	DRMO	1976-1985
	Mercury	5 lbs/year	DRMO	1976-1985

Table 5-1 (contd.)

Summary of Waste Generation, NC Great Lakes

Operation	Waste Material	Disposal Rate (gallons/year)	Disposal Practice 1	Duration of Practice
Dental Research Institute	Acids, bases	35	Sanitary sewer	1948-1985
	Organic wastes	9	DRMO	1948-1985
	Mice, rats, hamsters, monkeys	350 units	Incinerated	1948-1985
Print Shop	POL's	Trace	Rags sent to laundry	1983-1985
	Ink	Trace	Rags sent to laundry	1983-1985
	Perchloroethylene	0.50	Dumpster (cans rinsed)	1975-1985
	Perchloroethylene	¼0.50	Dumpster	pre-1975
	Photographic fixer and developers: alcohol, bromides, acetate, formaldehyde, bleach	320	Sanitary sewer after silver recovery	1981-1985
	Photographic fixer and developers: alcohol, bromides, acetate, formaldehyde, bleach	¼320	Sanitary sewer	pre-1981
CBU 401:				
	POL's	350	Off-site recycling	1975-1985
	POL's	350	Burned in Fire Fighting Training Center	pre-1975
	Lead-acid batteries	36 units	DRMO	1954-1985

* Assumes a waste generation rate of 0.5% in empty containers, rags, etc.

1 Dumpster contents were sent to Golf Course Landfill from 1942 to 1967, to Forrestal Landfill from 1968 to 1969, to Supplyside Landfill from 1969 to 1983, and were sent off-base, 1983 to 1985.

Cibachrome film. Originally located in Building 27, the lab has been located in Building 1 since 1982. Chemicals used by the lab are as follows: black-and-white developer Kodak D-76 (diluted 1:1 with water); black-and-white paper developer Kodak Royal Print Activator; color developer Kodak E-6LJ (color bleach); and Kodak fixer. Since 1975, spent fixer, film, and paper have been taken to the Defense Reutilization and Marketing Office (DRMO) for silver recovery. Spent black-and-white and color developers are poured down the drain leading into the sanitary sewers. Color bleach, an acid, comes with a neutralizer which is mixed in before it is poured down the drain. At least 95 percent of all negatives are either given to customers or stored permanently in the lab's files.

5.2.3 Navy Exchange.

5.2.3.1 Service Stations. Two service stations serve NC Great Lakes. They are located in Buildings 144 and 2710. The station in Building 2710 sells only gasoline. The other station, which has been located in Building 144 since January 1958, sells gasoline and provides routine automobile maintenance.

Waste oil has been stored in an aboveground tank and sold to an off-base contractor for reclamation since 1975. Used antifreeze is poured down the floor drains. All used engine parts and empty fluid containers are placed in a dumpster for off-base disposal. It is likely that, prior to the initiation of the current practices, spent oils, antifreeze and grease, and oil-soaked rags were discarded in the Golf Course Landfill (Site 1), which was operative prior to 1967. From 1967 to 1975, it is likely that much of the waste oil was stored at the Fire Fighting Training Area (Site 4) and burned during fire fighting exercises.

In 1983 a gasoline spill occurred at the service station on the Mainside area of the activity (Building 144). Approximately 3,000 gallons of gasoline were spilled when a line leading to underground storage tanks ruptured. The spill was cleaned up, and the gasoline-soaked soil was dug up and carried off-base. The area was monitored by the Fire Department for a month following the spill.

Despite the thorough cleanup at the spill site, the odor of gasoline has been reported in the basements of nearby buildings, particularly the Post Office, after heavy rains.

Also within the last 2 years, several gasoline spills took place at the service station in Building 2710. These spills, of several hundred gallons each, have been fairly regular occurrences. Since 1980 the spills have been cleaned up using an absorbing medium. Prior to 1980, spilled gasoline was washed into the storm sewers that lead to Skokie Ditch on the north side of the activity.

5.2.3.2 Laundry and Dry Cleaning. Dry cleaning has been performed on the activity since 1973. Prior to that all dry cleaning was performed off-base. Dry cleaning facilities were located in Building 415 until 1983,

when they moved to their present location in Building 105. A small VALCLEAN dry cleaning system, using Freon 113, has also been in operation in Building 415 since early 1985.

Perchloroethylene (PCE) has always been used for dry cleaning on the activity. The chemical is currently stored in a 3,000-gallon aboveground tank in Building 105; the tank has a full-service contract for maintenance. Prior to 1983, the chemical was stored in 55-gallon drums, and taken off-base for recycling by a contractor.

5.2.3.3 **Photo Lab.** The Naval Exchange operates a photo lab in Building 1312, located in the Recruit Training area. It is the only Exchange-operated photo lab in the Navy, and has been in Building 1312 since 1971. Chemicals used include bromides, acetic acid, bleach, acetone, formaldehyde, film, and paper. Together these chemicals constitute the 360 gallons of waste produced each year by this photo lab. Silver recovery was begun in 1981; prior to that, all spent chemicals were flushed down the sanitary sewer. At present, solutions not containing silver are flushed down the sanitary sewer. Used negatives and old pictures are thrown into the dumpster along with the other trash. The workload is much heavier now than in the past; thus, waste quantities can be assumed to have been much lower in the past.

5.2.4 **Recreational Services Department.** The Recreational Services Department at NC Great Lakes is in charge of the Auto Hobby Shop (Building 2110), the Ceramic Hobby Shop (Building 155), and the Golf Course.

5.2.4.1 **Auto Hobby Shop.** The Auto Hobby Shop was established in 1958, in Building 2110; previously, this building housed a rifle range. Prior to 1983, waste oils and other fluids drained from motor vehicles went into a 1,000-gallon underground storage tank. This tank was pumped out quarterly by a private contractor. In 1983, the tank was found to have a leak after complaints from the contractor of water contamination in the waste oil. PWC personnel removed the tank and surrounding soil and cemented the floor drain inside the building that led into the tank. The tank was inspected and the problem proved to be with the pipe fitting at the top of the tank, through which the contents were pumped out of the tank. Because this fitting was at the top of the tank, there was very little if any leakage out of the tank; rather, percolating rainwater was leaking into the tank.

All waste oils, transmisson fluid, and antifreeze generated by the Auto Hobby Shop now go into a 275-gallon aboveground storage tank that is emptied approximately twice per month by the same contractor. Parts cleaning is done in three separate cleaning stations consisting of a 35-gallon drum of SK solvent, a wash basin, and a circulating pump. The spent solvent is removed and replaced regularly by a private contractor. There are no painting or bodywork facilities on the premises. Discarded parts including tires, brakes, and starters are disposed of in dumpsters. Large parts such as engine blocks and cylinder heads are hauled off-base by a private contractor. These practices have continued for at least the last 3 years; many wastes generated by the Auto Hobby Shop prior to that time may have been disposed of in the Golf Course Landfill.

5.2.4.2 **Ceramic Hobby Shop.** The Ceramic Hobby Shop has been in operation since 1977, in Building 155. No chemical wastes are generated at the shop. Small quantities of paints are used, and the empty 2-ounce jars are disposed of in the dumpsters.

5.2.4.3 **Golf Course.** The Golf Course at NC Great Lakes was originally a 9-hole course which coexisted with the Fire Fighting Training Center and the landfilling activities of the Golf Course Landfill. From 1942 (the date of acquisition) to 1967, the Golf Course provided recreation, as well as a buffer between the landfill and Navy housing situated along Green Bay Road (the present site of the Commissary Store, Buildings 3451, 3452, and 3453). In 1967, concurrent with the closure of the Golf Course Landfill, the course was expanded to 18 holes.

The Golf Course Shop provides several services including maintenance and improvement of the grounds, pesticide applications, golf cart maintenance, and maintenance of the grounds equipment. In general, the grounds maintenance activities are conservative with respect to the application of fertilizers and pesticides. The areas of the course which were formerly used for the landfill are obvious because of problems with settling and the presence of steam plant coal ash fill, which was used as a final cover material before topsoil was applied.

Solvent usage is limited to a small 20-gallon tank in a batch-type parts cleaning area which recycles solvent into a tank. The tank is maintained periodically by an outside contractor. This practice dates back to at least 1983.

Waste crankcase oils and antifreeze from golf carts and grounds equipment are collected in a 55-gallon drum stored outside the maintenance building (Building 3311). These wastes were previously carried over to the neighboring Fire Fighting Training Area once or twice a year, where they were burned during training exercises. This practice ended in 1982, however, and now the drum containing the wastes is hauled off-base by a commercial waste oil processor.

5.2.5 **Supply Department.** The Supply Department is responsible for the procurement and distribution of all materials for NC Great Lakes. It is located in Buildings 3601, 3602, and 3603. The only waste generated is material that arrives in damaged containers. These materials are repackaged and sent back through DRMO. All outdated or off-spec materials are also handled by DRMO, which sells usable material and contracts for removal of unusable material by a private disposal firm.

5.3 RECRUIT TRAINING COMMAND.

5.3.1 **RTC Rifle Range.** The RTC Rifle Range has been located in Building 910 since 1942. Approximately 340,000 rounds of small arms ammunition (.22 caliber, .45 caliber, 12 gauge) per year are delivered from the Mainside armory to the Rifle Range. Spent ammunition is collected from the floor of the range and deposited into a 22-gallon can. This waste lead and brass is collected by DRMO once every 2 to 3 months. Chemicals used at the Rifle

Range include CLP brand cleaner (20 cases/year, each case containing 150 pint bottles), and standard issue bore cleaner #6850-00-224-6663 (375 1-gallon cans/year). Solvents are used on rags, and most of the solvent evaporates. Rags are reused as long as possible, then disposed of in the dumpsters, along with the empty solvent cans.

5.3.2 **Airman Laboratory.** The Airman Laboratory has been located in Building 929 since 1981 and generates very little waste. Cleaning solvent (PD 680) and paint thinner are used at the rate of 30 gallons/year each. All the cleaning solvent evaporates, and the used thinner is taken to Building 1212 for storage prior to disposal by DRMO. Small amounts of paints, varnish, and hydraulic fluid are also used by the laboratory (less than 5 gallons/year of each). These materials are stored in two fireproof metal cabinets. These storage and usage practices have been in effect since 1981.

5.3.3 **Building and Equipment Maintenance.** Building and Equipment Maintenance for the Recruit Training Command has been located in Building 1212 since 1943. Besides building maintenance operations, a Small Engine Shop and a Battery Locker are maintained in the same building.

The Small Engine Shop currently has one parts-cleaning station, which is maintained by an outside contractor. The shop also has an old parts cleaning tank (#4312-1454) that used Stoddard Solvent (30-gallon capacity); it is probable that used solvent was disposed of in the Golf Course Landfill (Site 1). The tank is currently unused and appears to have been unused for at least several years. Used engine oil and transmission fluid are collected in 55-gallon drums for pickup and disposal by DRMO, at the rate of approximately two drums/year. Waste generation rates have been approximately constant for the last 2 years.

There are no drains in the Battery Locker, and the batteries are not drained before being turned in to DRMO for disposal; DRMO retrieves batteries in this manner twice a year. Less than 10 batteries/year are disposed of in this manner. This practice has been in effect since prior to 1982.

5.3.4 **RTC Silk-Screening Shop.** The RTC Silk-Screening Shop has been located in Building 1212 since 1943. Personnel use mineral spirits, paint thinner, latex varnish, oil-based stains, inks, and acetone. The chemical composition of the substances used in printing operations at the RTC Silk-Screening Shop has changed recently, as manufacturers have upgraded and changed their formulas, and as different inks and thinners have been used.

Paint thinner is presently used at the rate of 3 gallons/week. Direct photo emulsion is used at the rate of 5 gallons/year. A large booth used for spraying and washing the finished silk screens is located in the northeast corner of the building. This booth has a drainpipe that penetrates the wall of the building and empties onto the ground outside. During busy periods, up to 200 gallons/week of wash waste were disposed of through this drain and onto the ground. This practice was started in 1972, when the booth was opened, and resulted in a prominent staining of the ground surrounding the

drain. The practice was discontinued in August 1985. (It is worth noting that the stained area is discussed as Site 7, RTC Silk-Screening Shop.)

5.4 SERVICE SCHOOL COMMAND.

5.4.1 EM/IC School. The EM/IC (Electricians Mate/Interior Communications Technician) School has been located in Building 2B since 1942, and expanded into Building 2C in 1964. EM/IC School provides basic electronics ("A-School") courses, advanced maintenance training ("C7-School") courses, and phone communication and navigational ("ICC1-School") courses. Coursework is based on a textbook, with some hands-on training involving small electrical components.

In Building 2C, all chemicals, primarily cleaning fluids such as paint remover, paint thinner, and waxes, are consumed in use. Empty containers are disposed of in trash dumpsters. Personnel reported that two to three 12-ounce cans of trichloroethylene per year were used for parts cleaning as recently as 1983, and that this material was also consumed in use. Broken electric components are sent through Supply to DRMO for disposal if they cannot be repaired.

In Building 2B, the same chemicals (see above) are consumed in use. All empty containers and used rags are discarded in trash dumpsters. Chemical generation has been constant since the late 1960's.

Rooms 329, 330, 330A, and 330B housed 15 gyro compasses from 1942 until 1976. Each mechanism contained 10 to 15 pounds of elemental mercury. EM/IC students removed, filtered, and replaced the mercury in each gyromechanism every 3 months. Reserve mercury was stored in a locker located in room 330C. The gyromechanisms were dismantled in 1976 and sent by way of Supply to DRMO. In 1979 a puddle of mercury somewhat less than 3 feet in diameter was discovered under the storage locker in room 330C. Further investigation revealed the presence of mercury in between the floor tiles and the baseboard edging in the room. School personnel called PWC, which contacted Preventative Medicine and the Fire Department. Personnel from all three groups arrived at the school, and Preventative Medicine vacuumed the area for mercury. Subsequent analyses for mercury vapor have been reported as below detection.

5.4.2 Fire Control Technician, Opticalman, and Instrument Control School. The Fire Control Technician, Opticalman, and Instrument Control (FT/OM/IC) School has existed at NC Great Lakes since 1954. FT/OM/IC consists of an "A-School" (Building 616) and a "C-School" (Building 617).

5.4.2.1 A-School. Several water-based paints are used in the school and consumed in use. Waste paint thinner and PD 680 (8 gallons/year and 50 gallons/year, respectively) are collected in a waste oil barrel and emptied into a waste oil tank located outside Building 325. Glass cleaner is diluted 15:1 with water; wasted cleaner goes directly into school drains. Five gallons/year of waste paint are disposed of into trash dumpsters. All other chemicals (waste paint thinner and PD 680) are consumed in use, with empty containers disposed of in trash dumpsters. Chemicals are

requisitioned and received from Supply. Volatile chemicals are stored in flammable materials lockers throughout the building; other household chemicals are stored on shelves.

5.4.2.2 **C-School.** Waste oil (up to 50 gallons/year) was disposed of directly into trash dumpsters until early 1985, when personnel began to dispose of the oil in the waste oil tank outside Building 325. Acetone, alcohols, and Permatex are consumed in use. Primer is also consumed in use.

Spent potassium hydroxide battery cells are replaced approximately once every 18 months. Spent cells are sent by way of Supply to DRMO for disposal.

5.4.3 **ET School.** The ET (Electronics Technician) School, located in Building 621, provides instruction in basic electrical theory. There are no laboratories associated with this school. The school generates only paper waste.

5.4.4 **Gunnery School.** The Gunnery School has existed in Building 521 since 1954. Waste PD 680, hydraulic fluid, transmission fluid, and greases are drained into 55-gallon barrels that are kept on the main deck of Building 521, outside a fire wall. A private contractor comes in annually to replace oils and fluids inside all gunnery machinery in the school. The contractor drains the spent fluids into the school's waste oil barrels, which are taken away by Supply personnel to DRMO, drained, and returned to the school. The total annual amount of waste petroleum, oils, and lubricants (POL's) from the Gunnery School is approximately 3,500 gallons/year. All other chemicals are consumed in use, with empty containers disposed of in trash dumpsters. Reportedly, waste quantities for the school have been reasonably constant for the past 10 to 15 years.

5.4.5 **Basic Electricity and Electronics, and Instructor Training Schools.** The Basic Electricity and Electronics (BE/E), and Instructor Training (IT) Schools have been located in Building 621 since 1969.

There are no chemical wastes generated in either school. Household chemicals are consumed in use, and the empty containers are disposed of in trash dumpsters.

The building was built on top of one of the former Demolition Debris Disposal Areas (Site 13B). Reportedly, disposal stopped during the mid-1950's. Building 621 experienced a shift in foundation (about a 1-inch drop) several years ago.

5.4.6 **Steam Propulsion School.** The Steam Propulsion School has existed at NC Great Lakes since 1961. It consists of a "600-psi" propulsion facility, a "1200-psi" propulsion facility, and classrooms in Building 236. Waste-generating facilities within the school include the 600-psi and 1200-psi facilities and the Steam Propulsion Repair Shop.

5.4.6.1 **Steam Propulsion Repair Shop.** Waste oils and diesel fuel (less than 10 gallons/year) are emptied into an 800-gallon underground waste oil

tank located outside Building 229. Acetone is consumed in use (1 gallon/year), and residual ammounts of waste paint from brush cleaning are emptied along with thinner into the sanitary sewer.

5.4.6.2 1200-psi Propulsion Facility. The 1200-psi Propulsion Facility has been located in Building 239 since 1978.

Boiler water testing and treatment are performed within the school. Ammonium molybdate, nitric acid, and chloride indicator tablets used in boiler water testing are emptied down lab sinks. Used mercuric nitrate ($HgNO_3$) solution is emptied into a 5-gallon bucket and poured through a high-capacity filter cartridge (Fisher Scientific, Catalog Number 903520 D8901 cartridge) that removes the $HgNO_3$ from solution. The filtrate flows into a lab sink. Once a week the cartridge becomes saturated with mercury, and lab personnel then replace the cartridge, seal both ends, and call PWC to take the cartridge, empty $HgNO_3$ vials, and any mercury-contaminated equipment or rags to Supply. Supply personnel forward the materials to DRMO for disposal at a Level 1 landfill. These practices have apparently continued without change since 1978.

All treatment chemicals used in the facility leave the boiler plant via blowdown to the sanitary sewer system. Hydrochloric acid and caustic soda are injected into influent boiler water by a shore demineralizer system, and the algacide is injected by means of a "unilock" system. Both systems are supplied, operated, and maintained by a private contractor who removes all waste.

Approximately 600 gallons of lacquer and paints are used each year in the 1200-psi Propulsion Facility. Paints are stored in six flammable materials storage lockers located throughout Building 239. Paints are consumed in use, with empty cans disposed of into trash dumpsters. Diesel fuel (10 gallons/year) is used as a general cleaning solvent. A substantial amount of POL waste (spent fluids from the boiler engine, diesel fuel) is generated by the facility. An estimated 4,000 gallons/year of waste fluids (including water, sludges, and oil) drain from the engine bilges into a 1,000-gallon underground oil/water separator, which discharges water into Pettibone Creek. PWC personnel drain less than 1,000 gallons of oil from the separator once a year.

5.4.6.3 600-psi Propulsion Facility. The 600-psi Propulsion Facility has been located in Building 229 since 1961.

Ammonium molybdate, nitric acid, and chloride indicator tablets are used and emptied down lab sinks. Used mercuric nitrate ($HgNO_3$) solution is emptied into a 5-gallon bucket and poured through a high-capacity filter cartridge (Fisher Scientific, Catalog Number 903520 D8901 cartridge) that removes the $HgNO_3$ from solution. The filtrate flows into a lab sink. Once a month the cartridge becomes saturated with mercury, and lab personnel then replace the cartridge, seal both ends, and call PWC to take the cartridge, empty $HgNO_3$ vials, and any mercury-contaminated equipment or rags to Supply. Supply personnel forward the materials to DRMO for disposal in a Level 1 landfill.

It is possible that prior to establishment of mercury monitoring, which was instituted in the late 1960's, mercury-containing compounds from these operations were disposed of in the then-operative Golf Course Landfill (Site 1). All treatment chemicals leave the boiler plant via blowdown to the sanitary sewer system.

The 600-psi Propulsion Facility uses 40 to 50 gallons of lacquer paints/year. Paints are stored in flammable materials storage lockers located in the basement of Building 229. Paints are consumed in use, with empty cans disposed of into trash dumpsters. Five gallons/year of PD 680 and 50 to 75 12-ounce spray cans/year of solvent are consumed in use. POL waste (200 gallons/year) drains from the engine bilges into a converted underground fuel tank that remained when an emergency generator was removed from Building 229 in the early 1970's. PWC personnel drain the tank for waste POL removal.

5.4.7 NTC Rifle Range. The NTC Rifle Range (Site 10) is located on a 14.2 acre plot at the northeastern corner of NC Great Lakes. The Rifle range has opeated at this location since 1918. At present, the Rifle Range is used by the Department of Justice, Federal Bureau of Investigation as a training and practice facility.

Shell casings and slugs of fired ammunition were left on the ground at the range, and these remain at the site (NORTHNAVFACENGCOM, 1984). Also, some live ordnance inadvertently dropped on the ground remains at the site in the uppermost soil layers (NORTHNAVFACENGCOM, 1984).

In August of 1984, the Northern Division, Naval Facilities Engineering Command (NORTHNAVFACENGCOM) conducted a study of the site and concluded that there is a high potential for lead contamination at the site. The cost of demilitarizing the site is estimated at $554,000, which is close to the fair market value of the site.

5.5 NAVAL CONSTRUCTION BATTALION UNIT 401. Naval Construction Battalion (CB) Unit 401 has occupied Buildings 3215, 3216B, and 3216C since 1954. Building 3215 houses the administrative offices, 3216B is the motor vehicle shop, and 3216C is an inside storage area. A battery locker is located in the southeast corner of Building 3216C.

CB Unit 401 provides support to the Administrative Command in the area of civil engineering projects. Recent projects which reflect this responsibility include the filling and grading of an old outdoor swimming pool area near Building 122 and the filling of the lakefront shoreline along the NTC Rifle Range.

Wastes generated by CB Unit 401 are principally the mixed office wastes generated in Building 3215, and the waste oil and lubricants from motor vehicle repair in Building 3216B. The individual projects may generate rubble.

Maintenance and repair of motor vehicles, including wheeled loaders, graders, dump trucks, bulldozers and pickup trucks, are the main activities which generate waste. These wastes consist primarily of used crankcase oil, gear lubricants, hydraulic fluids, and antifreeze. These wastes are collected in an aboveground 400-gallon tank on the west side of Building 3216B, and are removed from the activity by an outside contractor. This has been the practice since prior to 1982. The annual volume of waste material produced averages 350 gallons. Between 10 and 15 batteries are turned in to DRMO per year. Both new and used batteries are stored in the battery locker, a concrete-floored room with no deck drains. The room shows the signs of having been a battery locker for many years, but no signs of spillage exist outside.

5.6 PUBLIC WORKS CENTER. The Public Works Center (PWC) is responsible for the management and maintenance of all real property on the activity, including natural resources, activity infrastructure, buildings, and most vehicles. Additionally, PWC is responsible for planning facilities, including development of requirements, engineering services, and potential military construction projects. Administrative offices for PWC are located in Building 1A. These offices generate paper waste.

The Facilities Engineering Division, which is adminstered by PWC, was responsible for monitoring the closure of the Supplyside Landfill. A discussion of those shops that produce hazardous wastes follows.

5.6.1 Motor Vehicle Maintenance Shop. The PWC Motor Vehicle Maintenance Shop has been located in Building 106 since the 1950's. Prior to that, it was located in Building 3216. The maintenance shop currently services 500 vehicles, ranging from lawn mowers to large trucks. This number has been steady for the past 20 years. However, in the 1950's, there were approximately 900 Public Works vehicles.

The shop produces 100 gallons of waste oil per week. This oil is stored in a 450-gallon underground storage tank. This tank is periodically pumped out by DRMO. In the 1970's, oil was stored in 55-gallon drums, which were removed by DRMO every 10 days or so. Approximately 12 barrels of new oil are presently stored in Building 106. When these barrels are empty, they are steam cleaned in an area of the shop that drains into the underground storage tank, and are taken to DRMO for disposal. The underground storage tank is periodically pumped out by a DRMO contractor. It is likely that the Motor Vehicle Maintenance Shop supplied some waste oils that were disposed of in the Golf Course Landfill before current practices were initiated.

The shop disposes of three to four batteries per day. Battery acid is run through a baking soda and limestone bed and drains into the underground storage tank; the tank is periodically pumped by a private contractor, and the neutralized acid is removed off-base. The old battery shells are removed to DRMO on a periodic basis. The shop also uses a small amount of hydraulic fluid.

The shop operates a small paint booth for touch-up work. An air/waterfall system is used to capture paint particles from the air. The captured paint is carried into the sanitary sewer.

5.6.2 Motor Pool. The Public Works Motor Pool currently houses 500 pieces of equipment; this number has remained steady over the past 20 years. The Motor Pool has been located in Building 1600 for at least 20 years. The pool's gas terminal is located in an adjacent structure (Building 1600A). This building contains three gas pumps and a few oil drums with nozzles for topping off vehicles. The gas terminal has been located in Building 1600A for 8 years. Prior to that it was located in Building 1712; the empty gas tanks at this old location were removed in 1983. It is likely that in the past wastes generated by the Motor Pool were disposed of in the Golf Course Landfill.

5.6.3 Machine Shop and Tool Room. The Machine Shop fabricates metal components to specifications measured by shop personnel who visit job locations. The Tool Room maintains a central set of tools. The Machine Shop and Tool Room are both located in Building 4. The Tool Room has been in existence for 2 years.

The Tool Room uses solvent only in a closed parts tank. Solvent 144 is used. It is supplied from a single 55-gallon drum which is kept with the flammable materials locker in the rear of the shop. The parts tank works with a charge of 25 to 30 gallons of solvent at a time, which is replenished to maintain the fluid level as the solvent is lost to evaporation. When the sludge in the bottom of the tank builds up, the entire contents of the tank is drained. This results in 25 to 30 gallons of solvent/sludge waste per year. The waste is disposed of into a 55-gallon waste barrel in the neighboring Machine Shop.

The Machine Shop consists of typical metal-forming equipment like lathes, mills, and saws. Oil is used for lubrication, for washing cuttings out of the active cutting area of a tool, and as a seal treatment in air compressors. Solvent 144 is used for cleaning parts in a batch tank. The shop uses one 55-gallon drum for the solvent and produces two 55-gallon drums of waste solvents and oil per year (including the Tool Room waste). This level of waste generation is estimated to be consistent with past waste generation rates from this shop. Waste oils and metal cuttings were presumably disposed of for a time in the Golf Course Landfill, which was operative during the beginning years of Machine Shop operations.

5.6.4 Pipe Shop. The Pipe Shop, located in Building 104 since before 1973, maintains the plumbing of the activity. Shop personnel use 35 gallons/year of cutting oil, all of which is consumed. Uranine dye, used for sewer leak detection, is consumed at the rate of 2 pounds/year. Heating systems are cleaned with OXOFF, a hydrochloric acid cleaner, and then neutralized with COMMAND caustic cleaner. Two hundred gallons/year of OXOFF and 50 gallons/year of COMMAND are used in this manner. After being cleaned, the heating systems are flushed into the sanitary sewers.

5.6.5 **Welding and Sheet Metal Shop.** The Welding and Sheet Metal Shop has been located in Building 104 since the creation of the shop in 1934. Prior to 1934, it was known as the Blacksmith's Shop. A water-soluble cutting oil is consumed at the rate of 1 gallon/year. Scrap metal, the only waste generated, is taken to DRMO for salvage.

5.6.6 **Carpentry Shop.** The Carpentry Shop has performed most of the carpentry-type maintenance on both NC Great Lakes activity buildings and housing units. The shop has been located in Building 104 since about 1968. The shop also provides services to remote Navy locations such as Glenview NAS, and to Fort Sheridan (Army) and other government facilities as far away as Niagara Falls, New York. When on remote assignment, wastes generated are left at the job location.

The Carpentry Shop generates 2 to 3 quarts of waste Solvent 144, which is used to clean up after tiling jobs, per year. Even lesser amounts of paint and paint thinner (used to provide a primer coat on raw wood left outdoors) waste are generated.

Tile tools and the finished work are cleaned up with Solvent 144, which the Carpentry Shop obtains 1 gallon at a time (roughly once a year) from the Electrical Shop in Building 103. Any excess material is stored in a flammable materials storage locker in the shop. Most of the material used either evaporates or is soaked up on rags or towels used in cleaning the tools. Wastes are taken to the waste thinner containers in the Paint Shop. Small quantities (less than 4 or 5 ounces per job location) may have been disposed of into dumpsters at the job location on rags or with other dry trash. This material would have found its way into the activity landfill in use at that time.

Current usage rates are 5 gallons of Solvent 144 per year, of which about 2 to 3 quarts become waste. In the past, before the maintenance of housing units was contracted out, more material was used. A peak rate of 55 to 110 gallons/year was estimated, with the same ratio of waste production (10 to 15 percent).

Prior to use of Solvent 144 (also known as "White Lightning"), shop personnel used paint thinner for cleanups. They switched to Solvent 144 as soon as it became available to them (about 1982), since it was a more effective cleaning agent.

Paints (primarily latex primer) are used by Carpentry Shop personnel whenever they do outside work which will not be painted by the Paint Shop within a reasonably short time. At one time brushes were cleaned with paint thinner, which was sometimes discarded into the dry refuse at the job location and sometimes brought back to the Paint Shop waste thinner containers. Current practice is to use latex-based paints which do not require thinners.

Former Carpentry Shop (now Lagging Shop) personnel also do the asbestos rip-outs. This has been a big job over the past several years, dating from

the time asbestos hazards were first recognized. A separate group was formed and received the proper training to do these rip-outs; precautions were taken and the work was monitored to ensure the safety of the workers and the proper disposal of the wastes. Wastes were double-bagged, saturated with water, and hauled off-base for disposal by an outside contractor. Most of this work was done since 1982. Asbestos-containing wastes were probably disposed of in the Golf Course Landfill prior to the recognition of asbestos as a hazardous waste. The quantities of asbestos were probably small, however, since they were generated only as localized carpentry-maintenance was performed in small areas of specific buildings.

5.6.7 **Bricklayers Shop**. The Bricklayers Shop has been located in Building 2016 since 1981. Personnel, materials, and equipment were located in Building 210B (PW/Grounds Shop/Office) from 1968 to 1981. Additional materials and equipment for bricklaying have been stored in Building 1517 since 1977. Muriatic acid solution (18 percent) is requisitioned from and delivered by Supply. The solution is and has been diluted and sprayed directly on brick walls. Since 1983, 500 gallons/year of diluted muriatic acid have been used; 125 gallons/year were used from 1968 to 1983. Spent acid has evaporated in use and/or drained to grounds adjacent to areas where it is used (no wastes are collected). Empty 10-gallon acid drums are reclaimed by the supplying company. The shop workload increased approximately 50 percent from 1983 to the present and 25 percent from 1980 to 1983, and was relatively constant from 1968 to 1980.

5.6.8 **Roofers Shop**. The Roofers Shop has operated from Building 2016 since 1981. Personnel, materials, and equipment were located in Building 210B (PW/Grounds Shop/Office) from 1968 to 1981. Additional materials and equipment for roofing have been stored in Building 1517 since 1977. Chemicals are requisitioned from and delivered by Supply. Chemicals used by shop personnel include roof sealants ("Tremco" and "Monroe" brands), roof coating ("Mightyplate" and "Randustrial" brands), and gasoline. Less than 1 gallon/year of waste fuel gas is generated. Between 5 and 10 gallons/year of sealant and coating wastes are also generated. These wastes are discarded in a 55-gallon drum. Empty barrels and remaining compounds are hauled off-base directly by building trades personnel. The shop workload has increased approximately 50 percent from 1983 to the present and 25 percent from 1980 to 1983, and was relatively constant from 1968 to 1980.

5.6.9 **Sandblasters Shop**. The Sandblasters Shop has operated from Building 2016 since 1981. Personnel, materials, and equipment were located in Building 210B (PW/Grounds Shop/Office) from 1968 to 1981. Additional materials and equipment for sandblasting have been stored in Building 1517 since 1977. Materials are requisitioned from and delivered by Supply. The shop personnel use "Black Beauty" grit in 50-pound bags to sandblast buildings, facilities, barrels/containers, and anything else on the activity that requires sandblasting. Buildings and other nonportable outside facilities are sandblasted in-place, and the used grit and sandblasted materials fall to adjacent grounds. Portable equipment (barrels, etc.) is sandblasted in the yard outside Building 1517. Hydraulic fluid and oils for pneumatic tools are handled by PWC personnel. The shop workload has

increased approximately 50 percent from 1983 to the present and 25 percent from 1980 to 1983, and was relatively constant from 1968 to 1980.

5.6.10 Cement Finishing Shop. The Cement Finishing Shop has operated from Building 2016 since 1981. Personnel, materials, and equipment were located in Building 210B (PW/Grounds Shop/Office) from 1968 to 1981. Additional materials and equipment for finishing have been stored in Building 1517 since 1977. Materials are requisitioned from and delivered by Supply.

LANCE concrete sealer, epoxy cement, and lacquer spray paint are consumed in use. Empty containers are disposed of in trash dumpsters. The shop workload has increased approximately 50 percent from 1983 to the present and 25 percent from 1980 to 1983, and was relatively constant from 1968 to 1980.

5.6.11 Paint and Sign Shop. The Paint and Sign Shop has been located in Buildng 68H since 1970. Prior to that date painting was not centralized, with each location taking care of its own painting requirements. The Paint and Sign Shop normally employs 12 to 15 painters full-time; additional summer help expands the staff to 25 during peak activity.

Most of the paints now used are latex/water-based paints, so very small amounts of turpentine and paint thinner waste are generated. It is probable that at some time in the recent past a change in operational procedures occurred, and water-based paints replaced less convenient oil-based paints. The date of this change, however, is unknown.

Any thinner or tool-cleaning waste that is generated is stored in a 55-gallon drum for pickup and disposal by PWC; ammounts are on the order of 3 gallons/year. Used cans of paint are placed into the dumpster with the regular trash, usually at the location where they are used. In the past, washes generated in the brush-cleaning operations were disposed of in sinks in the shop. Prior to 1970, waste washes were probably disposed of at the painting job location.

A wet cascade spray booth in the sign shop sees only occasional use. A surfactant (SAF-PEEL) is added to the water to retard bacterial growth and keep paint particles suspended. The holding tank is flushed to the sanitary sewer once each quarter. The additive and agitation prevent the buildup of any significant sludge deposits. Caustic-based strippers are occasionally used in the booth, and these also are washed down the sanitary sewer during the quarterly holding tank cleaning.

Leftover full cans of paint are returned through DRMO for resale. Any lead-based paints that cannot be sold are disposed of through PWC. Partially full paint cans are disposed of in the regular trash dumpster. It is estimated that 100 partially filled 1-gallon cans per year are disposed of in this manner.

5.6.12 Locksmith Shop. The Locksmith Shop uses only a minimal amount of penetrating oil (WD-40 brand) in spray cans and a pint-sized squeeze bottle of Solvent 144 (1 pint/year), all of which is consumed in use. The Locksmith Shop also generates waste locks, which are discarded in dumpsters.

5.6.13 **Electric Shop**. The Electric Shop has been located in Building 104 since at least 1968. Until 1983, the Electric Shop included a Motor Shop; this shop has since been discontinued. When the Motor Shop was in operation, personnel used two 55-gallon drums of Solvent 144 per year. This solvent was used in a spray booth for parts cleaning. It was replenished occasionally, and all of it eventually evaporated. Copper wire, scrap iron, and used circuit boards are turned in to DRMO for salvage. This operation has continued unchanged since 1968.

5.6.14 **High Voltage Shop**. The High Voltage Shop, located in Building 103, is responsible for high voltage electricity transmission lines on the activity. Shop personnel perform the periodic transformer inspections but do not perform maintenance on polychlorinated biphenyl (PCB) transformers except under emergency conditions. High Voltage Shop personnel are trained in the handling of PCB material; however, PCB transformer maintenance is performed by an outside contractor.

There are seven PCB transformers currently out of service and in storage in Building 1405. All transformers not in service and other scrap and new cable materials have been stored in the "boneyard" south and west of Building 1517 (Site 5). A new building has just been completed for the storage of these transformers pending their disposal. It is located at the northern end of Camp Moffett, behind Building 1517. This is the staging area (also Site 5), which is used to accumulate waste for pickup by DRMO or by a contractor. There were approximately 40 units in storage in the boneyard at the time of the visit by the IAS team. None of these units contained PCB.

PCB transformers were stored on the lower level of Building 226 prior to its demolition. In 1981 there was a PCB spill incident related to the attempted theft of transformer metals (Site 6), but this area is no longer used for storage.

Current waste generation is minimal. Connections to transformer banks and maintenance of the lines are the major elements of the current workload. Cable splices are cleaned with 1,1,1-trichloroethane, which is supplied on presoaked towels in 2- to 4-ounce pop-top cans. These towels limit the quantity of material used and the amount of waste generated. Used towels are disposed of with the general activity refuse. Most of the 1,1,1-trichloroethane evaporates during use of the towels.

High Voltage Shop operations also include removal of underground cable. Scrap metal recovered from the removal of underground cable is cut into lengths and accumulated for DRMO. When a sufficient quantity is available, it is taken to the DRMO yard. Three trailer loads (approximately 10 tons per load) of waste lead-shielded cable were removed and transferred to the DRMO yard in the last 9 months; this translates into a 10.8 ton/year rate of waste generation.

In the past, before the hazards of PCB's were known, maintenance of PCB transformers included draining of PCB oils from transformers, followed by

dilution of these contents. Maintenance operations were performed on location, where the transformers were installed. In 1982 some PCB-contaminated switchgear was also worked on. This was described as an unusual assignment based upon current workloads.

5.6.15 **Heating, Ventilation, and Air-Conditioning (HVAC) Shop.** The HVAC Shop maintains all electrical, pneumatic, and manually controlled HVAC equipment at the activity. The shop has been located in Building 2016 since 1978. It was located in Building 103 (PWC Electronics/Maintenance Shop) from 1954 until 1978, and in Building 104A before 1954.

There are presently 26 cooling towers in use at NC Great Lakes. Water treatment chemicals are applied to the cooling systems by the HOH Chemical Company under a 3-year contract.

Chemicals are requisitioned from and delivered by Supply. Paints, WD-40, and Capella oil are stored in a flammable materials locker within the HVAC Shop. Freon in 55-pound cylinders and acetylene containers is stored on the floor in the shop; these containers are refilled and returned by Supply personnel as required. The shop workload has decreased to approximately 25 percent of pre-1983 workloads due to internal contractual agreements within PWC. The workload was reasonably constant before 1983.

5.6.16 **Utilities Division Wastewater Treatment Plant.** The Utilities Division formerly handled activity wastewater at two wastewater treatment plants. One plant is located on the Lake Michigan shoreline at the south end of the activity waterfront and received most of the waste from the main acitivity operations, including Hospitalside, Recruitside, and Mainside operations. The second plant (Green Bay Sewage Treatment Plant, in Forrestal Village) is located at the southwestern corner of the activity and received waste from activity housing areas and Supply Department and DRMO facilities. Both plants were activated sludge plants, and used no chemicals except chlorine.

Neither plant has operated since the activity was connected to the North Shore Sanitation District (NSSD) system in 1975. Effluent discharges went either into Lake Michigan (from the plant on the lake) or into the Skokie Ditch (from the Forrestal Village plant). Sludges were pumped into drying beds located on the south side of the inner boat basin. After agreements were signed to join the North Shore Sanitation District, these beds were removed under the assumption that they would no longer be required. When the North Shore connection was delayed, sludge from the lakefront plant was trucked over to the Forrestal Village plant lagoons.

Dried treated sludge was made available to activity personnel for home gardening use. Other sludge was used for on-base horticulture or disposed of on local farms (land spreading). In 1977-1978, the last of the wastewater treatment plant sludge was removed from the Forrestal Village area, and disposed of off-base.

Raw sludge from the lakefront plant was pumped at the rate of 10,000 to

15,000 gallons/day (5-day week) into trailer trucks for transfer to the Forrestal Village sludge drying lagoons. All dried (raw) sludge was disposed of off-base.

5.6.17 **Pest Control Shop**. The Pest Control Shop has been located in Building 68H since 1984. From approximately 1972 through 1984, it was located in Building 210B. Prior to that, the shop occupied a basement room in Building 216 from 1968 to 1972, and a room in Building 112 for a part of 1968. Prior to 1968, pest control operations were carried out by private contractors.

The primary function of the shop is insect control, but small amounts of herbicides and rodenticides are also used. The primary insecticides used are baygon diazinon, pyrethrum, and ficam W; additional pesticides too numerous to enumerate here are listed in Table 6-2. Chlordane and dichloro-diphenyl-ethane have not been used since 1971.

Sprayers are rinsed with alcohol between applications and the rinse is sprayed on-site. Empty containers are triple rinsed and disposed of in the regular trash dumpster. It is estimated that 7 to 10 gallons of pesticide per week are used year round. No pesticide containers from this shop ever went into activity landfills, as landfill operations ended before the activity took over its own pest control operations.

5.6.18 **Emergency Shop**. The Emergency Shop provides immediate service to activity buildings and housing units during the off-hours. Shop personnel perform small jobs which do not involve fabrication or other long-term commitments of personnel, time, and materials. The Emergency Shop vehicles carry a limited quantity of solvent, paint thinner, and paint in stock. Typical quantities of each material are less than 1 gallon. The Emergency Shop workload is divided almost equally between housing and the activity.

5.7 **HOSPITAL COMMAND**. Medical facilities have existed at NC Great Lakes since 1911, when the original U.S. Hospital, Great Lakes, Illinois, was commissioned. The hospital originally had only 81 beds. In 1918, the hospital's capacity was increased to 300 patients/day because of World War I. However, the hospital reached its greatest capacity during World War II. There were 38,384 admissions to the original hospital in 1943, including the all-time peak load of 8,179 in-patients. The original hospital served until 1961, when the present hospital (Building 200H) became fully operational.

The new hospital at NC Great Lakes, Building 200H, was commissioned in 1960 and became fully operational in 1961. Originally constructed as a 1,000-bed facility, the hospital housed as many as 1,400 beds during the Vietnam era. The hospital currently has an 800-bed capacity, with a reported Average Daily Patient Loading (ADPL) of 150.

Facilities within the hospital include the X-Ray Department, the Photo Lab, the Pharmacy, and all medical laboratories at NC Great Lakes (except Nuclear Medicine). Other medical facilities at NC Great Lakes include the Nuclear Medicine Department and the hospital incinerator.

Administrative medical personnel at NC Great Lakes became acutely aware of the potential hazards of industrial wastes during the late 1970's. A survey of all chemicals stored in Building 38H that were typically used within the Hospital Command was completed in 1981. Chemical wastes were taken off-base for disposal by a private contractor in 1981. It is probable that hazardous wastes generated by the Hospital Command prior to 1981 were discarded in the landfills operating at the time.

5.7.1 **Laboratory Department.** Individual labs include Hematology, Coagulation, Immunochemistry, Histology, Microbiology, Urinalysis, Clinical Chemistry, Bloodbank, Cytology, and Morgue Cognizance. Laboratory services have existed in Building 200H since 1961. Chemicals commonly used by the labs include methanol (stains), propane (lab burners), acetone (destaining), xylene (tissue sample preparation), elemental mercury (instruments, gauges), ethanol (tissue processing), formaldehyde (tissue processing), hydrochloric acid (urine preservative), acetic acid (urine preservative), and sulfuric acid (slide preparation). These chemicals are consumed in use. Residues and containers are sent to the hospital incinerator.

5.7.2 **Nuclear Medicine.** The Nuclear Medicine Department consists of two shops, the Drug Screening Lab and the Nuclear Medicine Lab. The department has been located in Building 38H since its inception in 1970.

5.7.2.1 **Drug Screening Lab.** Iodine 125, an isotope with a half-life of 60 days, is used in the Drug Screening Lab. This substance, which comes in liquid form and is stored in glass vials, has been (and continues to be) used at the rate of 200 milliCuries/year. This practice may have continued since 1970.

Iodine 125 is stored in a lead vault located in the Nuclear Medicine Lab. Used iodine and radioactively contaminated materials (vials, tubes, gloves, etc.) are collected in 55-gallon barrels that are stored by lab personnel in a lead vault located in the basement of Building 81H (Medical Supply). Approximately 15 55-gallon barrels of isotope-related wastes are generated every 2 weeks. The barrels are taken off-base bimonthly by a licensed private contractor.

5.7.2.2 **Nuclear Medicine Lab.** The following isotopes are used in the Nuclear Medicine Lab:

Isotope	Half-Life	Quantity/Form/Container
Iodine 125	60 days	200 milliCuries/year, liquid, glass vial
Iodine 123	13.2 hours	200 microCuries/week, capsules
Iodine 131	8.08 days	100 microCuries/month, capsules
Technium 99M	6 hours	1.5 milliCuries/week, in lead generators
Gallium 67	78.2 hours	5 milliCuries/week, liquid, glass vial
Thorium 201	3 days	5 milliCuries/week, liquid, glass vial
Cobalt 51	220 days	20 milliCuries/year, liquid, glass vial
Cobalt 58	78 days	10 milliCuries/year, capsules

Isotopes are stored in a lead vault in the Nuclear Medicine Department. Wastes from used Gallium 67, Thorium 201, Iodine 123, Iodine 125, and Cobalt 51 are held in the lead vault for at least 10 half-lifes. After 10 half-lifes, these materials are no longer classified as being radioactive, and are disposed of in trash dumpsters. Wastes from Iodine 131 (including urine and any materials that come in contact with a patient during his/her visit) and Cobalt 58 (urine) are stored in the lead vault for 10 half-lifes and burned in the hospital incinerator. Used lead generators containing Technium 99M are taken to the lead vault in Building 81H and taken off-base by private contractor. These practices and quantities have remained the same since 1970.

The Nuclear Medicine Department uses 1 to 2 gallons/year of acetone, which is consumed in use. Any broken or malfunctioning equipment containing radioactive materials is sent to Naval Electrical Systems Command for repair. Personnel interviewed knew of no previous accidents within the department or elsewhere at NC Great Lakes.

5.7.3 **X-Ray Department.** The hospital X-Ray Department uses standard photographic developer and fixers such as formaldehyde, bleach, alcohol, and acetone. Since about 1981, the developer has gone through a silver recovery process prior to disposal to the sanitary sewer. In the last few years the fixing solution has been treated in the same manner. From 1961 to 1981 fixer was disposed of in the sanitary sewer, with water used to dilute the acetone. Peacetime usage is estimated at 30 gallons/week of fixer and 20 gallons/week developer. Empty plastic containers are disposed of with normal trash. Processed film is kept for 5 years and then shipped to a private contractor for processing. The radiation source is handled on a contract basis with a private contractor through Medical Repair.

5.7.4. **Photo Lab.** The hospital Photo Lab is responsible for all photography assignments for the hospital. Black-and-white, color print (Kodak C-41), and color slide (Kodak E-6 and Ciba) chemicals are used. All process chemicals are sent to Medical Repair for silver recovery. Prior to 1975, all chemicals were disposed of in the Photo Lab sink. The chemical usage rate has been 12 to 15 gallons/year from 1967 through the present.

5.7.5 **Pharmacy.** The Pharmacy has been located in Building 200H since the hospital became operational in 1961. Materials handled by the Pharmacy include various vaccines, biologicals, and other prescription and non-prescription drugs. Materials are requisitioned weekly through Supply in accordance with physicians' requests.

The only wastes generated within the Pharmacy are materials that are not used before their expiration dates. Vaccines and toxic biologicals are burned in the hospital incinerator. Unused drugs are returned to the respective pharmaceutical companies or disposed of in dumpsters.

5.7.6 **Incinerator.** The hospital incinerator is rated at 250 pounds/hour and is operated by PWC at this capacity for 10 hours/day, 5 days/week. This has been the schedule since 1982, when the incinerator started to receive

waste from the Veterans' Administration (VA) hospital. Prior to that time the incinerator operated 3 days/week, 6 hours/day. The VA waste is estimated to be about 30 percent of the total. The incinerator is used primarily to burn pathological waste; however, on occasion confidential documents are burned as well. Exhaust gases are scrubbed prior to release to the atmosphere.

Ash and scrubber blowdown are collected in a 6-cubic-yard dumpster which is emptied by the Transportation Department approximately once every 2 months. Waste currently is trucked to off-base landfills. Prior to the closing of the activity landfills the ash was disposed of in whatever landfill was operative at the time.

5.8 TENANT COMMANDS.

5.8.1 Naval Regional Dental Center. The Naval Regional Dental Center (NRDC) at NC Great Lakes includes: Building 73, Dental Clinic Administration/Repair Shop (built in 1976); Building 152, Prosthetics Clinic (built in 1944); Building 237, Staff Dental Clinic (built in 1976); Building 1523, Recruit Dental Clinic (built in 1975); and Building 1017, Recruit Staff Dental Clinic (built in 1964).

The Prosthetics Clinic performs dental surgery and major dental fixture work. It generates no chemical wastes. The only waste generated from the administration building is 8 to 10 gallons/year of waste compressor oil that is drained from repair shop equipment and taken to PWC for disposal.

Current waste generation from the dental clinics includes: waste amalgam, 7 to 8 pounds/month; X-ray solution, 150 pounds/month; scrap lead, 100 pounds/year; and mercury, less than 6 pounds/year. These rates have been constant since at least 1976. Prior to 1975, elemental mercury was handled by DRMO (then Defense Property Disposal Office, or DPDO) as a raw material.

Dental clinic wastes are sent by way of Supply to DRMO for disposal or reclamation. Waste amalgam generations were 2 to 3 times greater prior to 1983, when the clinics acquired machines to produce fillings from capsules.

Silver reclamation of waste X-ray solution reportedly began 8 to 10 years ago. X-ray solution was emptied into clinic lab sinks before 1975. Waste X-ray solution, mercury, and scrap lead generation rates have been relatively constant since 1975.

5.8.2 Naval Dental Research Institute. The dental research facility has been located in Building 1H since 1974, when it was moved from Building 600. The department was started in 1948 as part of the Dental Clinic and became a separate branch in 1967. The institute is responsible for research in the field of dental procedures for the Navy.

The institute employs 40 to 45 people, including administrative personnel. The chemicals used consist mainly of inorganic laboratory chemicals, although toluene and alcohol are used occasionally for the fixing of biologi-

cal specimens. Acidic and basic wastes are flushed down the sinks to the sanitary sewer; water is added to neutralize the pH. Organic wastes such as saliva, blood, and animal carcasses are stored in a 5-gallon container for disposal by DRMO. It is estimated that less than 10 gallons per year of organic waste are generated by the institute, and this amount will be greatly reduced in the near future when histopathology research is phased out. Current rates of organic waste generation are equal to or slightly lower than past rates.

Mice and rats are the primary research animals used at the institute. Hamsters and monkeys were used at various times in the past. All sacrificed animals are sent to the hospital incinerator for disposal.

5.8.3 **Naval Publication and Printing Service Office (NPPSO).** NPPSO has been operating in Building 2A since about 1952. Prior to that time the shop was located in Building 222, near Building 237. Chemical usage in the shop falls into four major categories: oils and lubricants, inks, cleaning solvents, and photographic chemicals.

Lubricating oil WD-40 is consumed in use, and any leaks and spills are cleaned with rags. Rags are in turn cleaned by an off-base laundry.

Approximately 28 pounds of ink per week are used by NPPSO. This represents an increase of about 50 percent over the ink usage of 15 years ago, when more duplicating than printing was done. The only waste ink generated is residue on the cleaning rags, which are cleaned by an off-base laundry.

Blankrola 1 (perchlorethylene) is used as a cleaning solvent for the printing equipment. Usage was estimated at 100 gallons/year. Blankrola 2 (believed to be trichloroethane) will be used when the current stock of Blankrola 1 is exhausted.

Blankrola currently is purchased in 55-gallon drums which are triple rinsed and disposed of through DRMO. Prior to about 1975 the solvent was purchased in 5-gallon cans which were disposed of unrinsed in the dumpster. It is likely that these cans and their residual contents were disposed of in the Golf Course Landfill.

Since 1981 photo chemicals have been processed for silver recovery, then disposed of down the sanitary sewer. Prior to 1981 all chemicals were discarded in the sanitary sewer. Only black-and-white photo chemicals are used by NPPSO. Usage is estimated at 5 gallons/week of fixer and 5 gallons/month of equalizer.

CHAPTER 6. MATERIAL HANDLING: STORAGE AND TRANSPORTATION

6.1 INDUSTRIAL STORAGE.

6.1.1 Materials Storage: Defense Reutilization and Marketing Office. The Defense Reutilization and Marketing Office (DRMO), formerly known as the Defense Property Disposal Office (DPDO), has been located in Building 3212A since 1941. DRMO is the Department of Defense organization which has been responsible for disposal of surplus government property of any type. After the Resource Recovery and Conservation Act defined hazardous waste, DRMO assumed responsibility for contract disposal of these materials as well.

DRMO at NC Great Lakes is a tenant activity that arranges for the removal of industrial wastes from the activity as well as from several other military installations in the region. Typical wastes that DRMO takes responsibility for the removal of include paints, polychlorinated biphenyls (PCB's), pesticides, batteries, and tires. Shops and facilities that need waste pickups send completed 1348 forms to the Public Works Center (PWC), from which the requests are dispatched to DRMO. DRMO is responsible for wastes once it has made written responses to the pickup requests.

Waste materials turned in to DRMO are generally stored at the shop generating the waste until off-base removal is arranged. The generating shop retains physical custody of the waste, while paperwork management is handled by DRMO. This has been the practice since about 1967, when the NC Great Lakes Commander placed strict controls on material which could be disposed of in the three activity landfills (Site 1, 1942 to 1967; Site 2, 1967 to 1969; Site 3, 1969 to 1983).

DRMO facilities at NC Great Lakes include two large warehouses and a storage yard. Flammable materials are stored in a separate room on pallets in one of the warehouses, as are hazardous materials. The present flammable material storage system appears to be consistent with past practice, though lesser amounts of these materials are stored now. Some of the flammable wastes were formerly stored at Site 4, the Fire Fighting Training Area, prior to being burned during training exercises there. The outdoor storage area located south and west of Building 3212A and currently used by DRMO had formerly been used as a coal storage pile (Site 14G, use began in 1943).

6.1.2 Chemical and Hazardous Materials Storage. The Supply Department purchases chemicals for most shops and operations at NC Great Lakes. Many shops maintain their own set of vendor catalogs from which they prepare orders before turning them in to Supply. Supply then places the order and delivers the material. Flammable and hazardous materials are stored in secure lockers in the individual shops.

6.1.3 Petroleum, Oils, and Lubricants (POL's) Storage. The major fuel storage facilities in use at NC Great Lakes are listed in Table 6-1. These facilities provide a total storage capacity of approximately 3,354,000 gallons.

Table 6-1

Storage Tanks at NC Great Lakes

Building or Tank No.	Capacity (Gallons)	Tank Type	Material Stored
11E	400,000	aboveground	#6 fuel oil
11F	400,000	aboveground	#6 fuel oil
11K	1,000,000	aboveground	#6 fuel oil
11L	1,000,000	aboveground	#6 fuel oil
11 east MUSE (Mobile Utilities Support Equipment) generator	2,000	underground	#2 fuel oil
1	550	underground	#2 fuel oil
11 west MUSE generator	500	aboveground	#2 fuel oil
12	250	aboveground	gasoline
13	unknown	underground	gasoline
106FD	1,000	underground	gasoline
137VA	unknown	underground	gasoline
144NE	600	underground	gasoline
144NE	40,000	underground	gasoline
200H WS	unknown	underground	#2 fuel oil
229	12,500	underground	#2 fuel oil
229	1,000	underground	#2 fuel oil
229	700	inside building	lube oil
229	400	inside building	#2 fuel oil
238	5,000	underground	#2 diesel fuel
239	18,500	underground	#2 diesel fuel
239	12,000	underground	#2 diesel fuel
324	14,000	underground	#2 diesel fuel
325	16,890	aboveground	fuel oil
325	16,890	aboveground	fuel oil
326	210,000	aboveground	fuel oil
811	10,000	underground	#2 fuel oil
1600A	20,000	underground	gasoline
1600A	6,000	underground	diesel fuel
1912	150	inside building	gasoline
2216A	1,000	underground	#2 fuel oil
2710	40,000	underground	gasoline
2710	11,000	underground	gasoline
3114A	1,000	underground	gasoline
3216	12,000	underground	gasoline
3217	2,250	aboveground	#2 fuel oil
3400	40,000	underground	#6 fuel oil
3305A	5,000	underground	#2 fuel oil
3305B	5,000	aboveground	#2 fuel oil
3305C	4,000	aboveground	#2 fuel oil
3305D	4,000	underground	#2 fuel oil
3511	40,000	underground	#6 fuel oil

The main fuel oil tanks (Buildings 11K and 11L) have experienced numerous oil spills, which were usually the result of tank-filling activities. Spilled oil was always contained within the concrete berm surrounding the tanks.

The service stations run by Naval Exchange have been the sites of gasoline spills. The spills in Building 2710 have been the result of careless tank-filling procedures; the Fire Department is called in to clean up these spills. Fire Department personnel report that such spills are not unusual, with from four to eight spills of up to several hundred gallons of gasoline each occurring within the last 2 years. The Fire Department uses Absorball to absorb the spilled gasoline. Gasoline-contaminated Absorball is collected in plastic bags and picked up by a private contractor for disposal off-base.

In 1979, Building 144 was the scene of a major leak (Site 8). A leak in an underground storage tank went unnoticed until gasoline appeared in the storm sewers and Post Office basement. Shallow wells were drilled surrounding the tank and were pumped for several days to remove the gasoline. Gasoline fumes continue to show up occasionally in the Post Office basement (within 300 feet of the tanks which leaked), particularly after heavy rains.

6.1.4 Pesticide Storage. The Pest Control Shop (Building 68-H) maintains an estimated 1-month supply of pesticides. Approximately 30 to 40 gallons of pesticides are used per month, year-round. The supply of pesticides is replenished as necessary through the Supply Department.

The Pest Control Shop originated on the activity in 1968, and historical rates of pesticide usage have been determined to be approximately equal to the present usage rate. The first Pest Control Shop was housed in Building 112 (the present activity Post Office) and stayed there for less than 1 year. This shop then occupied space in the basement of Building 216 from 1968 through 1972 (Building 216 was demolished approximately 5 years after the Pest Control Shop moved out of the building). From 1972 through 1984, the shop was housed in Building 210B. The shop moved into Building 68-H in 1984. The inventory of pesticides maintained by this shop at the end of 1984 is listed in Table 6-2. This inventory is typical of pesticide storage since the shop originated on the activity. No report of spillage, leakage, or packing problems was found.

Golf Course personnel maintain a 1-year supply (maximum) of herbicides for use on their grounds. In the course of a year, all of this material is applied to the grounds. The sprayer is rinsed by diluting the residue and applying the rinseate to the grounds. The herbicides (in dry powder form) are delivered to the Golf Course in bags. After these bags are emptied, they are disposed of with general activity refuse.

6.1.5 Polychlorinated Biphenyls (PCB's) Storage. Out-of-service transformers, capacitors, and other devices that may have contained PCB insulating fluid have always been stored in the Public Works Center "boneyard" (Site 5), located adjacent to the southwest corner of Building 1517. There is no roof over any part of the area, and the ground is

Table 6-2

Pesticide Inventory,
Public Works Center, NC Great Lakes,
December 1984

Pesticide Name	Percent	Formulation	Unit	Amount on Hand
Malathion	57	EC	Gal.	89
Carbaryl (Sevin)	80	W.P.	Lb.	187
Phostoxin	55	Tablets	Cn	3
Diazinon	12.5	EC	Gal.	7
Diazinon	47.5	EC	Gal.	16.5
Baygon	14.6	EC	Gal.	3
Diazinon	2.0	Dust	Lb.	35
Kroke (Pyrethrin)		Aerosol	Cn	54
Rozol (rodenticide)	0.005	Grain mixed bait	Lb.	20
Lindane	99.0	Dust	Cn (2 oz.)	63
Pyrethrum (ULD)	3.0	Ready to use	Gal.	15
Malathion (Cynthion)	91.0	Ready to use	Gal.	18
Ficam (Bendiocarb)	.76	W.P.	Bx (10 pkts)	23 packets
Warfarin (rodenticide)	0.3	To dilute in dry cereal	Cn (1 lb.)	80
Borid (boric acid)	1.0	Powder	Lb.	6
Drione (Pyrethrin)	1.0	Dust	Lb.	50
Pyrethrin (synergized)	0.40	Ready to use	Gal.	10
Herbicides				
Bromacil	80	W.P.	Lb.	40
2-4-D	2.77	EC	Gal.	5
Methar (30)	18.90	EC	Gal.	4
Terra-Var	2.0	Granular	Lb.	10
Surveyed, but on Hand				
Lead arsenate	58	Powder	Lb.	160
Sodium fluoride	not listed	Granular	Cn (1 lb.)	9 (not to be used)

saturated with oily residue in spots. In 1984, however, a fully enclosed, freestanding PCB storage building (Building 1405) was constructed along the perimeter of Navy property, north of Building 1517.

Another location where PCB transformers were stored is the basement of former Building 226, an old steam plant (Site 6). Between 1979 and 1981, this temporary basement storage area had a dirt floor and contained at least six PCB transformers. These transformers were opened and turned over by vandals, who drained the 132 gallons of fluids and removed the copper. The transformers were removed several years ago, and the area is not presently being used for storage. This area is discussed as Site 6, Mainside Transformer Storage Area.

6.1.6 Storage Lots and Scrapyards. Almost all of the scrap material generated by NC Great Lakes is stored at the DRMO facilities. Scrap metals, such as empty barrels, vehicles, etc., are stored in the lot behind Building 3212C until the material is sold at public auction. Waste POL's are retained at the shop where they are generated until DRMO arranges for removal with an outside contractor. This has been the practice since the 1940's.

Another scrap storage area is located southwest of Building 1517 (Site 5). Scrap metal, drums, and electric transformers, some of which contained PCB's, have been stored in this area since 1942. Most of the material, which includes lead-shielded cable (which is stored only until a large enough volume of material is accumulated to warrant a scrap contract through DRMO), bodies of old electrical devices, and copper cable, is inert. There has been spillage of tarry electrical insulation material and PCB-laden oil at this site. No disposal is done in this area. Site 5 is discussed in more detail in Chapter 8.

An automotive "boneyard" is located just north of this second scrap area. Several dozen vehicles in various states of cannibalization are located there. They are being used as sources of spare parts for other vehicles which are still in service. There is no disposal in this area. Vehicles which can no longer provide useful parts are transferred to the DRMO yard for sale.

6.1.7 Coal Storage. Coal was the major fuel source for NC Great Lakes from its origin until the mid-1970's, when the boilers were changed to the oil-firing type. Each of the areas where coal was stockpiled are described in detail in Chapter 8 (Sites 14A through 14G). These descriptions were compiled largely from old maps and photographs. At one time or another, every barracks had its own coal furnace. There were major coal storage piles at several locations on the activity from which coal was trucked to steam plants and barracks. There were also centralized heating facilities right from the activity's inception which provided steam for the nonresidential buildings.

One major coal pile was located near the steam plant (Building 11), on the shore of the lake. A very high concrete trestle was constructed along with the building, from which coal dropped approximately 40 feet to the pile on

the beach. This arrangement caused some problems -- coal dust would blow into the residential area on Perry Street -- and was discontinued in 1911 after a brief trial.

From 1911 until at least 1943, and perhaps as late as 1954, the coal for the Building 11 steam plant was stored in large piles on the edge of the bluff, at the present site of the Officer's Club. This pile was approximately 200 feet wide and at various times extended from the trestle tracks north as far as Cluverius Avenue.

Another coal pile was located at the present location of Building 144 from 1911 through the early 1950's. One railroad line served this pile, the pile near the Building 11 steam plant, and the Hospitalside steam plant at Building 58H. There was no outside coal pile at Building 58H; coal was supplied to the indoor bunker as needed.

The three Recruitside steam plants each had outdoor coal storage piles from 1942 into the 1950's. These piles were not as large as the piles on Mainside, as they were intended primarily for the individual steam plants which they served. Another large coal storage pile was located at Camp Moffett. This major pile covered most of the area north of Building 1517, and, at times, the area east of Building 1517 from the north property line southward to the drill field.

Another coal storage pile was located in the NC Supply Area from 1942 until coal was replaced as the major activity fuel. This pile covered the present DRMO scrapyard and part of the area behind Building 3215, the Construction Battalion Administration Building. As with all of the other coal storage areas except for the one in the Building 11 area, there is no current indication of their previous use, except for the scattered coal which remains on the surface. At Building 11, some high-sulfur Illinois coal remains from a fluidized bed combustion experiment. This remaining coal is slated for off-base removal in the near future.

6.2 MATERIAL AND WASTE TRANSPORTATION.

6.2.1 Petroleum, Oils, and Lubricants. Most POL's used at NC Great Lakes are ordered through the Supply Department and delivered by vendors directly to the shops and operations where they are to be used. The Supply Department tests incoming shipments of fuel and gasoline for water content and specific gravity. If the shipment passes inspection, the fuel is unloaded at the receiving tank or operation. Several accidental spills which occurred during unloading have been reported by Fire Department personnel. Most of the spills reported at NC Great Lakes occurred while vendors were filling activity tanks. (Filling of the storage tanks has always been handled by the outside vendor.) Areas reporting fuel spillage during tank-filling activities include both Navy Exchange service stations (Buildings 144 and 2710) and the lakeshore fuel oil storage tanks (Buildings 11K and 11L).

6.2.2 Hazardous Waste. Since the late 1970's or early 1980's, DRMO has had the responsibility for handling and disposal of hazardous waste at NC

Great Lakes. Shops or operations that generate hazardous waste notify PWC, which then contacts DRMO. The material remains in the physical custody of the generator, while DRMO handles the paperwork and arranges with a private contractor for its removal from the activity.

Prior to the late 1970's and early 1980's all waste was handled by PWC. Most of the time it was not segregated. At various times, segregated POL was taken by either the generating shop or PWC to the Fire Fighting Training Area (Site 4), or to the activity landfill (Site 1, 1942 to 1967 only) for disposal. In the past, much of the waste that is now classified hazardous may have been mixed with general activity refuse, especially if the quantity was small and could be absorbed by the predominantly paper office waste. Thus, these wastes may have been disposed of into the activity landfills (Sites 1, 2, and 3).

6.2.3 Solid Waste. Until 1980, collection of the activity's solid waste was the responsibility of PWC. From 1942 until 1980, all refuse was taken to one of three landfills located on naval property: the Golf Course Landfill (Site 1), the Forrestal Village Landfill (Site 2), or the Supplyside Landfill (Site 3). The waste generation rate in 1977, with a base population of 30,000, was approximately 40 tons/day, broken down as follows: 25 percent cardboard, 25 percent residential, 20 percent commercial, 20 percent paper, 5 percent food waste, 2.5 percent yard waste, and 2.5 percent mixed office waste. Prior to 1967, when strict directives were issued concerning the types of waste which could be disposed of in the activity landfill (Site 1), small amounts of hazardous waste may have been disposed of along with the general mixed office, residential, and shop waste. It is also known that POL wastes were disposed of in the Golf Course Landfill (Site 1) in the past.

Although the population of the activity has fluctuated widely (high wartime levels compared to low peacetime levels), the 1977 waste generation rate is considered representative of the entire 1942-1980 period during which waste was disposed of in on-base facilities.

A private contractor currently handles solid waste disposal at NC Great Lakes. All disposal is off the activity.

CHAPTER 7. WASTE PROCESSING

7.1 SEWAGE TREATMENT PLANT. NC Great Lakes has been serviced by the North Shore Sanitation District (NSSD) since 1975. The NSSD plant is located north of the activity's northern boundary, on the shoreline of Lake Michigan.

The Navy has a service contract with NSSD to transfer all sewage from the Navy-owned Green Bay Sewage Treatment Plant (in Forrestal Village) to a collection point at the Mainside plant on the shore of Lake Michigan, where a pumping and transmission system delivers the sewage to NSSD facilities in North Chicago. The service contract with NSSD limits the Navy to 10 million gallons per day (MGD), which is expected to exceed all future requirements. During storms, however, infiltration into the system causes maximum flows to exceed 10 MGD. To prevent the excess from overflowing into Lake Michigan, the Mainside sewage treatment plant sludge beds (which are no longer in use) are used to temporarily store these surges.

NC Great Lakes is divided into two gravity sewerage systems by Green Bay Road, which runs north-south on a topographic high. All sewage originating from west of Green Bay Road flows to the former Green Bay Sewage Treatment Plant in Forrestal Village, from which it is pumped to the former Mainside plant. Sewage originating east of Green Bay Road flows directly to the Mainside plant where it, along with the sewage from the Green Bay plant, is pumped to NSSD for treatment in North Chicago.

In the past, the Navy operated two sewage treatment plants to handle wastes. The original plant served the entire Mainside and Recruitside areas, including Hospitalside and Navy housing units east of Green Bay Road. This plant underwent several modifications during its time of operation, some to increase its life-span and others to improve its level of treatment. When first constructed, raw sewage from Hospitalside was transported to this plant at the base of the bluff on the lake via an open flume. This flume was later modified to a closed pipe to eliminate odor problems. Effluent was disposed of through a diffuser into Lake Michigan. Sludges that had been digested in the plant digesters were dried in drying beds adjacent to the inner boat basin prior to the anticipated hookup to the NSSD in 1975. The beds were removed in 1975 prior to the actual hookup to the NSSD facility. Digested sludges from the Mainside treatment plant were trucked to the Green Bay treatment plant sludge drying lagoons during the period between the removal of the Mainside sludge drying beds and the hookup to NSSD. Sludges had always been used on the activity for landscaping and were made available for use by activity personnel.

A second Navy-operated sewage treatment plant, the Green Bay plant, was located in the southwest corner of Forrestal Village. This plant served the activity facilities west of Green Bay Road. Effluent was discharged to Skokie Ditch, which exited the activity just a few yards south of the Green Bay Road plant site. Sludges, including the sludges from the Mainside plant during the aforementioned transition period, were dried in a series of shallow lagoons and prepared for distribution to grounds maintenance

personnel and to residents. No dried sludges were landfilled on the activity, but a substantial volume was used as a soil amendment. Neither of the former Navy-operated sewage treatment plants is currently operating as a treatment plant.

7.2 HOSPITAL INCINERATOR. The hospital incinerator has been in operation since 1942. From 1942 to 1982 the 250-pound/hour batch incinerator was operated 2 or 3 days/week. Beginning in the summer of 1982, pathological waste was accepted from the Veterans' Administration (VA) Hospital, and from that date through the present the incinerator has run 5 days/week, 8 to 10 hours/day. Approximately 30 percent of the total waste processed is received from the VA Hospital. Ash waste from the hospital incinerator averaged approximately 3 cubic yards per month from 1942 to 1982.

The pathological incinerator was designed by Brule and its rated capacity is 250 pounds/hour by batch feed. Natural gas is used to fire the two primary burners and the afterburner to maintain a temperature of 1,200 to 1,300 degrees Fahrenheit. Exhaust gases are scrubbed to remove particles and gaseous emissions. Ash from the incinerator was disposed in the activity landfills (Sites 1, 2, and 3).

Ash and scrubber blowdown from the incinerator are collected in a 6-cubic-yard dumpster which is emptied off-base. The waste generation rate will be reduced in the near future when histopathology research is phased out.

Mice and rats are the primary research animals used at the hospital. Hamsters and monkeys were used at various times in the past. All sacrificed animals are sent to the hospital incinerator for disposal.

CHAPTER 8. DISPOSAL SITES AND POTENTIALLY CONTAMINATED AREAS

Fourteen potentially contaminated areas were identified at NC Great Lakes during this study. Information presented was compiled from on-site examinations, interviews, and records review. Table 8-1 summarizes the information collected at these sites.

8.1 SITE 1, GOLF COURSE LANDFILL. The Golf Course Landfill was located at the northwestern corner of NC Great Lakes. As Figure 8-1 shows, the site is located under the fairways, greens, and tees of at least 12 holes of the present NC Great Lakes Golf Course. The site occupies 49 acres and is located at coordinates HH25 on the General Development Map. The northern and western boundaries of the site are also activity boundaries; the Fire Fighting Training Area forms parts of the southern and eastern boundaries of this former disposal area. Access to the site was from Buckley Road, south of the site. Reportedly, there was never a gate to limit access to the site.

The site was the active disposal area for NC Great Lakes from 1942 through 1967. There may have been a hiatus of disposal activity during the years when the land title was passed to the Veterans' Administration; however, no record of other land disposal areas existing during this time period was found. In 1967, the area was closed and covered when more stringent controls were placed on land disposal by the activity Commander.

Because the site was used as a trench-burn landfill, it is impossible to estimate the volume of material which was disposed of at the site based on its physical dimensions; rather, by prorating the volume of material comprising the present disposal rate of 400 tons/day (5-day week) back in time, we can estimate that approximately 1.5 million tons of material were disposed of there. In addition, this site apparently received the bulk of the coal ash which was disposed of on the activity. Records of the use of coal ash for other landscaping and grading needs were not kept; therefore, it is difficult to estimate the total volume of ash disposed of at this site. During the on-site visit, an excavation was opened in a roadway bordering Ross Field; the excavation revealed approximately 2-1/2 to 3 feet of what appeared to be ash under the roadbed. This is reportedly typical of other locations on the activity.

The first step in the trench-burn process was the excavation of a trench into the earth. At NC Great Lakes, a dragline was used for this excavation. Each trench was approximately 8 feet wide and 6 to 8 feet deep (the distance to the top of the water table in this area). Occasionally, a trench may have had water in the bottom during the active disposal process. General refuse and trash were disposed of directly into these trenches. Reportedly, oil was also disposed of into the waste trenches. When material came close to filling the trench, the pile was ignited and allowed to burn to completion. Proceeding in this manner, the trenches were progressively filled and covered. Several local residents recalled the large smoky plumes rising from this area.

Table 8-1

Summary of Disposal Sites and Waste Types, NC Great Lakes

Site	Shop	Waste Material	Years of Disposal Operation	Generation Rate/Yr.	Total
Site 1, Golf Course Landfill	RTC Rifle Range	Lead, brass	1942-1967	340,000 rounds some recycled	undetermined
		CLP = Clean, Lube Preserve gun oil	1942-1962	0.095 gal/yr.	4 gal.
		Bore cleaner #6850-00-224-6663	1942-1962	0.095 gal/yr.	4 gal.
	Building and Equipment Maintenance	POL	1943-1967	100 gal/yr.	<2,400 gal.*
		Paint thinner	1943-1967	0.05 gal/yr.	1.2 gal.
		12 v. batteries	1965-1967	10	20 batteries
	Motor Vehicle Maintenance	POL	1942-1967	5,200	<130,000*
	Carpentry Shop	Asbestos	1947-1967	unknown	unknown
		Solvent 144	1947-1967	11 gal.	220*
		Oil primer and oil-based paint	1947-1967	1 gal.	20 gal.
	HVAC Shop	Oil-based paint	1954-1967	1 gal	23*
		WD-40 lubricant	1959-1967	1 gal	23*
	Machine Shop	Solvent 144	1942-1967	110	3,850*
	Welding and Sheet Metal Shop	Cutting oil	1934-1967	1 gal	33
		Scrap metal	1934-1967	unknown	unknown
	EM/IC School	Stoddard solvent (PD 680)	1942-1967	0.05	1
		Oil paint	1942-1967	0.175	3.50
		WD-40 Oil	1942-1967	0.008	0.20
		Isopropyl alcohol	1942-1967	0.030	0.75
	Fire Control Technician, Opticalman, and Instrument Control School	Alcohols	1954-1967	0.060 gal/yr.	0.780
		Acetone	1954-1967	0.025 gal/yr.	0.325
		penetrating oil	1954-1967	0.010 gal/yr.	0.130
		Turpentine/linseed oil	1954-1967	0.040 gal/yr.	0.520
		Oil paints	1954-1967	0.025 gal/yr.	0.325
		Stoddard solvent	1954-1967	48 gal/yr.	624*
		Gear oil	1954-1967	48 gal/yr.	624*

Table 8-1 (contd.)

Summary of Disposal Sites and Waste Types, NC Great Lakes

Site	Shop	Waste Material	Years of Disposal Operation	Generation Rate/Yr.	Total
Site 1 (cont'd.)	Gunnery School	Stoddard Solvent	1954-1967	1.75 gal/yr.	22.75
		Hydraulic/transmission fluid	1954-1967	3,500 gal/yr.	45,500
		Grease	1954-1967	120 gal/yr.	1,560
		Mineral oil	1954-1967	0.025 gal/yr.	0.325
		Corrosion inhibitor	1954-1967	0.08 gal/yr.	1.04
		Turpentine/linseed oil	1954-1967	0.06 gal/yr.	0.78
	Dental Research Institute	Animal carcasses	1948-1967	350 carcesses	8,050
	Naval Construction Battallion Unit 401	POL	1954-1967	350 gal/yr.	8,050 gal.*
		Lead-acid batteries	1954-1967	36 batteries	828
	Steam Propulsion School	Acetone	1961-1967	0.005 gal/yr.	0.030
		Mercuric nitrate solution	1961-1967	0.020 gal/yr.	0.120
		Cutting oil	1961-1967	0.010 gal/yr.	0.060
		Oil paints	1961-1967	3.250 gal/yr.	19.500
		Stoddard solvent	1961-1967	0.025 gal/yr.	0.150
		Spray solvent	1961-1967	0.035 gal/yr.	0.210
Site 2, Forrestal Landfill	All shops	Mixed office waste	1968-1969	-	273,000 cubic yards
Site 3, Supply-side Landfill	All shops	Mixed office waste	1969-1983	-	1.02 million cubic yards

Table 8-1 (contd.)

Summary of Disposal Sites and Waste Types, NC Great Lakes

Site	Shop	Waste Material	Years of Disposal Operation	Generation Rate/Yr.	Total
Site 4, Fire Fighting Training Area	Auto Hobby Shop, Golf Course, Building and Equipment Maintenance, Motor Vehicle Maintenance, Carpentry Shop, EM/IC School, Steam Propulsion School	POL, Stoddard solvent, WD-40	?-1985	unknown	unknown*
Site 5, Transformer Storage "Boneyard"	PWC jurisdiction	PCB oil	N/A	N/A	unknown
Site 6, Main-side Transformer Storage Area	PWC jurisdiction	PCB oil	N/A	N/A	132 gals. spilled
Site 7, RTC Silk-Screening Shop	RTC Silk-Screening Shop	Oil- and water-based paints, turpentine, linseed oil, acetone, bleach, inks, alcohol	1972-1985	1,400 gal/yr. washwaste	18,200 gal.
Site 8, Exchange Service Station	Exchange Service Station	Gasoline spill	1982	3,000 gal.	3,000 gal.
Site 9, Camp Moffett Disposal Area	All shops	Galley wastes	pre-1942	unknown	

Table 8-1 (contd.)

Summary of Disposal Sites and Waste Types, NC Great Lakes

Site	Shop	Waste Material	Years of Disposal Operation	Generation Rate/Yr.	Total
Site 10, NTC Rifle Range	NTC Rifle Range	Lead, brass, ordnance	1942-1985	390,000 rounds	unknown
Site 11, BE/E School Gyro Compass Room	BE/E Gyro Compass School	Mercury	spilled about 1972	2-foot-diameter	removed pool
Site 12, Harbor Dredge Spoil Area	All shops, residents, and off-base industry	Dredge spoils, PCB, oils, heavy metals	unknown	5,000 cubic yds.	unknown
Site 13, Demolition Debris Disposal Areas	Demolition	Demolition debris	Early in activity history to present	unknown	unknown
Site 14, Former Coal Storage Areas		Coal	N/A	unknown	unknown

* mostly incinerated

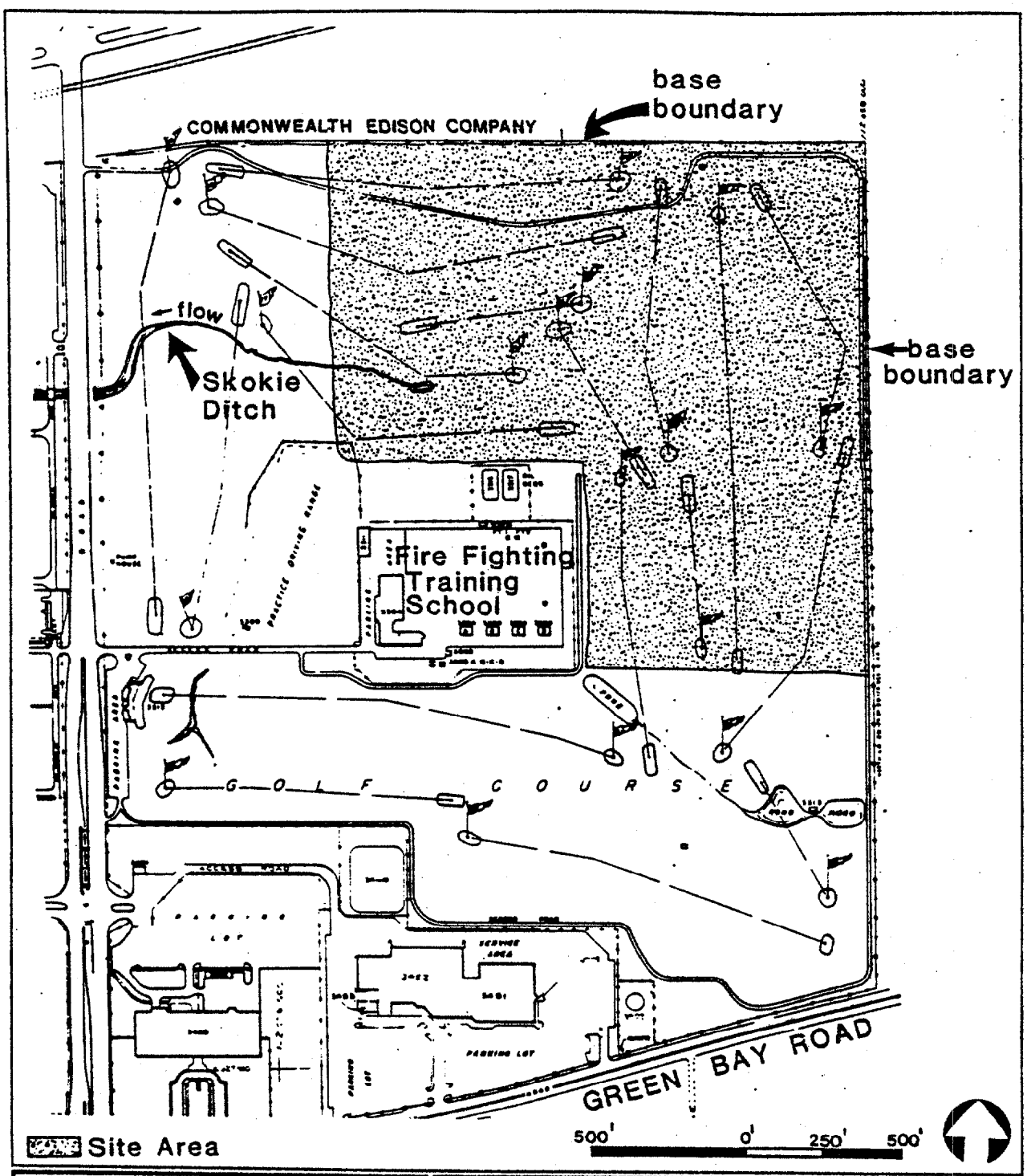


Figure 8-1

Site 1, Golf Course
Landfill

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Wastes known to have been disposed of at Site 1 include general refuse from classroom and administrative activities, oils (including transformer oils), coal ash, and residential trash from activity housing units. It was explicitly stated from several sources that metallic scrap was kept to a minimum; such scrap always went to the Defense Reutilization and Marketing Office (DRMO), formerly the Defense Property Disposal Office (DPDO), for disposal. Specific chemicals disposed of there included perchloroethylene (PCE) from dry cleaning, polychlorinated biphenyls (PCB's) from transformer oil disposal, solvents, including carbon tetrachloride and Solvent 144, and motor crankcase oil.

Most refuse material disposed in the Golf Course Landfill would have decomposed immediately as it was being burned in the trenches. However, some material may not have burned if it was lying in water in the bottom of the trench or if the combustion was not complete. After the residue filled a substantial portion of each trench, the trench was filled and a new one was started.

An ash layer was used for final cover of the site. Reportedly, it is difficult to get shrubbery, trees, and the more desirable grass species to grow in those areas of the Golf Course where the coal ash was disposed of. At Site 1, ash was encountered within the first several feet when holes were dug for trees within the disposal area. If the depth of these holes averaged 1.5 feet, a low-end estimate of the volume of coal ash disposed of at the Golf Course Landfill would be 118,000 cubic yards.

There is evidence that some of the waste is still decomposing. In the area of the 5th and 15th tees, the ground has settled and continues to settle as the landfill material decomposes and compacts. Some of the settled areas approach 2 to 3 feet in depth and 6 to 10 feet in length. They provide an interesting natural hazard for golfers.

8.2 SITE 2, FORRESTAL LANDFILL. After controls were placed upon the disposal of waste by the NC Great Lakes Commander, the Forrestal Landfill (Figure 8-2) was the first disposal area used by NC Great Lakes. This area is located between Superior Street and Skokie Ditch, south of Virginia Court (General Development Map Coordinates EE10). The site occupies approximately 4 acres.

The site was operated from 1967 to 1969 as a trench-type landfill with no burning. This disposal method represented the transition from the largely uncontrolled operation at the Golf Course Landfill (Site 1) to a fully controlled operation. A guard shack was constructed and access to the site was limited to a gate located on Superior Street. Activity housing units on Virginia Court had not been constructed at the time that the landfill was operating.

The site is presently an open field, elevated above Skokie Ditch and the land west of Superior Street. Several pieces of recreational equipment are positioned on the filled area. The southern boundary of the disposal area is a wooded area. Access to the site from Supplyside is limited by a chain link fence. Open access to Forrestal Village is by way of Virginia Court.

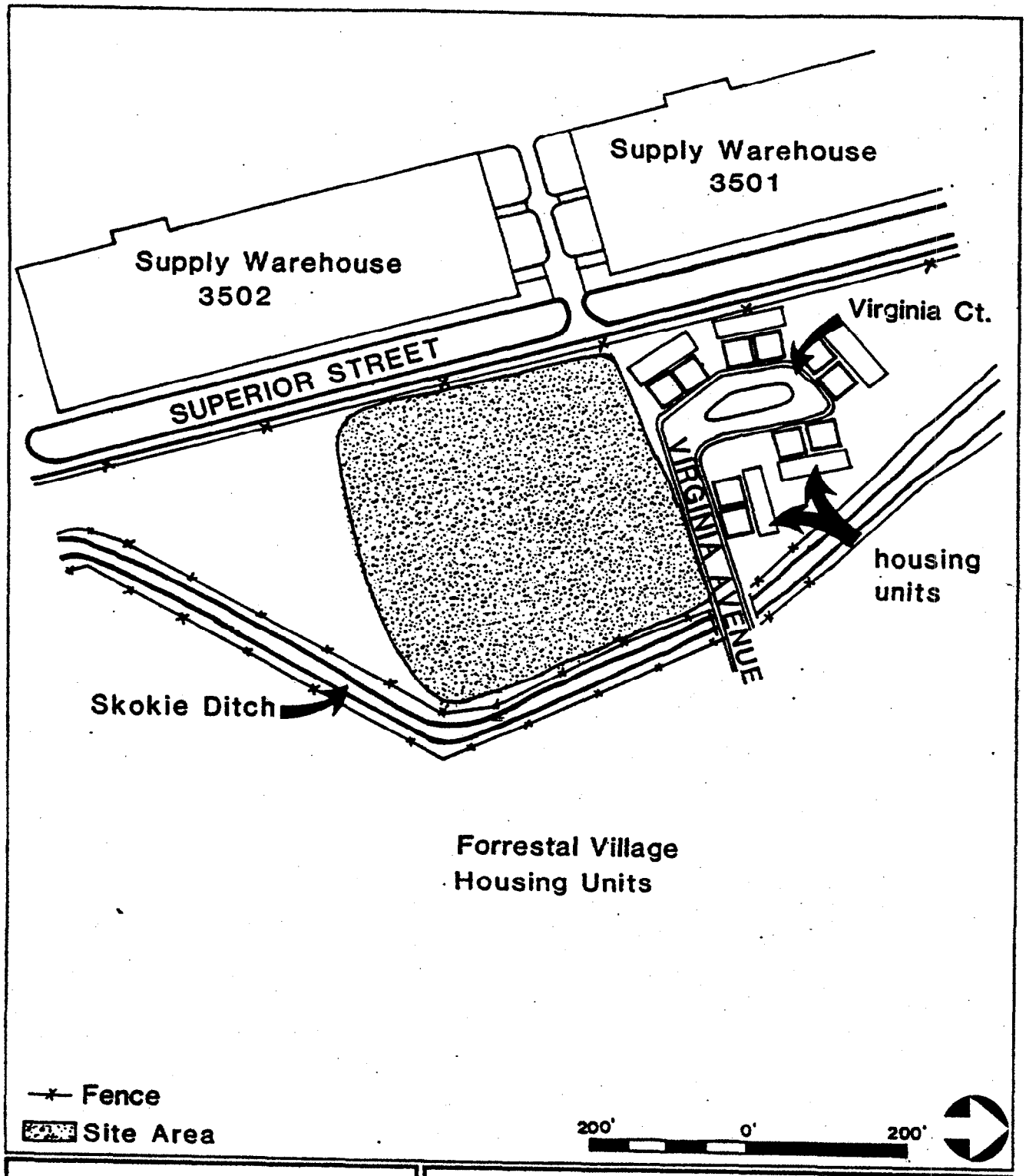

Figure 8-2

Site 2, Forrestal Landfill

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The total volume of material disposed of in the Forrestal Landfill was limited by the size of the parcel involved, and the fact that the disposed material was not burned. In addition, the period during which the site was operated coincided with a period during which responsibility for waste collection from most activity housing switched from Navy personnel to private contractors, with disposal off Navy property. With these considerations in mind, the total volume disposed of in the Forrestal Landfill site is estimated to be 276,000 cubic yards (280 tons/week for 78 weeks times 3.5 cubic yards per ton of uncompacted trash).

The waste disposed of in the Forrestal Landfill was primarily mixed office waste generated by the Administrative Command at NC Great Lakes and the various training schools. Shop waste, notably that from the Public Works Center shops, was also disposed of there. The disposal of liquids like motor crankcase oil and transformer oils at this site was reportedly prohibited. Metals were disposed of through DRMO (then DPDO), as was the case both before and after the operation of this disposal area.

Specific chemicals disposed of included less-than-reportable quantities of solvents, paint, and thinners (residue on rags and building materials). Residential waste from Navy housing was not a major component of the material disposed of since off-base disposal of this waste began during the period of operation of this landfill.

8.3 SITE 3, SUPPLYSIDE LANDFILL. Supplyside Landfill (Figure 8-3) is the disposal area shown in the General Development Map in the southwest corner of NC Great Lakes and labeled "Closed Sanitary Landfill Area." It is adjacent to the activity boundary and south of the last of the Supply Department warehouses (Building 3503), and extends almost to the westward extension of Alabama Avenue. A railroad spur serving the Supply Department warehouses crosses the southeastern third of the landfill. The landfill occupies approximately 7 acres. Its coordinates on the General Development Map are EE6.

Supplyside Landfill was regraded in 1985 with final cover, which was to be seeded for the first time during the 1985 growing season. The grading was performed by Naval Construction Batallion Unit 401, a tenant command on the activity. The landfill surface rises 15 to 20 feet above the surrounding grade on the east and the west. Skokie Ditch drains the surface water from the area and lies adjacent to the landfill to the east. To the west, an area of poorly drained land begins at the fence marking the activity boundary that adjoins the Commonwealth Edison Company right-of-way. This area drains into Skokie Ditch.

This landfill was operated from 1969 to 1983, when it was closed and all refuse was sent off-base for the first time. The period of operation was concurrent with the institution of additional controls and monitoring of landfill operations; in fact, a surface and ground water monitoring program is in effect at the site of this former landfill. The landfill was operated as a trench-type landfill with no burning. There are four parallel trenches on this site. Landfilling was conducted on both sides of the railroad spur.

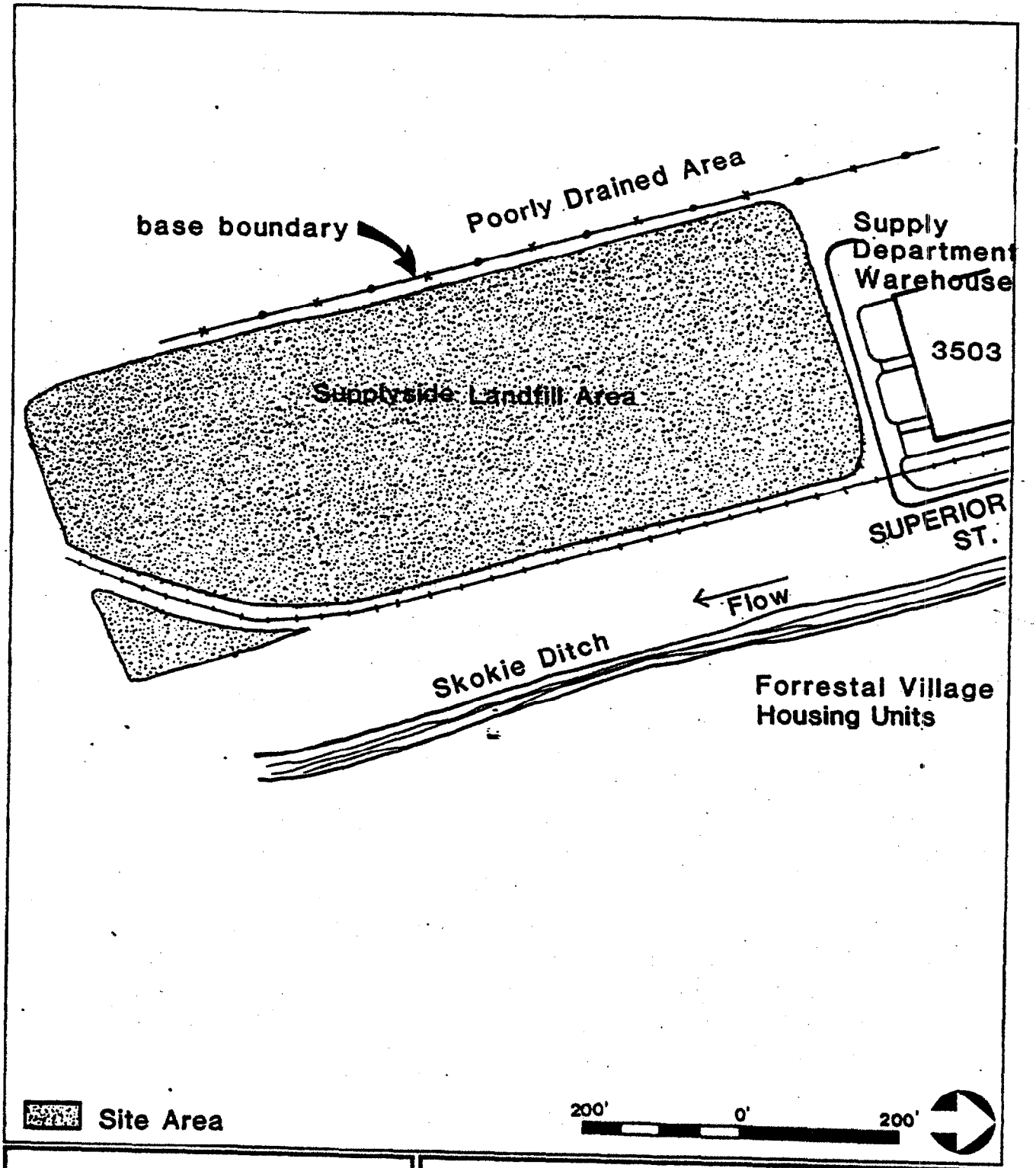

Figure 8-3

Site 3, Supplyside Landfill

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The main component of disposed material at the Supplyside Landfill site was general office waste. All household wastes were disposed of off-base by contract collectors/haulers. No liquids, metals, or sanitary wastes were accepted for disposal at the Supplyside Landfill.

Specific chemical wastes likely to have been disposed of in the landfill are less-than-reportable quantities of spent chemical cleaners, solvents, and oils on waste building materials or rags used for cleanup. Other wastes typical of an office source like typewriter ribbons, paper, and ink are thought to be major constituents of the landfill waste.

8.4 SITE 4, FIRE FIGHTING TRAINING AREA. The Fire Fighting Training Area (Figure 8-4) occupies about 10 acres, located at FF23 on the General Development Map. This area has been in constant use as a training facility since 1942. All recruits are trained by allowing them to fight practice fires in open steel tanks and in smoke practice buildings. These fires are set with #2 fuel oil which is floated on water and ignited by burning gasoline. In the training exercises, instructors and recruits extinguish the fires as soon as possible using Aqueous Film Forming Foam (AFFF) and other agents (like dry chemical extinguishers).

The entire training area is drained by an underground plumbing system which leads the water, oil, and emulsions to one of two lagoons located west of the training area. A centrifugal oil/water separator was installed in the waste line between the training area and the lagoons in 1979. The separator effluent is directed to one of the two lagoons. Any residual oil still found in the effluent is allowed to separate by gravity; recruits remove this oil from the top of the lagoons manually. Water is decanted from the bottom of the lagoons to prevent contamination of Skokie Ditch; a pipeline carries effluent water decanted from the lagoons to the headwaters of Skokie Ditch, located on the Golf Course.

From 1942 to 1979, the Fire Fighting Training Area stored and burned waste POL's and solvents from shops (such as the Carpentry Shop and the Transportation Shop) on the activity. Some of this material was burned in the training exercises on an as-available basis. The remainder, stored in 55-gallon drums, was allowed to accumulate in the area. In addition, oil that had been removed from the oil/water separator and that had been skimmed manually from the lagoons was drummed and stored in this area. These drums were stored along the western fence line of the training area.

The practice of accepting waste materials from other shops on the activity was discontinued in 1979, about the same time that the oil/water separator was installed. However, by 1982 approximately 300 drums of waste solvents, oil, and oil/water emulsions had accumulated in the area. The first of a series of contracts for the off-base disposal of these liquid wastes was let in 1983. All the drums had been emptied by spring of 1985, and the empty drums were awaiting disposal by DRMO. Oil that is skimmed from the lagoons and removed from the separator is taken away regularly and is not allowed to accumulate.

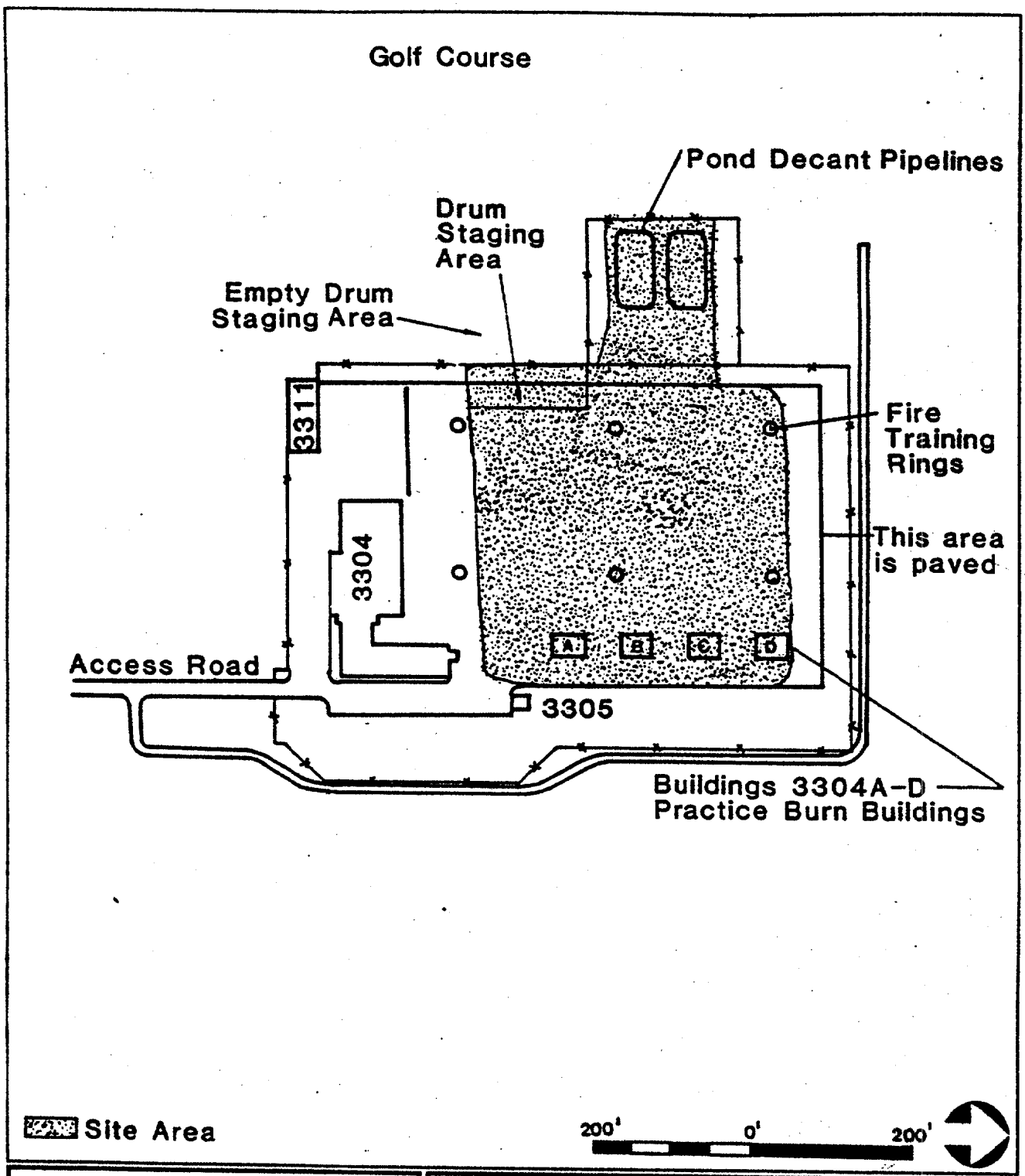

Figure 8-4

Site 4, Fire Fighting Training Area

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The area where the 300 drums were stored is underlain by soil which is soaked with residual oil from spillage. The area is not diked, and runoff could reach the Skokie Ditch during an extremely heavy rainfall. It is estimated that approximately 1 percent of the material stored, or about 165 gallons of water, solvent, oil, and oil/water emulsions, has leaked onto the soil.

Specific chemicals which may have been stored in the drums include Solvent 144, turpentine, gasoline, #2 diesel fuel, crankcase motor oil, and antifreeze. Some of these materials were likely to have degraded before they entered the soil. Limited evaporation of the more volatile components of gasoline and solvent before they got below the top 6 inches of soil is also likely to have occurred.

8.5 SITE 5, TRANSFORMER STORAGE "BONEYARD". Located in the northern end of Camp Moffett (R24 on the General Development Map), the Transformer Storage "Boneyard" area occupies 2 acres southwest of Building 1517, east of the Elgin, Joliet & Eastern Railroad right-of-way. From 1945 to 1985, this site was the primary storage area for out-of-service transformers, including those filled with PCB oils. In 1985, PCB-filled devices were transferred to a new building specially designed to hold them. This building (Building 1405) is located about 250 feet north-northeast of Building 1517.

Prior to 1985, transformers were moved about within the area outlined in Figure 8-5. At one time or another, the actual location of the transformers could have been anywhere within the outline. In 1985, there were about 40 devices in storage in the area, none labeled as containing PCB's. Seven PCB-labeled devices were in storage in Building 1405.

Wastes found in the soils of the Transformer Storage "Boneyard" may include transformer oils, PCB transformer oils, and lead insulation from high voltage cables. The wastes are mostly tied up in the upper layers of the soils.

Transformer Storage "Boneyard" area surface drainage crosses the site from west to east, and is picked up by storm sewers which discharge into Pettibone Creek. Several samples were collected by PWC in 1984 for PCB testing. The results shown in Table 8-2 indicate that the ground is in need of cleanup. Since the samples were collected at random locations with no documentation, and since the location of PCB transformers was not limited to the corner of the indicated area, a more thorough investigation is needed.

8.6 SITE 6, MAINSIDE TRANSFORMER STORAGE AREA. Between 1979 and 1981, at least six transformers reportedly containing PCB oils were stored on the basement-floor level of Building 226 (M-25 on the General Development Map). This building has since been razed. In 1981, while these transformers were stored there, vandals removed the tops from six of them, spilled the contents onto the ground, and stripped out the copper cores. The entire contents of the transformers (a total of approximately 132 gallons of oil) was lost into the soil of this 100-square-foot area. No cleanup attempts were made. The vegetation in this area appears to be stressed, but it is not clear whether the stress is caused by PCB's or other factors.

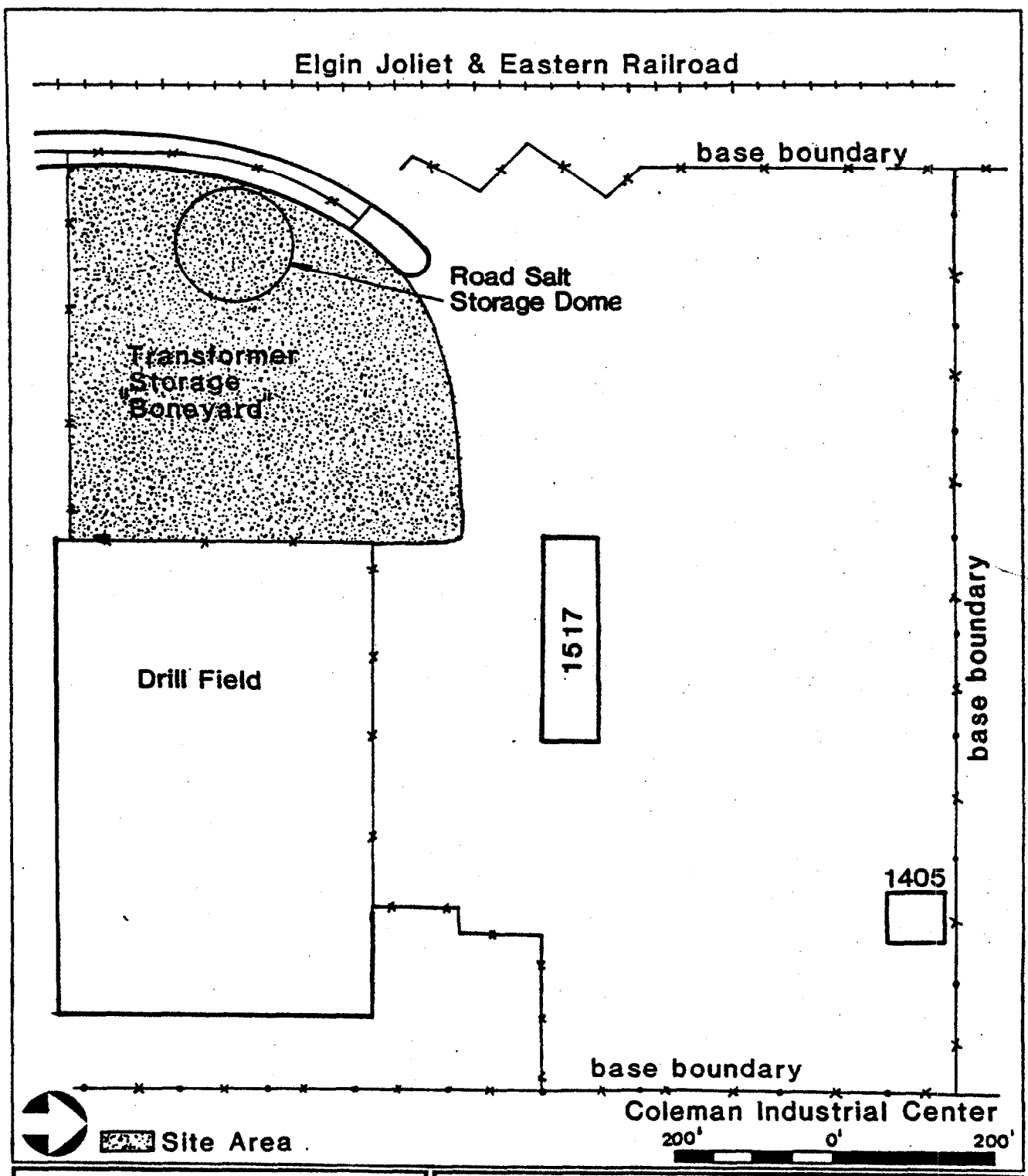

Figure 8-5

Site 5, Transformer Storage "Boneyard"

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Naval Complex
Great Lakes, Illinois

Table 8-2

Soil Samples Analyzed for PCB Content,
Transformer Storage "Boneyard," NC Great Lakes

Sample Number	PCB Content
1	45 ppm
2	60 ppm
3	100 ppm
4	50 ppm

During the on-site visit, a tour was made of the disposal site (Figure 8-6). The southeast corner of the foundation wall was examined, and some of the soil in the area was found to have a slight oily stain. This was also the only area of the foundation without a thick stand of weeds. It was not possible to determine whether the lack of weeds is related to the PCB oils or to some other cause.

8.7 SITE 7, RTC SILK-SCREENING SHOP. The RTC Silk-Screening Shop (Figure 8-7) is located in the RTC Training Aids Branch in Building 1212. This shop has been in its present location since at least 1965. The various flags and banners used by the recruits during parades, graduations, etc., are made in the shop. The screens are painted or dyed with ink during their preparation. Upon completion, the finished silk screens are washed in a booth located in the northeast corner of the building. This practice has been in effect since at least 1972. The ground surrounding the outlet was very obviously stained for an area of approximately 3 feet by 15 feet at the time of the research team's visit (June 1985). Upon closer examination it was seen that the staining continued for many more feet into the dirt road behind the building where, reportedly, the effluent often formed pools during periods of heavy discharge.

The shop uses a variety of inks, dyes, paints, and thinners in preparing the finished silk screens. Included are water- and oil-based lacquers and enamels, mineral spirits (T-125), acetone (T-948), thinners (T-460, T-900, and T-910), direct photo emulsion, and various ink products. Reportedly, the ink products and solvents handled by the Silk-Screening Shop have changed over the years.

Various combinations of the thinners are used at the rate of 3 gallons per week during heavy work periods. Virtually all of this material leaves the building via the wash booth drain. Photo emulsion is used at the rate of approximately 5 gallons per year, all of which is also washed out the booth drain. Specific quantities of paints and inks used are unknown; reportedly, however, during busy periods approximately 200 gallons per week of wash wastes are flushed out of this drain onto the ground. This practice ended in August 1985. Wastes are now disposed of through DRMO.

8.8 SITE 8, EXCHANGE SERVICE STATION. In 1983 a major gasoline spill occurred at the Navy Exchange service station (Building 144) on the Mainside area of the activity (Figure 8-8). Approximately 3,000 gallons of gasoline were spilled when a line leading to the underground storage tanks ruptured. Product recovery wells were installed in order to pump out the contaminated gasoline. The recovered fuel was delivered to the Fire Fighting Training Area for disposal. After the recoverable gasoline was removed from the ground, contaminated soil was also removed for off-base disposal. A 24-hour fire watch was put in effect, and the area was monitored by the Fire Department for a month following the spill.

Despite the thorough cleanup at the spill site, the odor of gasoline can still be detected in the basement of the nearby Post Office (Building 112) after heavy rain. Apparently, residual gasoline remaining in the subsurface gets displaced by percolating rainwater and enters the lowest levels of the building.

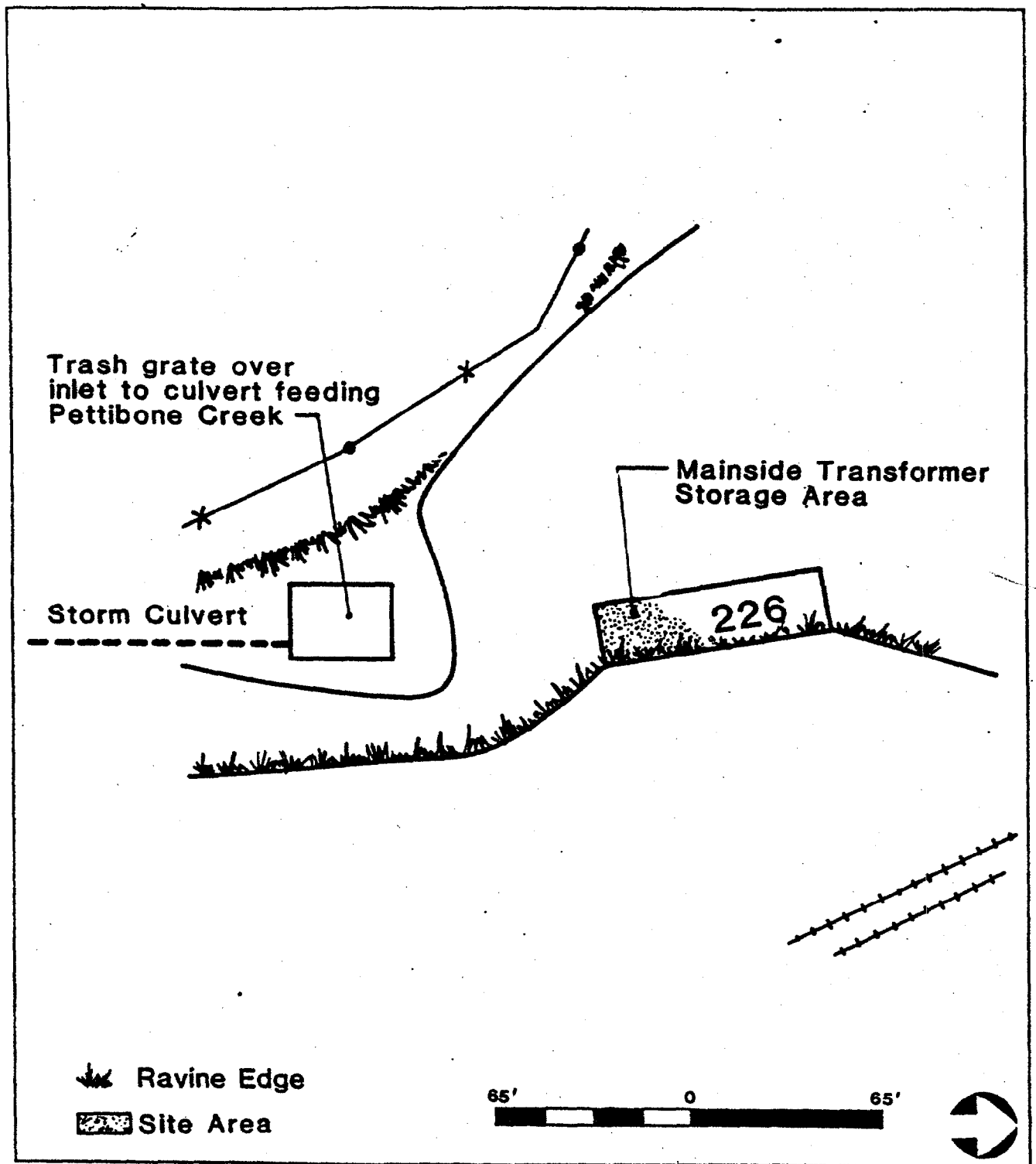
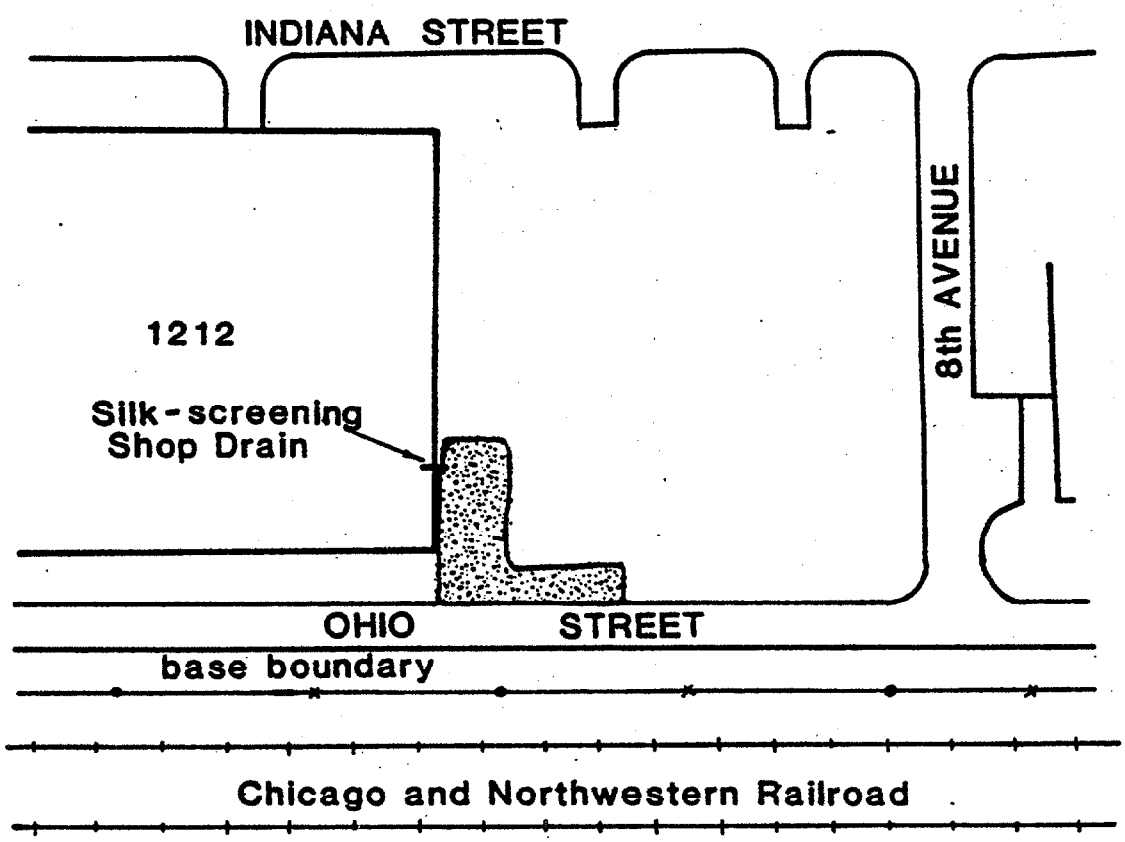


Figure 8-6

Site 6, Mainside Transformer Storage Area

Initial Assessment Study
Naval Complex
Great Lakes, Illinois



Site Area

100' 0' 100'

Figure 8-7

Site 7, RTC
Silk-Screening Shop

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

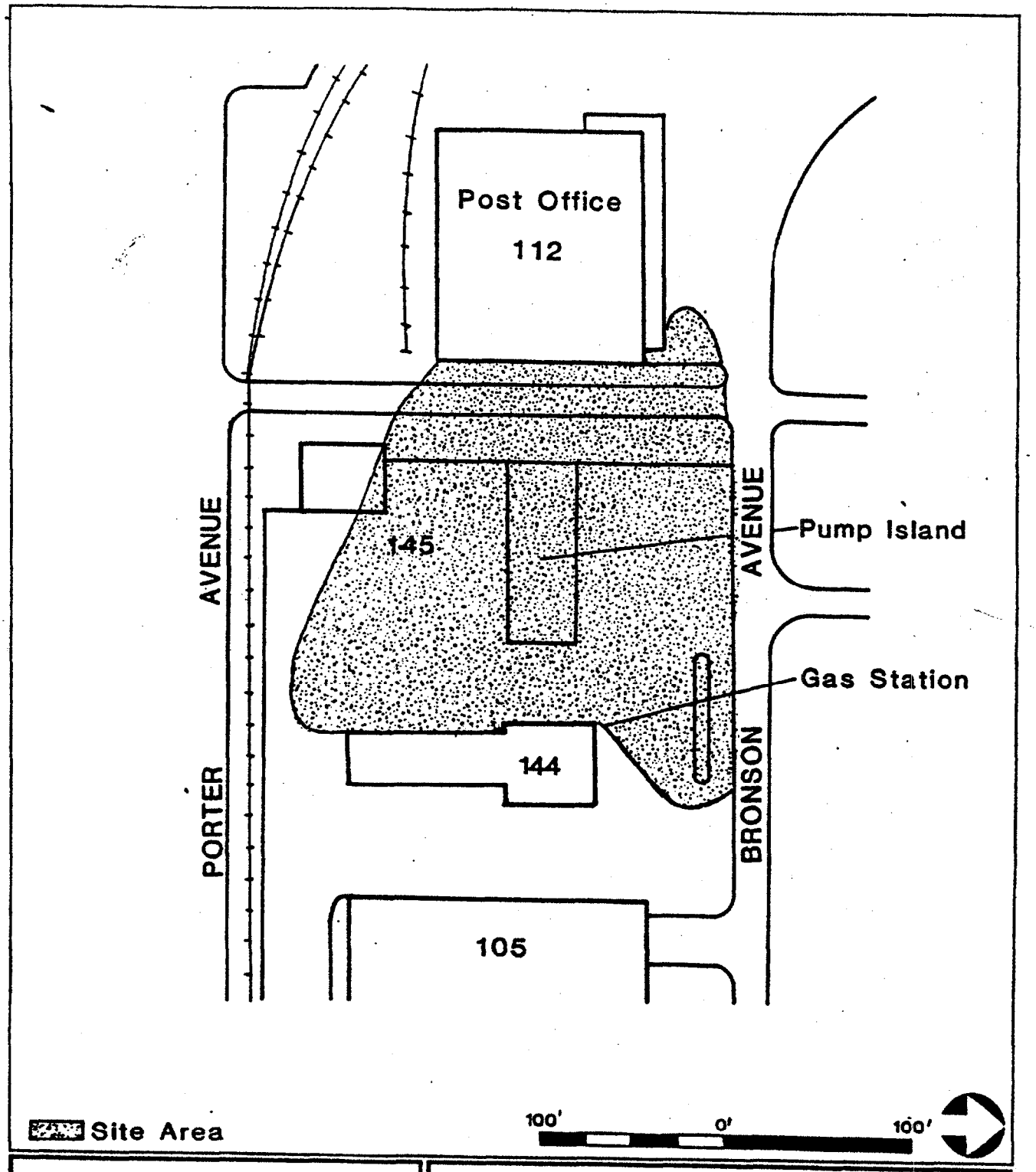


Figure 8-8

Site 8, Exchange Service Station

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

8.9 SITE 9, CAMP MOFFETT DISPOSAL AREA. A 1980 excavation to repair a portion of the roadway in Camp Moffett which had collapsed uncovered a variety of galley-type wastes. These wastes included stainless steel serving trays and food wastes. The excavation went to the limit of reach of the backhoe which was available (approximately 8 feet below the surface) and did not reach the bottom of the fill. No effort was made to determine the lateral extent of the fill; however, examination of older aerial photographs and topographic maps of the area suggests that the area was formerly a narrow, V-shaped ravine, a former tributary of Pettibone Creek (Figure 8-9). No other information is available about the Camp Moffett Disposal Area.

8.10 SITE 10, NTC RIFLE RANGE. The NTC Rifle Range (Figure 8-10) is located on a 14.2-acre plot at the extreme northeastern corner of NC Great Lakes. The Rifle Range has been located in this particular area since the land was purchased in 1918. It is currently being used by the Department of Justice, Federal Bureau of Investigation as a training and practice facility.

In August 1984, the Northern Division, Naval Facilities Engineering Command (NORTHNAVFACENGCOM) conducted a preliminary site investigation to determine the amount of environmental contamination at the site. Unfired rounds of old ammunition and other ordnance items were found regularly in the uppermost soil layer throughout the site. It appeared that these items had been buried in the soil and surfaced due to erosion. Investigators concluded that a serious safety hazard would exist were the Navy to change the land use of this property without sweeping the entire site for ordnance.

The site also has a high contamination potential for lead, due to the presence of almost 70 years worth of lead accumulation in the soil. Investigators concluded that the lead had a high potential for contaminating ground and surface waters due to its exposure to a variety of weather and environmental conditions. The cost for demilitarizing the site has been estimated at approximately $554,000, which is close to the fair market value of the site (NORTHNAVFACENGCOM ESR #21-696-250, September, 1984).

8.11 SITE 11, BE/E SCHOOL GYRO COMPASS ROOM. Building 2B (rooms 329, 330, 330A, and 330B) housed 15 gyro compasses from 1942 until 1976 (Figure 8-11). Each mechanism contained 10 to 15 pounds of elemental mercury. Reserve mercury was stored in a locker located in room 330C, on the third floor of Building 2B. The gyromechanisms were dismantled in 1976 and sent via Supply to DRMO (then DPDO).

A large (more than 3 feet in diameter) puddle of mercury was discovered under the storage locker in room 330C in 1979 during conversion of the rooms from laboratories into classrooms. Further investigation revealed the presence of mercury in between the floor tiles and the baseboard edging in the room. The other rooms were monitored for mercury vapor. Mercury vapor levels were reportedly negligible and these other rooms were not cleaned further. School personnel called PWC, which contacted Preventative Medicine and the Fire Department. Personnel from all three groups were present while

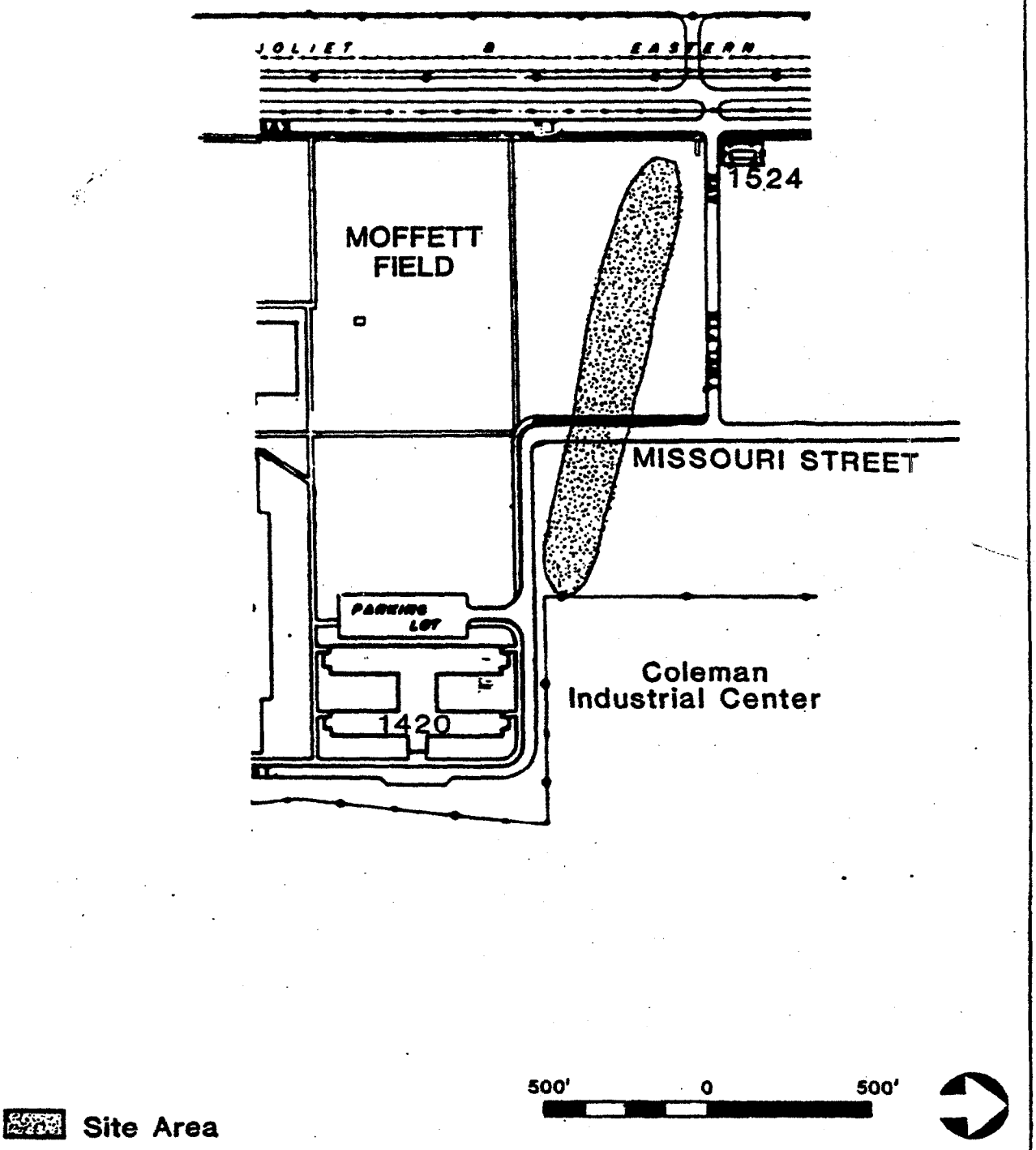
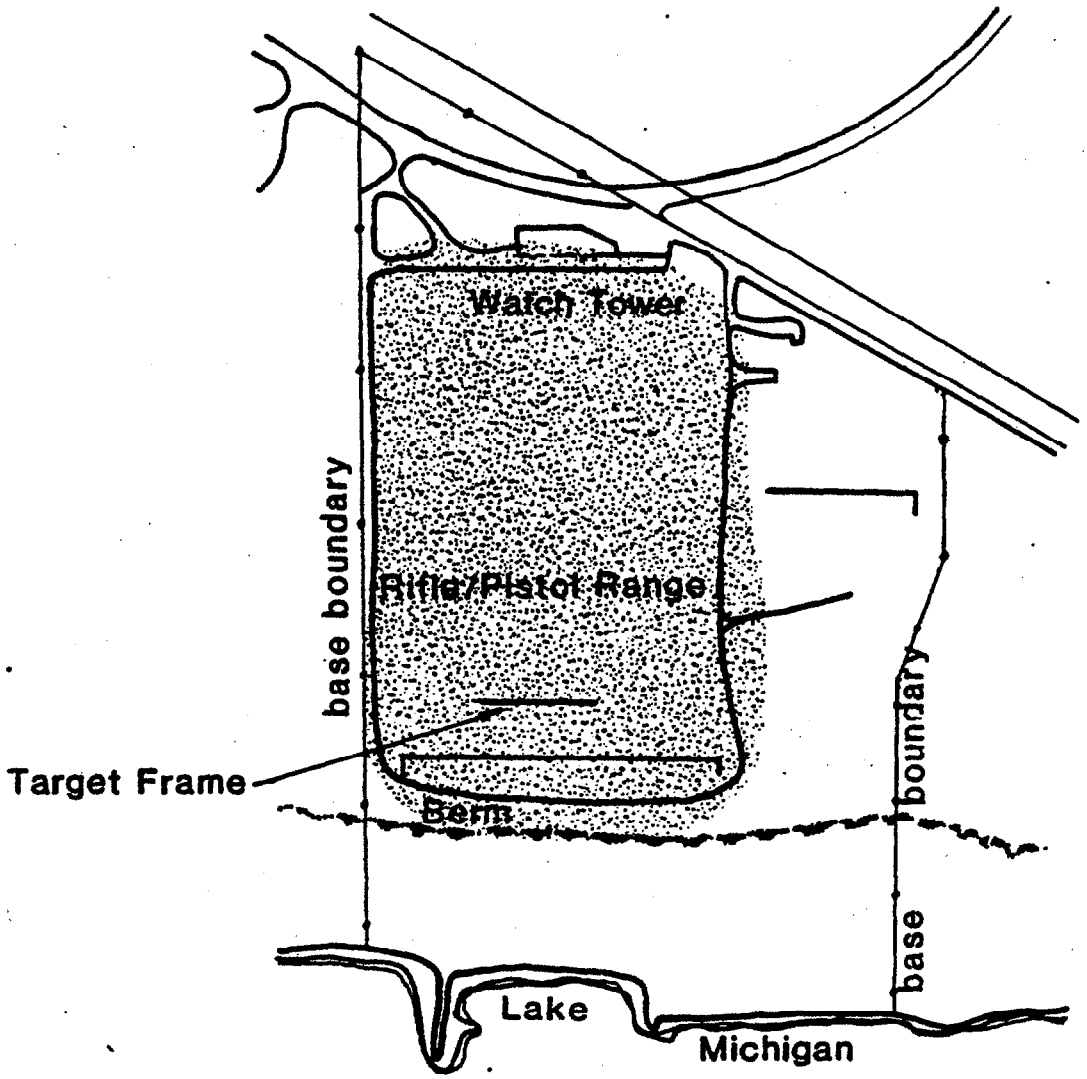


Figure 8-9

Site 9, Camp Moffett Disposal Area

Initial Assessment Study
Naval Complex
Great Lakes, Illinois



Site Area

200' 0' 200'

Figure 8-10

Site 10, NTC Rifle Range

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

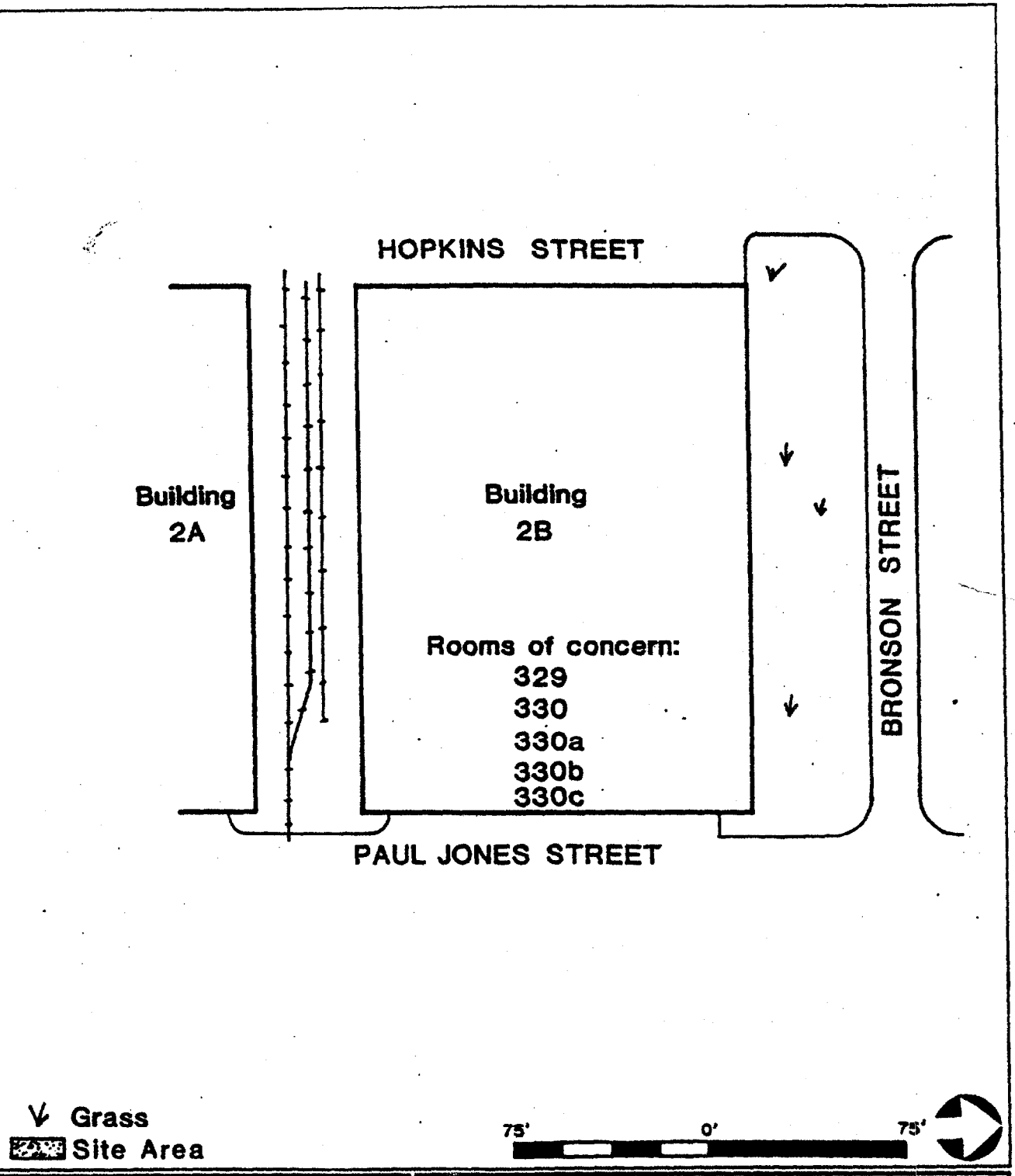


Figure 8-11

Site 11, BE/E School Gyro Compass Room

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

Preventative Medicine vacuumed the area for mercury. Reportedly, there have been no problems with mercury since 1979. The rooms have been used as classrooms since 1979.

8.12 SITE 12, HARBOR DREDGE SPOIL AREA. The harbor area (Figure 8-12) has experienced siltation since the original breakwaters were installed. With the construction of the outer breakwater the siltation problems became worse, since wave energy entering the area decreased even further. From 1952 to 1970, the boat slip area was dredged twice. The dredge spoil was placed on the 3-acre area at the base of the outer harbor breakwater (G17 on the General Development Map), where the jetty meets the southern boundary of the activity. The spoil has created a wide flat area where other materials are sometimes marshaled, but no other disposal takes place there.

The harbor area receives the runoff from Pettibone Creek, which on several occasions has conveyed contaminants that were generated off-base. These contaminants may sink to the bottom when they reach the larger Lake Michigan, or they may adsorb onto the surface of fine-grained sediments which collect in the sheltered waters of a harbor.

The NC Great Lakes Master Plan cites contamination of the inner harbor sediments with heavy metals, oils, and PCB's. The source of these contaminants was apparently the off-base industries upstream of NC Great Lakes, some of which are identified in the section on adjacent land uses in Chapter 4 of this report. Spoils dredged from the Inner Harbor and deposited at Site 12 could also contain this contamination. The Inner Harbor is not Navy property; the waters are under the jurisdiction of the State of Illinois. Site 12, however, is definitely Navy property.

A proposal to place dredge spoils into the foundation of former NC Great Lakes Building 112 was approved by the U. S. Army Corps of Engineers in the early 1980's. No further dredging had occurred as of 1985, however, and it is presumed that the proposed disposal of Inner Harbor spoils into that foundation did not occur.

8.13 SITE 13, DEMOLITION DEBRIS DISPOSAL AREAS. During the course of the on-site visit by the IAS team, several areas which were used for the disposal of inert demolition debris were discovered (Figures 8-13a and 8-13b). As a result of the findings regarding other past disposal practices, the judgment of the IAS team is that the material disposed of in these areas included only inert material, even though documentation of the disposal practices, including dates and volumes, was unavailable. The primary reason for this conclusion is that the methods used to dispose of office waste, putrescible waste, and industrial materials at NC Great Lakes are well known. Each of the demolition debris areas discovered is described in this section.

Demolition debris disposal sites 13A, 13B, and 13C are located along the shoreline of Lake Michigan. The sites include the entire shoreline, exclusive of the immediate vicinity of the Inner Harbor and Boat Basin. Areas behind and in front of bulkheads and piers constructed to protect the bluffs from coastal erosion were filled. Most of this fill material was

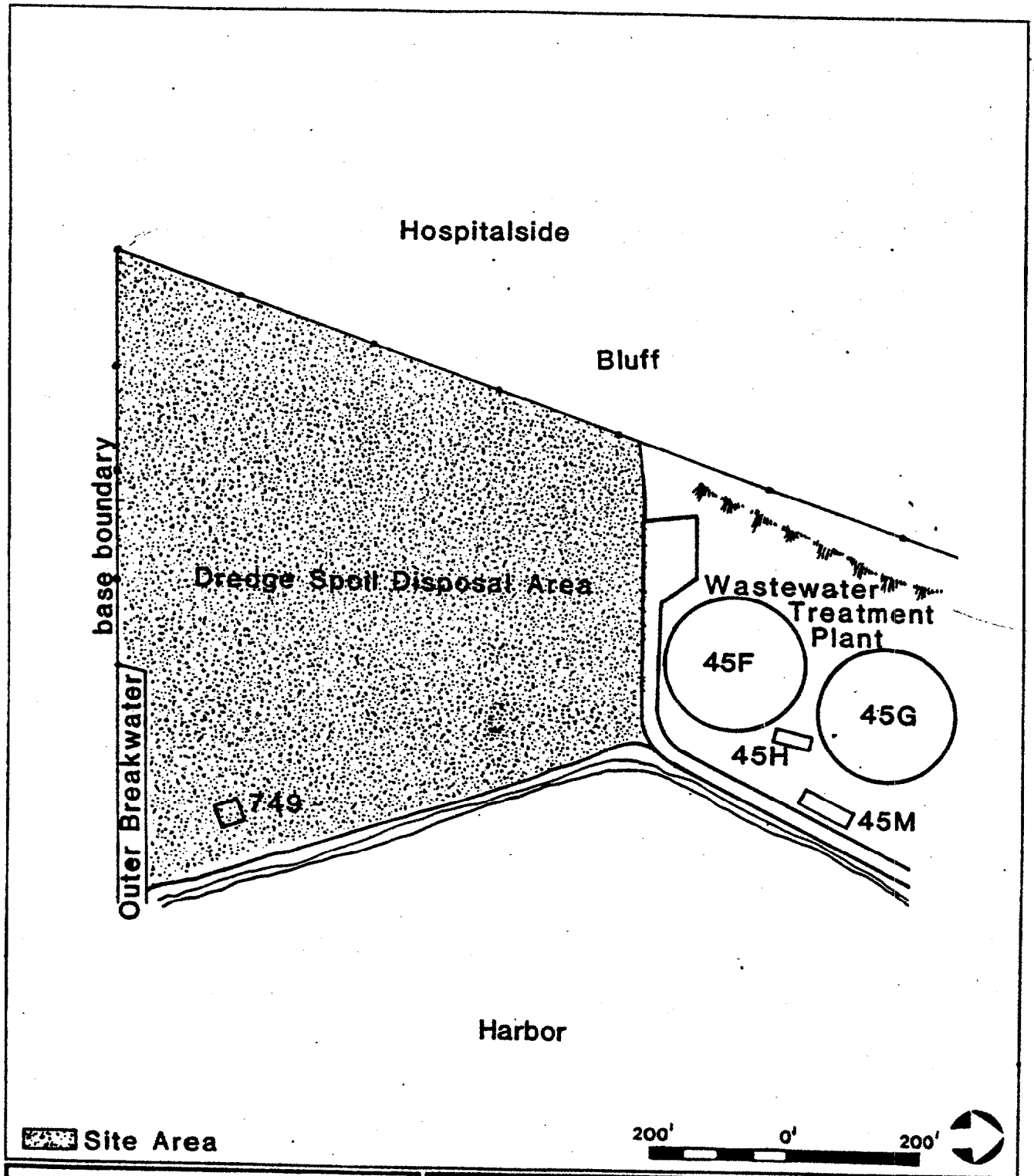


Figure 8-12

Site 12, Harbor Dredge Spoil Area

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Naval Complex
Great Lakes, Illinois

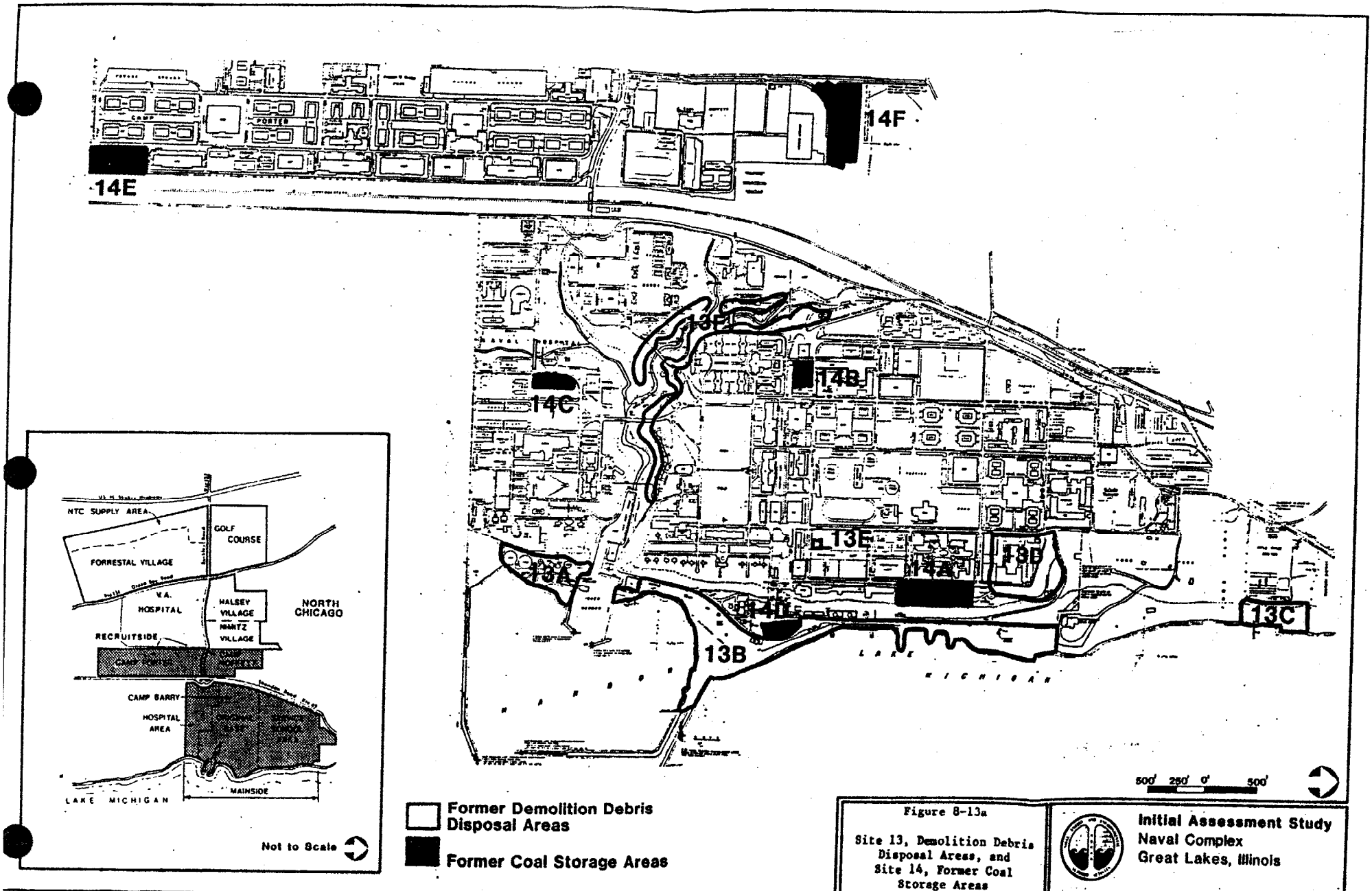

Figure 8-13a

Site 13, Demolition Debris Disposal Areas, and Site 14, Former Coal Storage Areas

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

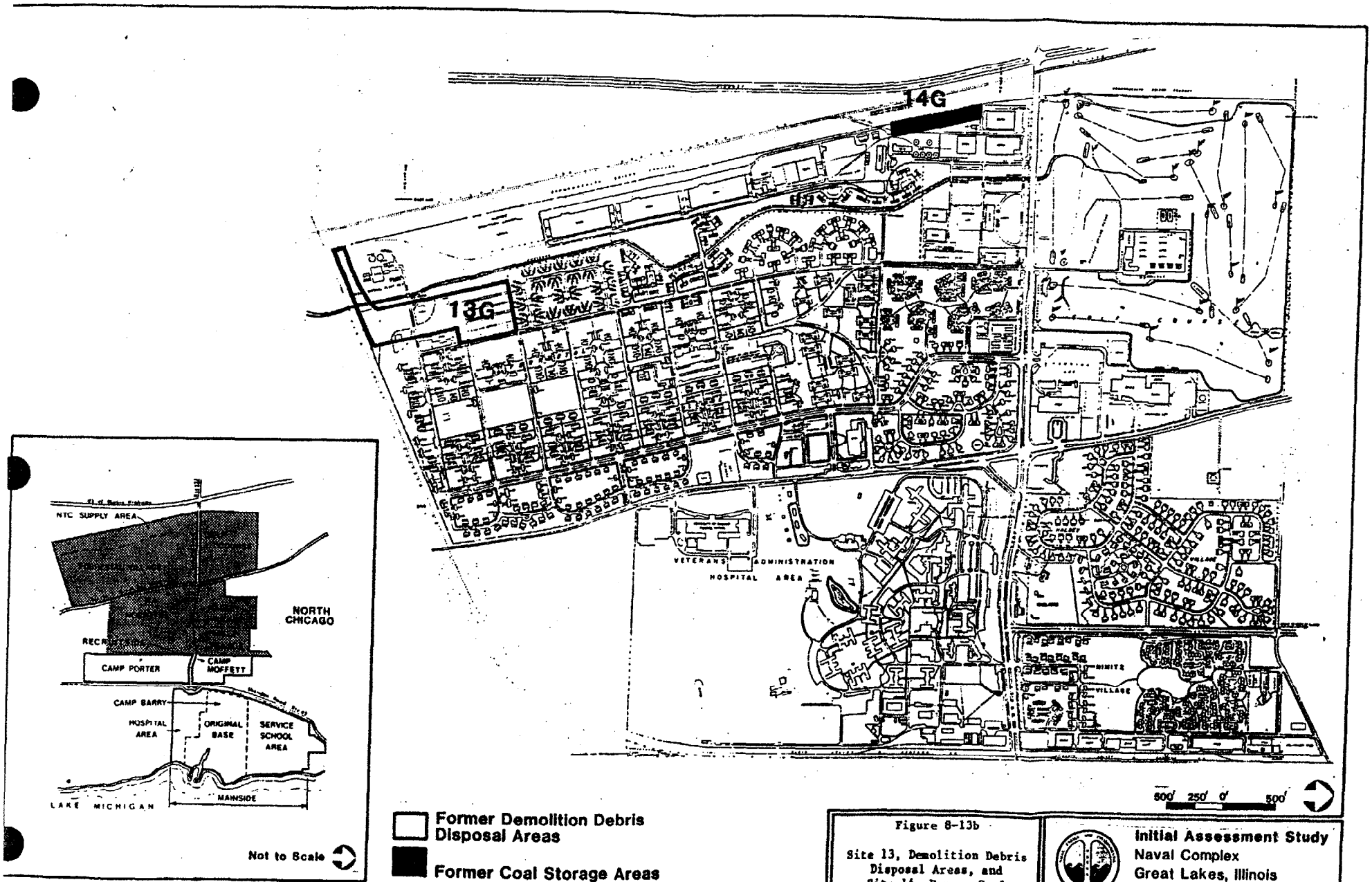

Figure 8-13b

Site 13, Demolition Debris Disposal Areas, and Site 14, Former Coal Storage Areas

Initial Assessment Study
Naval Complex
Great Lakes, Illinois

composed of bricks, concrete, and other building materials large enough to provide protection for the receding shoreline. These materials may be examined in the actual shore zone, and especially in the vicinity of the Skeet Range, Building 743, where large blocks of concrete are visible amidst typical building demolition debris material. On-ground inspection did not reveal any materials which are not inert that may have been disposed of there. Some of the material had been placed by the Naval Construction Batallion Unit 401, some by the Public Works Center, and some by contractors working on the activity. Between 1981 and 1984, Naval Construction Batallion Unit 401 placed fill at the NTC Rifle Range shoreline (Site 13C) to restore the bluff after particularly severe erosion. No active disposal was evidenced during the on-site visit.

Site 13D included the area along the western and southern sides of Zeigemeier Street as it rises from the shoreline onto the Mainside campus. The disposal site is bounded by the bluff to the east, Zeigemeier Street on the north, and Paul Jones Street on the west, and ends north of Cluverius Street. Disposal there ended prior to the development and construction of Building 621, the ET "A-School," in 1969. PWC personnel also noted problems with installing portable building anchor systems in the area east of Building 621, on top of the bluff. The present appearance of the area provides no clue to the existence of the demolition debris and no seepage was observed on the bluff.

Site 13E was a former swimming pool facility located on the north side of Bronson Avenue, opposite Building 122. The facility was out of service due to leakage of the concrete walls and was filled in the period 1984 to 1985 by the Naval Construction Battalion Unit 401. Completion of this project preceded the 1985 on-site visit by the IAS team by several weeks.

Site 13F is along the banks of Pettibone Creek. Based upon examination of topographic maps, archive photographs, and general development maps, the location of the top of these banks has moved up to 100 feet toward the stream bed. This is consistent with the observations of many activity personnel who related that coal ash had been disposed of almost anywhere on the activity where fill was required for grading purposes.

The final demolition debris disposal site (Site 13G) is in the area of the present Auto Hobby Shop (Building 2110). Prior to the construction of the new trailer court area along Great Lakes Drive, Arkansas Road, and Georgia Road, the area was used for demolition debris disposal. Disposal of this inert material proceeded south from Delaware Avenue, around Building 2110, and across Alabama Avenue to the southern activity boundary. The area along the southern activity boundary and south of Sewage Disposal Plant No. 2 was filled along a 50- to 100-foot swath from the vicinity of Building 2262 to the southwest corner of the activity. Some of the evidence supporting this observation includes the difficulty experienced by the PWC personnel in installing tiedown facilities in the trailer court area, the general lay of the land in that area, and the surface appearance of the grounds in the playing fields south of Alabama Avenue. No sign of material other than demolition debris was encountered in these areas. No outcroppings of these materials were found in Skokie Ditch.

8.14 SITE 14, FORMER COAL STORAGE AREAS. Coal was used as the primary source of fuel for space heating and power at NC Great Lakes from its inception until the early 1970's, when coal was phased out in favor of oil at the Mainside power station. Coal was stored at various locations throughout the activity during the time it was used as the primary fuel (Figures 8-13a and 8-13b). These locations are identified in this section because of the potential for leachates developing from coal residues which may remain at these locations.

From 1911 through at least 1930, the Mainside and Hospitalside portions of NC Great Lakes formed the majority of the activity. The only Navy-owned facilities west of Sheridan Road included a water tank and pipeline right-of-way. As shown in Figures 8-13a and 8-13b, Site 14A on the lakefront bluffs (the present location of Buildings 616 and 617), Site 14B along Bronson Avenue (the present location of Building 144 and its parking apron), and Site 14C opposite the Hospitalside steam plant (presently an open area opposite Building 58-H) were the primary locations where coal was stored. A trestle existed at the Mainside power plant on the lakefront. No coal storage was noted on the June 30, 1930, Map of the Station. Coal was moved from these storage piles to the points of use either with trucks or on an activity-operated narrow gauge railway.

Site 14A was noted to have a concrete pad beneath the coal pile. Residues, if any, were most likely removed during construction of the new buildings (616 and 617) in 1954 and 1955. Site 14B residues, if any, are presently covered under an impermeable surface of asphalt paving. Site 14C has been redeveloped several times. There is presently no vegetative stress in this landscaped area.

By 1943, the activity had expanded west of both Sheridan and Green Bay Roads, and with that expansion, the need for additional heating plants also led to the need for additional coal storage piles. The three maps of NC Great Lakes dated June 30, 1943, show that Site 14A was still in use on the Mainside portion of the activity. Site 14B was replaced with a laundry in Building 105 and an office building (Building 95). Site 14C, on Hospitalside, was replaced with a recreation building (Building 82) and athletic fields. Site 14D was a new coal storage pile on the lakefront behind an extension of the harbor seawall. The railway trestle was extended to serve this new storage area. This area is presently the site of the fluidized bed combustion power plant. Heating plants were fitted with indoor storage to eliminate the need for some of these piles.

With the expansion of the activity facilities west of Sheridan Road, coal piles were established at the southeastern corner of Camp Porter (south of Building 800 in Recruitside, Site 14E) and at the northern end of Camp Moffett, north of Building 1517 (Site 14F). These facilities were both located along existing railroad rights-of-way. Site 14E is presently a recreational area with two baseball diamonds. Site 14F is paved with loose ash and possibly some remaining coal residue.

Also by 1943, the area between Green Bay Road and the Public Service Company of Northern Illinois was developed by the Navy. A coal storage pile (Site

14G) was established along the western boundary of the activity, south of Buckley Road and behind Building 3212 (present site of the DRMO warehouse). Site 14G is presently the DRMO open storage area and is unpaved.

The only remaining coal on the activity is located at Site 14D, where some fine-grained high sulfur coal used to fire the fluidized bed combustion unit is still stored. According to NORTHNAVFACENGCOM personnel, a contract is soon to be let to have an off-base contractor remove the coal which remains there.

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APPENDICES

Appendix A

AGENCIES CONTACTED FOR IAS

Naval Energy and Environmental Support Activity, Port Hueneme, CA 93043

Ordnance Environmental Support Office (OESO), Indian Head, MD 20640

Naval Historical Center, Operational Archives, Building 57, Washington Navy Yard, Washington, D.C. 20374

National Archives (Cartographic Branch), Washington, D.C. 20408

Federal Archives and Records, Region 5, Chicago, IL 60629

Naval Facilities Engineering Command Historian, NCBC Port Hueneme, CA 93043

Naval Facilities Engineering Command Historian, NCBC Port Hueneme, CA 93043

Naval Facilities Engineering Command, Northern Field Division, Philadelphia, PA 19112

Naval Sea Systems Command, Crystal City, Alexandria, VA

DOD Explosives Safety Board, Hoffman Building I, Room 856-C, 2461 Eisenhower Avenue, Alexandria, VA 22331

Illinois Department of Conservation, Springfield, Illinois.

Illinois Department of Public Health, Consumer Health Protection, Springfield, IL 62761

Appendix B

ENDANGERED SPECIES

STATE OF ILLINOIS
DEPARTMENT OF CONSERVATION
Administrative Order 1978

ARTICLE CXXXVIII - ILLINOIS LIST OF ENDANGERED AND THREATENED VERTEBRATE SPECIES ISSUED IN ACCORDANCE WITH PROVISIONS OF SECTION 337 OF THE ILLINOIS ENDANGERED SPECIES PROTECTION ACT.

The following list has been adopted by the Ilinois Endangered Species Protection Board as the Official List of Endangered and Threatened Vertebrate Species of Illinois.

To be in compliance with the Federal and State Endangered Species Acts, the following definitions apply:

FEDERALLY ENDANGERED SPECIES — Any species which is in danger of extinction throughout all or a significant portion of its range. (Denoted by two asterisks (**) on abandoned list).

FEDERALLY THREATENED SPECIES — Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. (Denoted by a single asterisk (*) on adopted list).

STATE ENDANGERED SPECIES — Any species which is in danger of extinction as a breeding species in Illinois.

STATE THREATENED SPECIES — Any breeding species which is likely to become a state endangered species within the foreseeable future in Illinois.

Endangered Fishes of Illinois

Bigeye Chub	Hybopsis amblops
Bluebreast Darter	Ethcostoma camurum
Bluehead Shiner	Notropsis sp. (undescribed)
Harlequin Darcer	Etheostoma histrio
Longjaw Cisco**	Coregonus alpenae

Threatened Fishes of Illinois

Cisco	Coregonus artedii
Longnose Sucker	Catostomus catostomus
Alligator Gar	Lepisosteus spatula
Pugnose Shiner	Notropis anogenus
Blacknose Shiner	Notropis heterolepus
Bantam Sunfish	Lepomis symmetricus
Lake Whitefish	Coregonus clupeaformis
Lake Sturgeon	Acipenser fulvescens

Endangered Amphibians and Reptiles of Illinois

Dusky Salamander	Desmognathus fuscus
Silvery Salamander	Ambystome platineum
Spotted Turtle	Clemmys guttata
Slider	Pseudemys floridana x concinna
Illinois Mud Turtle	Kinosternon flavescens
Broad-banded Watersnake	Nerodia fasciata
Eastern Ribbon Snake	Thamnophis sauritus

Threatened Amphibians and Reptiles of Illinois

Illinois Chorus Frog	Pseudacris streckeri
Western Hog-nosed Snake	Heterodon nasicus
Whip Snake	Masticophis flagellum
Great Plains Rat Snake	Elaphe guttata

Endangered Birds of Illinois

Double-crested Cormorant	Phalacrocorax auritus
Snowy Egret	Egretta thula
Great Egret	Casmerodius albus
Little Blue Heron	Florida caerulea
American Bittern	Botaurus lentiginosus
Black-browned Night Heron	Nycticorax nycticorax
Mississippi Kite	Ictinia mississippiensis
Cooper's Hawk	Accipiter cooperii
Red-shouldered Hawk	Buteo lineatus
Swainson's Hawk	Buteo swainsoni
Bald Eagle	Haliaeetus leucocephalus
Osprey	Pandion haliaetus
Marsh Hawk	Circus cyaneus
Peregrine Falcon**	Falco peregrinus
Greater Prairie Chicken	Tympanuchus cupido
Yellow Rail	Coturnicops noveboracensis
Black Rail	Laterallus jamacensis
Purple Gallinule	Porphyrula martinica
Piping Plover	Charadrius melodus
Eskimo Curlew**	Numenius borealis
Upland Sandpiper	Bartramia longicauda
Wilson's Phalarope	Steganopus tricolor
Forster's Tern	Sterna forsteri
Common Tern	Sterna hirundo
Least Tern	Sterna albifrons
Plack Tern	Chlidonias niger
Barn Owl	Tyto alba
Long-eared Owl	Asio otus
Short-eared Owl	Asio flammeus
Brown Creeper	Certhia familiarus
Bachman's Warbler**	Vermivora bachmanii
Yellow-headed Blackbird	Xanthocephalus xanthocephalus
Bachman's Sparrow	Aimophila aestivalis

Threatened Birds of Illinois

Common Gallinule	Gallinula chloropus
Bewick's Wren	Thryomanes bewickii
Veery	Catharus fuscescens
Loggerhead Shrike	Lanius ludovicianus
Swainson's Warbler	Limnothlypis swainsonii
Brewer's Blackbird	Euphagus cyanocephalus
Henslow's Sparrow	Ammodramus henslowii

Endangered Mammals of Illinois

Gray Bat**	Myotis grisescens
Indiana Bat**	Myotis sodalis
Eastern Wood Rat	Neotoma floridana
White-tailed Jackrabbit	Lepus townsendii

Threatened Mammals of Illinois

River Otter	Lutra canadensis
Bobcat	Lynx rufus
Golden Mouse	Ochrotomys nuttalli
Rice Rat	Oryzomys palustris

Source: State of Illinois, Dept. of Conservation

Appendix C

ACRONYMS

AFFF	Aqueous Film Forming Foam
ADCOM	Administrative Command
ADPL	Average Daily Patient Loading
AIMD	Aircraft Intermediate Maintenance Department
BA	Borrow Areas
BE/E	Basic Electricity and Electronics
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CB	Construction Battalion
CNO	Chief of Naval Operations
CO	Commanding Officer
CSRS	Confirmation Study Ranking System
DOD	Department of Defense
DPDO	Defense Property Disposal Office
DRMO	Defense Reutilization and Marketing Office
EFD	Engineering Field Division
EM/IC	Electricians Mate/Interior Communications Technician
EPA	Environmental Protection Agency
ET	Electronics Technician,
FT/OM/IC	Fire Control Technician, Opticalman, and Instrument Control
$HgNO_3$	Mercuric Nitrate
HVAC	Heating, Ventilation, and Air-Conditioning
IAS	Initial Assessment Study
IEPA	Illinois Environmental Protection Agency
ISGS	Illinois State Geological Survey
IT	Instructor Training
MGD	million gallons per day
ML	Madeland
MUSE	Mobile Utilities Support Equipment
NACIP	Naval Assessment and Control of Installation Pollutants
NAVFACENGCOM	Naval Facilities Engineering Command
NAVHOSP	Naval Hospital
NC	Naval Complex (Great Lakes)
NEESA	Naval Energy and Environmental Support Activity
NEPSS	Naval Environmental Protection Support Service
NOAA	National Oceanographic and Atmospheric Administration
NORTHNAVFACENGCOM	Northern Division, Naval Facilities Engineering Command
NPPSO	Naval Publication and Printing Service Office
NRDC	Naval Regional Dental Center
NSSD	North Shore Sanitary District
PCB's	Polychlorinated Biphenyls
PCE	Perchloroethylene
POL's	Petroleum, Oils, and Lubricants
PPM	parts per million
PWC	Public Works Center

RTC	Recruit Training Center
TCE	Trichloroethylene
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
USDA	United States Department of Agriculture
VA	Veterans' Administration

DEPARTMENT OF THE NAVY
NAVAL STATION
2601 E PAUL JONES ST
GREAT LAKES, ILLINOIS 60088-2845

NAVSTAGLAKESINST 11130.1
ENV
29 Sep 03

NAVAL STATION GREAT LAKES INSTRUCTION 11130.1

From: Commanding Officer, Naval Station Great Lakes

Subj: Ground Water Use Restrictions

1. Purpose. To ensure compliance with environmental regulations for activities and personnel located on Naval Station Great Lakes.

2. Scope. This instruction applies to all geographic areas of the Naval Station.

3. Discussion.

a. The use of ground water and surface water runoff for any purpose is strictly prohibited unless prior, written approval is obtained from the Commanding Officer, Naval Station Great Lakes. This includes, but is not limited to the installation of wells for any purpose, use of storm water run off from streams or retention ponds, etc.

b. The only exception to this prohibition is the installation of ground water monitoring wells for the exclusive purpose of sampling ground water and monitoring of ground water/surface water. Approval for this activity must be secured in writing in advance from the Naval Station Great Lakes Environmental Department in coordination with the appropriate regulatory agencies.

4. Action. To initiate the process for installing a ground water well aboard the Naval Station, contact Naval Station Great Lakes Environmental Department, at (847) 688-5999 Or DSN 792-5999.

H P Rand
for K. M. Hobbs

Distribution:
NAVASTAGLAKES 5216.5
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SUBTITLE G: WASTE DISPOSAL
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SUBCHAPTER f: RISK BASED CLEANUP OBJECTIVES

PART 742
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AUTHORITY: Implementing Sections 22.4, 22.12, Title XVI, and Title XVII and authorized by Sections 27 and 58.5 of the Environmental Protection Act [415 ILCS 5/22.4, 22.12, 27, and 58.5 and Title XVI and Title XVII].

SOURCE: Adopted in R97-12(A) at 21 Ill. Reg. 7942, effective July 1, 1997; amended in R97-12(B) at 21 Ill. Reg. 16391, effective December 8, 1997; amended in R97-12(C) at 22 Ill. Reg. 10847, effective June 8, 1998; amended in R00-19(A) at 25 Ill. Reg. 651, effective January 6, 2001; amended in R00-19(B) at 25 Ill. Reg. 10374, effective August 15, 2001; amended in R00-19(C) at 26 Ill. Reg. 2683, effective February 5, 2002; amended in R06-10 at 31 Ill. Reg. 4063, effective February 23, 2007; amended in R11-09 at 37 Ill. Reg. 7506, effective July 15, 2013.

NOTE: Italics indicates statutory language.

SUBPART A: INTRODUCTION

Section 742.100 Intent and Purpose

a) This Part sets forth procedures for evaluating the risk to human health posed by environmental conditions and developing remediation objectives that achieve acceptable risk levels.

b) The purpose of these procedures is to provide for the adequate protection of human health and the environment based on the risks to human health posed by environmental conditions while incorporating site related information.

Section 742.105 Applicability

a) Any person, including a person required to perform an investigation pursuant to the Illinois Environmental Protection Act [415 ILCS 5] (Act), may elect to proceed under this Part to the extent allowed by State or federal law and regulations and the provisions of this Part and subject to the exceptions listed in subsection (h) below. A person proceeding under this Part may do so to the extent such actions are consistent with the requirements of the program under which site remediation is being addressed.

b) This Part is to be used in conjunction with the procedures and requirements applicable to the following programs:

1) Leaking Underground Storage Tanks (35 Ill. Adm. Code 731 and 734);

2) Site Remediation Program (35 Ill. Adm. Code 740); and

3) RCRA Part B Permits and Closure Plans (35 Ill. Adm. Code 724 and 725).

c) The procedures in this Part may not be used if their use would delay response action to address imminent and substantial threats to human health and the environment. This Part may only be used after actions to address such threats have been completed.

d) This Part may be used to develop remediation objectives to protect surface waters, sediments or ecological concerns, when consistent with the regulations of other programs, and as approved by the Agency.

e) A no further remediation determination issued by the Agency prior to July 1, 1997 pursuant to Section 4(y) of the Act or one of the programs listed in subsection (b) of this Section that approves completion of remedial action relative to a release shall remain in effect in accordance with the terms of that determination.

f) Site specific groundwater remediation objectives determined under this Part for contaminants of concern may exceed the groundwater quality standards established pursuant to the rules promulgated under the Illinois Groundwater Protection Act [415 ILCS 55] as long as done in accordance with Sections 742.805 and 742.900(c)(9). (See 415 ILCS 5/58.5(d)(4))

g) Where contaminants of concern include polychlorinated byphenyls (PCBs), a person may need to evaluate the applicability of regulations adopted under the Toxic Substances Control Act (15 USC 2601).

h) This Part may not be used in lieu of the procedures and requirements applicable to landfills under 35 Ill. Adm. Code 807 or 811 through 814.

i) An evaluation of the indoor inhalation exposure route under this Part addresses the potential of contaminants present in soil gas or groundwater to reach human

receptors within buildings. This Part does not address the remediation or mitigation of any contamination within a building from a source other than soil gas or groundwater, such as the building structure itself and products within the building.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.110 Overview of Tiered Approach

a) This Part presents an approach for developing remediation objectives (see Appendix A, Illustrations A and B) that include an option for exclusion of pathways from further consideration, use of area background concentrations as remediation objectives and three tiers for selecting applicable remediation objectives. An understanding of human exposure routes is necessary to properly conduct an evaluation under this approach. In some cases, applicable human exposure routes can be excluded from further consideration prior to any tier evaluation. Selecting which tier or combination of tiers to be used to develop remediation objectives is dependent on the site-specific conditions and remediation goals. Tier 1 evaluations and Tier 2 evaluations are not prerequisites to conducting Tier 3 evaluations.

b) A Tier 1 evaluation compares the concentration of contaminants detected at a site to the corresponding remediation objectives for residential and industrial/commercial properties contained in Appendix B, Tables A, B, C, D, E, G, H and I. To complete a Tier 1 evaluation, the extent and concentrations of the contaminants of concern, the groundwater class, the land use classification, human exposure routes at the site, and, if appropriate, soil pH, must be known. If remediation objectives are developed based on industrial/commercial property use, then institutional controls under Subpart J are required. For the indoor inhalation exposure route, institutional controls under Subpart J are required to use remediation objectives in Appendix B, Table H or Table I.

c) A Tier 2 evaluation uses the risk based equations from the Soil Screening Level (SSL) model, Risk Based Corrective Action (RBCA) model and modified Johnson and Ettinger (J&E) model documents listed in Appendix C, Tables A, C and L, respectively. In addition to the information that is required for a Tier 1 evaluation, site-specific information is used to calculate Tier 2 remediation objectives. As in Tier 1, Tier 2 evaluates residential and industrial/commercial properties only. If remediation objectives are developed based on industrial/commercial property use, then institutional controls under Subpart J are required. For the indoor inhalation exposure route, institutional controls under Subpart J are required to develop remediation objectives pursuant to Appendix C, Table L.

d) A Tier 3 evaluation allows alternative parameters and factors, not available under a Tier 1 or Tier 2 evaluation, to be considered when developing remediation objectives. Remediation objectives developed for conservation and agricultural properties can only be developed under Tier 3.

e) Remediation objectives may be developed using area background concentrations or any of the three tiers if the evaluation is conducted in accordance with applicable requirements in Subparts D through I. When contaminant concentrations do not exceed remediation objectives developed under one of the tiers or area background procedures under Subpart D, further evaluation under any of the other tiers is not required.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.115 Key Elements

To develop remediation objectives under this Part, the following key elements shall be addressed.

a) Exposure Routes

1) This Part identifies the following as potential exposure routes to be addressed:

A) Outdoor inhalation;

B) Indoor inhalation;

C) Soil ingestion;

D) Groundwater ingestion; and

E) Dermal contact with soil.

2) The evaluation of exposure routes under subsections (a)(1)(A), (a)(1)(B), (a)(1)(C) and (a)(1)(D) is required for all sites when developing remediation objectives or excluding exposure pathways. Evaluation of the dermal contact exposure route is required for use of RBCA equations in Appendix C, Table C or use of formal risk assessment under Section 742.915.

3) The groundwater ingestion exposure route is comprised of two components:

A) Migration from soil to groundwater (soil component); and

B) Direct ingestion of groundwater (groundwater component).

4) The outdoor inhalation route is comprised of two components:

A) Migration from soil through soil gas to outdoor air (soil component); and

B) Migration from soil gas to outdoor air (soil gas component).

5) The indoor inhalation exposure route is comprised of two components:

A) Migration from soil gas to indoor air (soil gas component); and

B) Migration from groundwater through soil gas to indoor air (groundwater component).

b) Contaminants of Concern

The contaminants of concern to be remediated depend on the following:

1) The materials and wastes managed at the site;

2) The extent of the no further remediation determination being requested from the Agency pursuant to a specific program; and

3) The requirements applicable to the specific program, as listed at Section 742.105(b) under which the remediation is being performed.

c) Land Use

The present and post-remediation uses of the site where exposures may occur shall be evaluated. The land use of a site, or portion thereof, shall be classified as one of the following:

1) Residential property;

2) Conservation property;

3) Agricultural property; or

4) Industrial/commercial property.

d) Environmental Media of Concern

This Part provides procedures for developing remediation objectives for the following environmental media:

1) Soil;

2) Soil gas;

3) Groundwater.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.120 Site Characterization

Characterization of the extent and concentrations of contamination at a site shall be performed before beginning development of remediation objectives. The actual steps and methods taken to characterize a site are determined by the requirements applicable to the specific program under which site remediation is being addressed.

SUBPART B: GENERAL

Section 742.200 Definitions

Except as stated in this Section, or unless a different meaning of a word or term is clear from the context, the definition of words or terms in this Part shall be the same as that applied to the same words or terms in the Act.

"Act" means the Illinois Environmental Protection Act [415 ILCS 5].

"ADL" means Acceptable Detection Limit, which is the detectable concentration of a substance that is equal to the lowest appropriate Practical Quantitation Limit (PQL) as defined in this Section.

"Agency" means the Illinois Environmental Protection Agency.

"Agricultural Property" means any real property for which its present or post-remediation use is for growing agricultural crops for food or feed either as harvested crops, cover crops or as pasture. This definition includes, but is not limited to, properties used for confinement or grazing of livestock or poultry and for silviculture operations. Excluded from this definition are farm residences, farm outbuildings and agrichemical facilities.

"Aquifer" means *saturated (with groundwater) soils and geologic materials which are sufficiently permeable to readily yield economically useful quantities of water to wells, springs, or streams under ordinary hydraulic gradients.* (Illinois Groundwater Protection Act [415 ILCS 55/3(a)])

"Area Background" means *concentrations of regulated substances that are consistently present in the environment in the vicinity of a site that are the result of natural conditions or human activities, and not the result solely of releases at the site.* [415 ILCS 5/58.2]

"ASTM" means the American Society for Testing and Materials.

"Board" means the Illinois Pollution Control Board.

"Building" means a man-made structure with an enclosing roof and enclosing walls (except for windows and doors) that is fit for any human occupancy for at least six consecutive months.

"Building Control Technology" means any technology or barrier that affects air flow or air pressure within a building for purposes of reducing or preventing contaminant migration to the indoor air.

"Cancer Risk" means a unitless probability of an individual developing cancer from a defined exposure rate and frequency.

"Cap" means a barrier designed to prevent the infiltration of precipitation or other surface water, or impede the ingestion or inhalation of contaminants.

"Capillary Fringe" means the zone above the water table in which water is held by surface tension. Water in the capillary fringe is under a pressure less than atmospheric.

"Carcinogen" means *a contaminant that is classified as a category A1 or A2 carcinogen by the American Conference of Governmental Industrial Hygienists; a category 1 or 2A/2B carcinogen by the World Health Organization's International Agency for Research on Cancer; a "human carcinogen" or "anticipated human carcinogen" by the United States Department of Health and Human Service National Toxicological Program; or a category A or B1/B2 carcinogen* or as "carcinogenic to humans" or "likely to be carcinogenic to humans" *by the United States Environmental Protection Agency in the integrated risk information system or a final rule issued in a Federal Register notice by the USEPA.* [415 ILCS 5/58.2]

"Class I Groundwater" means groundwater that meets the Class I: Potable Resource Groundwater criteria set forth in 35 Ill. Adm. Code 620.

"Class II Groundwater" means groundwater that meets the Class II: General Resource Groundwater criteria set forth in 35 Ill. Adm. Code 620.

"Conservation Property" means any real property for which present or post-remediation use is primarily for wildlife habitat.

"Construction Worker" means a person engaged on a temporary basis to perform work involving invasive construction activities including, but not limited to, personnel performing demolition, earth-moving, building, and routine and emergency utility installation or repair activities.

"Contaminant of Concern" or "Regulated Substance of Concern" means *any contaminant that is expected to be present at the site based upon past and current land uses and associated releases that are known to the* person conducting a remediation *based upon reasonable inquiry.* [415 ILCS 5/58.2]

"County Highway" means county highway as defined in the Illinois Highway Code [605 ILCS 5].

"District Road" means district road as defined in the Illinois Highway Code [605 ILCS 5].

"Engineered Barrier" means a barrier designed or verified using engineering practices that limits exposure to or controls migration of the contaminants of concern.

"Environmental Land Use Control" means an instrument that meets the requirements of this Part and is placed in the chain of title to real property that limits or places requirements upon the use of the property for the purpose of protecting human health or the environment, is binding upon the property owner, heirs, successors, assigns, and lessees, and runs in perpetuity or until the Agency approves, in writing, removal of the limitation or requirement from the chain of title.

"Exposure Route" means the transport mechanism by which a contaminant of concern reaches a receptor.

"Federally Owned Property" means real property owned in fee by the United States of America on which institutional controls are sought to be placed in accordance with this Subpart.

"Federal Landholding Entity" means that federal department, agency, or instrumentality with the authority to occupy and control the day-to-day use, operation and management of Federally Owned Property.

"Free Product" means a contaminant that is present as a non-aqueous phase liquid for chemicals whose melting point is less than 30°C (e.g., liquid not dissolved in water).

"GIS" means Geographic Information System.

"GPS" means Global Positioning System.

"Groundwater" means underground water which occurs within the saturated zone and geologic materials where the fluid pressure in the pore space is equal to or greater than atmospheric pressure. [415 ILCS 5/3.64]

"Groundwater Quality Standards" means the standards for groundwater as set forth in 35 Ill. Adm. Code 620.

"Hazard Quotient" means the ratio of a single substance exposure level during a specified time period to a reference dose for that substance derived from a similar exposure period.

"Highway" *means any public way for vehicular travel which has been laid out in pursuance of any law of this State, or of the Territory of Illinois, or which has been established by dedication, or used by the public as a highway for 15 years, or which has been or may be laid out and connect a subdivision or platted land with a public highway and which has been dedicated for the use of the owners of the land included in the subdivision or platted land where there has been an acceptance and use under such dedication by such owners, and which has not been vacated in pursuance of law. The term "highway" includes rights of way, bridges, drainage structures, signs, guard rails, protective structures and all other structures and appurtenances necessary or convenient for vehicular traffic. A highway in a rural area may be called a "road", while a highway in a municipal area may be called a "street".* (Illinois Highway Code [605 ILCS 5/2-202])

"Highway Authority" means *the Department* of Transportation *with respect to a State highway;* the Illinois State Toll Highway with respect to a toll highway; *the County Board with respect to a county highway or a county unit district road if a discretionary function is involved and the County Superintendent of Highways if a ministerial function is involved; the Highway Commissioner with respect to a township or district road not in a county unit road district; or the corporate authorities of a municipality with respect to a municipal street.* (Illinois Highway Code [605 ILCS 5/2-213])

"Human Exposure Pathway" means a physical condition which may allow for a risk to human health based on the presence of all of the following: contaminants of concern; an exposure route; and a receptor activity at the point of exposure that could result in contaminant of concern intake.

"Industrial/Commercial Property" means any real property that does not meet the definition of residential property, conservation property or agricultural property.

"Infiltration" means the amount of water entering into the ground as a result of precipitation.

"Institutional Control" means a legal mechanism for imposing a restriction on land use, as described in Subpart J.

"Intrusive activities" means activities that would affect potential flow of contaminants into a building (e.g., breaching the integrity of a foundation due to repairs or installation of utilities).

"Land Use Control Memoranda of Agreement" mean agreements entered into between one or more agencies of the United States and the Illinois Environmental Protection Agency that limit or place requirements upon the use of Federally Owned Property for the purpose of protecting human health or the environment.

"Man-Made Pathways" means *constructed* physical conditions *that may allow for the transport of regulated substances including, but not limited to, sewers, utility lines, utility* or elevator *vaults, building foundations, basements, crawl spaces, drainage ditches, previously excavated and filled areas* or sumps. [415 ILCS 5/58.2]

"Natural Pathways" means *natural* physical conditions that may allow *for the transport of regulated substances including, but not limited to, soil, groundwater, sand seams and lenses, and gravel seams and lenses.* [415 ILCS 5/58.2]

"Person" means an *individual, trust, firm, joint stock company, joint venture, consortium, commercial entity, corporation (including a government corporation), partnership, association, state, municipality, commission, political subdivision of a state, or any interstate body including the United States government and each department, agency, and instrumentality of the United States.* [415 ILCS 5/58.2]

"Point of Human Exposure" means the points at which human exposure to a contaminant of concern may reasonably be expected to occur. The point of human exposure is at the source, unless an institutional control limiting human exposure for the applicable exposure route has been or will be in place, in which case the point of human exposure will be the boundary of the institutional control. Point of human exposure may be at a different location than the point of compliance.

"Populated Area" means:

> an area within the boundaries of a municipality that has a population of 10,000 or greater based on the year 2000 or most recent census; or
>
> an area less than three miles from the boundary of a municipality that has a population of 10,000 or greater based on the year 2000 or most recent census.

"Potable" means *generally fit for human consumption in accordance with accepted water supply principles and practices.* (Illinois Groundwater Protection Act [415 ILCS 55/3(h)])

"PQL" means practical quantitation limit or estimated quantitation limit, which is the lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions in accordance with "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", EPA Publication No. SW-846, incorporated by reference in Section 742.210. When applied to filtered water samples, PQL includes the method detection limit or estimated detection limit in accordance with the applicable method revision in: "Methods for the Determination of Organic Compounds in Drinking Water", Supplement II", EPA Publication No. EPA/600/4-88/039; "Methods for the Determination of Organic Compounds in Drinking Water, Supplement III", EPA Publication No. EPA/600/R-95/131, all of which are incorporated by reference in Section 742.210.

"Q_{soil}" means the volumetric flow rate of soil gas from the subsurface into the enclosed building space.

"RBCA" means Risk Based Corrective Action as defined in ASTM E-1739-95, as incorporated by reference in Section 742.210.

"RCRA" means the Resource Conservation and Recovery Act of 1976 (42 USC 6921).

"Reference Concentration" or "RfC" means an estimate of a daily exposure, in units of milligrams of chemical per cubic meter of air (mg/m^3), to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a portion of a lifetime (up to approximately seven years, subchronic) or for a lifetime (chronic).

"Reference Dose" or "RfD" means an estimate of a daily exposure, in units of milligrams of chemical per kilogram of body weight per day (mg/kg/d), to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a portion of a lifetime (up to approximately seven years, subchronic) or for a lifetime (chronic).

"Regulated Substance" means *any hazardous substance as defined under Section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (P.L. 96-510) and petroleum products including crude oil or any fraction thereof, natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).* [415 ILCS 5/58.2]

"Rendered inoperable" means having become unable to operate effectively, including, but not limited to, being shut down as part of routine maintenance or due to a malfunction, power failure, or vandalism.

"Residential Property" *means any real property that is used for habitation by individuals, or* where children have the opportunity for exposure to contaminants through ingestion or inhalation (indoor or outdoor) at educational facilities, health care facilities, child care facilities or recreational areas. [415 ILCS 5/58.2]

"Right of Way" means *the land, or interest therein, acquired for or devoted to a highway.* (Illinois Highway Code [605 ILCS 5/2-217])

"Saturated Zone" means a subsurface zone in which all the interstices or voids are filled with water under pressure greater than that of the atmosphere.

"Similar-Acting Chemicals" are chemical substances that have toxic or harmful effect on the same specific organ or organ system (see Appendix A.Tables E and F for a list of similar-acting chemicals with noncarcinogenic and carcinogenic effects).

"Site" means *any single location, place, tract of land or parcel of property, or portion thereof, including contiguous property separated by a public right-of-way.* [415 ILCS 5/58.2]

"Slurry Wall" means a man-made barrier made of geologic material which is constructed to prevent or impede the movement of contamination into a certain area.

"Soil Gas" means the air existing in void spaces in the soil between the groundwater table and the ground surface.

"Soil Saturation Limit" or "C_{sat}" means the contaminant concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals that are liquid at ambient soil temperatures) do not apply, and alternative modeling approaches are required.

"Soil Vapor Saturation Limit" or "C_v^{sat}" means the maximum vapor concentration that can exist in the soil pore air at a given temperature and pressure.

"Solubility" means a chemical specific maximum amount of solute that can dissolve in a specific amount of solvent (groundwater) at a specific temperature.

"SPLP" means Synthetic Precipitation Leaching Procedure (Method 1312) as published in "Test Methods for Evaluating Solid Waste, Physical/Chemical

Methods", USEPA Publication No. SW-846, as incorporated by reference in Section 742.210.

"SSL" means Soil Screening Levels as defined in USEPA's Soil Screening Guidance: User's Guide and Technical Background Document, as incorporated by reference in Section 742.210.

"State Highway" means State highway as defined in the Illinois Highway Code [605 ILCS 5].

"Stratigraphic Unit" means a site-specific geologic unit of native deposited material and/or bedrock of varying thickness (e.g., sand, gravel, silt, clay, bedrock, etc.). A change in stratigraphic unit is recognized by a clearly distinct contrast in geologic material or a change in physical features within a zone of gradation. For the purposes of this Part, a change in stratigraphic unit is identified by one or a combination of differences in physical features such as texture, cementation, fabric, composition, density, and/or permeability of the native material and/or bedrock.

"Street" means street as defined in the Illinois Highway Code [605 ILCS 5].

"TCLP" means Toxicity Characteristic Leaching Procedure (Method 1311) as published in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", USEPA Publication No. SW-846, as incorporated by reference in Section 742.210.

"Toll Highway" means toll highway as defined in the Illinois Highway Code [605 ILCS 5].

"Total Petroleum Hydrocarbon" or "TPH" means the additive total of all petroleum hydrocarbons found in an analytical sample.

"Township Road" means township road as defined in the Illinois Highway Code [605 ILCS 5].

"Unconfined Aquifer" means an aquifer whose upper surface is a water table free to fluctuate under atmospheric pressure.

"Volatile Chemicals" means chemicals with a Dimensionless Henry's Law Constant of greater than 1.9×10^{-2} or a vapor pressure greater than 0.1 Torr (mmHg) at 25°C. For purposes of the indoor inhalation exposure route, elemental mercury is included in this definition.

"Water Table" means the top water surface of an unconfined aquifer at atmospheric pressure.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.205 Severability

If any provision of this Part or its application to any person or under any circumstances is adjudged invalid, such adjudication shall not affect the validity of this Part as a whole or any portion not adjudged invalid.

Section 742.210 Incorporations by Reference

a) The Board incorporates the following material by reference:

Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs), U.S. Environmental Protection Agency, 1600 Clifton Road, Mailstop F32, Atlanta, Georgia 30333, (770) 488-3357 (November 2007).

ASTM International. 100 Barr Harbor Drive, West Conshohocken PA 19428-2959, (610) 832-9585.

ASTM D 2974-00, Standard Test Methods for Moisture, Ash and Organic Matter of Peat and Other Organic Soils, approved August 10, 2000.

ASTM D 2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), approved February 10, 2000.

ASTM D 1556-00, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method, approved March 10, 2000.

ASTM D 2167-94, Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method, approved March 15, 1994.

ASTM D 2922-01, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth), approved June 10, 2001.

ASTM D 2937-00e1, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method, approved June 10, 2000.

ASTM D 854-02, Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer, approved July 10, 2002.

ASTM D 2216-98, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass, approved February 10, 1998.

ASTM D 4959-00, Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating, approved March 10, 2000.

ASTM D 4643-00, Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method, approved February 10, 2000.

ASTM D 5084-03, Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, approved November 1, 2003.

ASTM D 422-63 (2002), Standard Test Method for Particle-Size Analysis of Soils, approved November 10, 2002.

ASTM D 1140-00, Standard Test Methods for Amount of Material in Soils Finer than the No. 200 (75 μm) Sieve, approved June 10, 2000.

ASTM D 3017-01, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth), approved June 10, 2001.

ASTM D 4525-90 (2001), Standard Test Method for Permeability of Rocks by Flowing Air, approved May 25, 1990.

ASTM D 2487-00, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System), approved March 10, 2000.

ASTM D 1945-03, Standard Test Method for Analysis of Natural Gas by Gas Chromatography, approved May 10, 2003.

ASTM D 1946-90, Standard Practice for Analysis of Reformed Gas by Gas Chromatography, approved June 1, 2006.

ASTM E 1527-00, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, approved May 10, 2000. Vol. 11.04.

ASTM E 1739-95 (2002), Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, approved September 10, 1995.

ASTM E 2121-09, Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings, approved November 1, 2009.

ASTM E 2600-10, Standard Practice for Assessment for Vapor Intrusion into Structures on Property Involved in Real Estate Transactions, approved June 2010.

API. American Petroleum Institute, 1220 L Street, NW, Washington DC 20005-4070 (202) 682-8000.

BIOVAPOR-A 1-D Vapor Intrusion Model with Oxygen-Limited Aerobic Biodegradation, Version 2.0 (January 2010).

Barnes, Donald G. and Dourson, Michael. (1988). Reference Dose (RfD): Description and Use in Health Risk Assessments. Regulatory Toxicology and Pharmacology. 8, 471-486.

EPRI. Electric Power Research Institute. 3420 Hillview Avenue, Palo Alto, California 94304. (650) 855-2121.

Polycyclic Aromatic Hydrocarbons (PAHs) in Surface Soil in Illinois: Background PAHs, EPRI, Palo Alto CA, We Energies, Milwaukee WI and IEPA, Springfield IL: 2004. 1011376.

Reference Handbook for Site-Specific Assessment of Subsurface Vapor Intrusion to Indoor Air, Electric Power Research Institute (EPRI), Inc., Program No. 1008492 (March 2005).

GPO. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20401, (202) 783-3238.

USEPA Guidelines for Carcinogenic Risk Assessment, 51 Fed. Reg. 33992-34003 (September 24, 1986).

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", USEPA Publication number SW-846 (Third Edition, Final Update IIIA, April 1998), as amended by Updates I, IIA, III, and IIIA (Document No. 955-001-00000-1).

"Methods for the Determination of Organic Compounds in Drinking Water", EPA Publication No. EPA/600/4-88/039 (December 1988 (Revised July 1991)).

"Methods for the Determination of Organic Compounds in Drinking Water, Supplement I", EPA Publication No. EPA/600/4-90/020 (July 1990).

"Methods for the Determination of Organic Compounds in Drinking Water, Supplement II", EPA Publication No. EPA/600/R-92/129 (August 1992).

"Methods for the Determination of Organic Compounds in Drinking Water, Supplement III", EPA Publication No. EPA/600/R-95/131 (August 1995).

"Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9, QAOO Update," EPA/600/R-96/084 (July 2000). Available at www.epa.gov/quality/qs-docs/g9-final.pdf.

"Assessment of Vapor Intrusion in Homes Near the Raymark Superfund Site Using Basement and Sub-Slab Air Samples", EPA Publication No. EPA/600/R-05/147 (March 2006).

"Model Standards and Techniques for Control of Radon in New Residential Buildings" EPA Publication No. EPA/402/R-94/009 (March 1994).

"Radon Reduction Techniques for Existing Detached Houses: Technical Guidance (Third Edition) for Active Soil Depressurization Systems", EPA Publication No. EPA/625/R-93/011 (October 1993).

Illinois Environmental Protection Agency, 1021 N. Grand Ave East, Springfield IL 62701, (217) 785-0830.

"A Summary of Selected Background Conditions for Inorganics in Soil", Publication No. IEPA/ENV/94-161 (August 1994).

IRIS. Integrated Risk Information System, National Center for Environmental Assessment, U.S. Environmental Protection Agency, 26 West Martin Luther King Drive, MS-190, Cincinnati, OH 45268, (513) 569-7254.

"Reference Dose (RfD): Description and Use in Health Risk Assessments", Background Document 1A (March 15, 1993).

"EPA Approach for Assessing the Risks Associated with Chronic Exposures to Carcinogens", Background Document 2 (January 17, 1992).

Johnson, Paul C. (2005). Identification of Application Specific Critical Inputs for the 1991 Johnson and Ettinger Vapor Intrusion Algorithm. Ground Water Monitoring and Remediation. 25(1), 63-78.

Murray, Donald M. and Burmaster, David E. (1995). Residential Air Exchange Rates in the United States: Empirical and Estimated Parametric Distributions by Season and Climatic Region. Risk Analysis. 15(4), 459-465.

Nelson, D.W., and L.E. Sommers (1982). Total carbon, organic carbon, and organic matter. In: A.L. Page (ed.), Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties. 2nd Edition, pp. 539-579, American Society of Agronomy. Madison, WI.

NTIS. National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4600.

"Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites," USEPA Office of Emergency and Remedial Response, OSWER 9285.6-10 (December 2002), PB 2003-104982.

"Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils", OSWER Draft Guidance. EPA Publication No. EPA/530D-02/004 (November 2002).

"Exposures Factors Handbook, Vol. I: General Factors", EPA Publication No. EPA/600/P-95/002Fa (August 1997).

"Exposures Factors Handbook, Vol. II: Food Ingestion Factors", EPA Publication No. EPA/600/P-95/002Fb (August 1997).

"Exposures Factors Handbook, Vol. III: Activity Factors", EPA Publication No. EPA/600/P-95/002Fc (August 1997).

"Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors", OSWER Directive 9285.6-03 (March 1991).

"Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites", EPA Publication No. EPA/600/8-85/002 (February 1985), PB 85-192219.

"Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final", EPA Publication No. EPA/540/R/99/005 (July 2004).

"Risk Assessment Guidance for Superfund, Vol. 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final", EPA Publication No. 540-R-070-002 (January 2009).

"Soil Screening Guidance: Technical Background Document", EPA Publication No. EPA/540/R-95/128, PB 96-963502 (May 1996).

"Soil Screening Guidance: User's Guide", EPA Publication No. EPA/540/R-96/018, PB 96-963505 (April 1996).

"Superfund Exposure Assessment Manual", EPA Publication No. EPA/540/1-88/001 (April 1988).

"Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites", OSWER Directive 9355.4-24 (December 2002).

"User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings", EPA Publication No. EPA/68/W-02/33 (February 2004).

Polynuclear Aromatic Hydrocarbon Background Study, City of Chicago, Illinois, Tetra Tech Em Inc., 200 E. Randolph Drive, Suite 4700, Chicago IL 60601, February 24, 2003.

RCRA Facility Investigation Guidance, Interim Final, developed by USEPA (EPA 530/SW-89-031), 4 volumes (May 1989).

United States Environmental Protection Agency, Office of Environmental Information (2000). "Guidance for Data Quality Assessment, Practical Methods for Data Analysis," EPA QA/G-9, QAOO update. EPA Publication No. EPA/600/R-96-084. (Available at www.epa.gov/oswer/riskassessment/pdf/ucl.pdf).

United States Environmental Protection Agency, Office of Solid Waste and Emergency Response (2003). "Human Health Toxicity Values in Superfund Risk Assessments," OSWER Directive 9285.7-53. (Available at http://www.epa.gov/oswer/riskassessment/pdf/hhmemo.pdf)

United States Environmental Protection Agency, Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air, Second Edition, EPA Publication No. EPA/625/R-96/010b, January 1999, available at http://www.epa.gov/ttnamti1/files/ambient/airtox/tocomp99.pdf.

United States Environmental Protection Agency, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 through Revision IVB (February 2007), available at http://www.epa.gov/sw-846/main.htm.

United States Environmental Protection Agency, CFR Promulgated Test Methods, Methods 3C and 16, Technology Transfer Network, Emission Measurement Center (2007), available at http://www.epa.gov/ttn/emc/promgate.html.

United States Environmental Protection Agency. "Guidelines for Carcinogen Risk Assessment (2005)". U. S. Environmental Protection Agency, Washington, DC, EPA Publication No. EPA/630/P-03/001F, 2005. (Available at http://cfpub.epa.gov/ncea/raf/recordisplay.cfm?deid=116283.)

"Vapor Intrusion Pathway: A Practical Guide", Technical and Regulatory Guidance. Interstate Technology and Regulatory Council (January 2007).

b) CFR (Code of Federal Regulations). Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (202)783-3238:

40 CFR 761 (1998).

c) This Section incorporates no later editions or amendments.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.215 Determination of Soil Attenuation Capacity

a) The concentrations of organic contaminants of concern remaining in the soil shall not exceed the attenuation capacity of the soil, as determined under subsection (b) of this Section.

b) The soil attenuation capacity is not exceeded if:

1) The sum of the organic contaminant residual concentrations analyzed for the purposes of the remediation program for which the analysis is performed, at each discrete sampling point, is less than the natural organic carbon fraction of the soil. If the information relative to the concentration of other organic contaminants is available, such information shall be included in the sum. The natural organic carbon fraction (f_{oc}) shall be either:

A) A default value of 6000 mg/kg for soils within the top meter and 2000 mg/kg for soils below one meter of the surface; or

B) A site-specific value as measured by the analytical method referenced in Appendix C, Table F, multiplied by 0.58 to estimate the fraction of organic carbon, as stated in, Nelson and Sommers (1982), as incorporated by reference in Section 742.210;

2) The total petroleum hydrocarbon concentration is less than the natural organic carbon fraction of the soil as demonstrated using a method approved by the Agency. The method selected shall be appropriate for the contaminants of concern to be addressed; or

3) Another method, approved by the Agency, shows that the soil attenuation capacity is not exceeded.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.220 Determination of Soil Saturation Limit

a) For any organic contaminant that has a melting point below 30°C, the remediation objective for the outdoor inhalation exposure route developed under Tier 2 shall not exceed the soil saturation limit, as determined under subsection (c).

b) For any organic contaminant that has a melting point below 30°C, the remediation objective under Tier 2 for the soil component of the groundwater ingestion exposure route shall not exceed the soil saturation limit, as determined under subsection (c).

c) The soil saturation limit shall be:

1) The value listed in Appendix A, Table A for that specific contaminant;

2) A value derived from Equation S29 in Appendix C, Table A; or

3) A value derived from another method approved by the Agency.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.222 Determination of Soil Vapor Saturation Limit

a) For any volatile chemical, the soil gas remediation objective for the indoor and outdoor inhalation exposure routes developed under Tier 2 shall not exceed the soil vapor saturation limit, as determined under subsection (b).

b) The soil vapor saturation limit shall be:

1) The value listed in Appendix A, Table K for that specific contaminant;

2) A value derived from Equation J&E5 in Appendix C, Table L; or

3) A value derived from another method approved by the Agency.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.225 Demonstration of Compliance with Soil and Groundwater Remediation Objectives

Compliance with soil and groundwater remediation objectives is achieved if each sample result does not exceed that respective remediation objective unless a person elects to proceed under subsections (c), (d) and (e).

a) Compliance with groundwater remediation objectives developed under Subparts D through F and H through I shall be demonstrated by comparing the contaminant concentrations of discrete samples at each sample point to the applicable groundwater remediation objective. Sample points shall be determined by the program under which remediation is performed.

b) Unless the person elects to composite samples or average sampling results as provided in subsections (c) and (d), compliance with soil remediation objectives developed under Subparts D through G and I shall be demonstrated by comparing the contaminant concentrations of discrete samples to the applicable soil remediation objective.

1) Except as provided in subsections (c) and (d), compositing of samples is not allowed.

2) Except as provided in subsections (c) and (d), averaging of sample results is not allowed.

3) Notwithstanding subsections (c) and (d), compositing of samples and averaging of sample results is not allowed for the construction worker population.

4) The number of sampling points required to demonstrate compliance is determined by the requirements applicable to the program under which remediation is performed.

c) If a person chooses to composite soil samples or average soil sample results to demonstrate compliance relative to the soil component of the groundwater ingestion exposure route, the following requirements apply:

1) A minimum of two sampling locations for every 0.5 acre of contaminated area is required, with discrete samples at each sample location obtained at every two feet of depth, beginning at six inches below the ground surface for surface contamination and at the upper limit of contamination for subsurface contamination and continuing through the zone of contamination. Alternatively, a sampling method may be approved by the Agency based on an appropriately designed site-specific evaluation. Samples obtained at or below the water table shall not be used in compositing or averaging.

2) For contaminants of concern other than volatile chemicals:

A) Discrete samples from the same boring may be composited; or

B) Discrete sample results from the same boring may be averaged.

3) For volatile chemicals:

A) Compositing of samples is not allowed.

B) Discrete sample results from the same boring may be averaged.

4) Composite samples may not be averaged. An arithmetic average may be calculated for discrete samples collected at every two feet of depth through the zone of contamination as specified in subsection (c)(1).

d) If a person chooses to composite soil samples or average soil sample results to demonstrate compliance relative to the outdoor inhalation exposure route or ingestion exposure route, the following requirements apply:

1) A person shall submit a sampling plan for Agency approval, based upon a site-specific evaluation;

2) For volatile chemicals, compositing of samples is not allowed;

3) All samples shall be collected within the contaminated area;

4) Composite samples may not be averaged. Procedures specified in "Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites", USEPA Office of Emergency and Remedial Response, OSWER 9285.6-10 (December 2002), as incorporated by reference in Section 742.210, or an alternative procedure approved by the Agency, shall be used to determine sample averages.

e) When averaging under this Section, if no more than 15% of sample results are reported as "non-detect", "no contamination", "below detection limits", or similar terms, such results shall be included in the averaging calculations as one-half the reported analytical detection limit for the contaminant. However, when performing a test for normal or lognormal distribution for the purpose of calculating a 95% Upper Confidence Limit of the mean for a contaminant, a person may substitute for each non-detect value a randomly generated value between, but not including, zero and the reported analytical detection limit. If more than 15% of sample results are "non-detect", procedures specified in "Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9, QA00 Update", EPA/600/R-96/084 (July 2000), as incorporated by reference in Section 742.210, or an alternative procedure approved by the Agency shall be used to address the non-detect values, or another statistically valid procedure approved by the Agency may be used to determine an average.

f) All soil samples collected after August 15, 2001 shall be reported on a dry weight basis for the purpose of demonstrating compliance, with the exception of the TCLP and SPLP and the property pH.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.227 Demonstration of Compliance with Soil Gas Remediation Objectives for the Outdoor and Indoor Inhalation Exposure Routes

a) For purposes of the outdoor inhalation exposure route and the indoor inhalation exposure route, compliance with soil gas remediation objectives developed under any tier shall be demonstrated in accordance with this Section by comparing the contaminant concentrations of discrete samples at each sample point to the applicable soil gas remediation objective.

b) This Section applies to exterior soil gas samples for the outdoor inhalation exposure route, near-slab soil gas samples collected outside of an existing building for the indoor inhalation exposure route, and exterior soil gas samples collected at the footprint of a potential building for the indoor inhalation exposure route. Proposals to use sub-slab soil gas data for the indoor inhalation exposure route shall follow Section 742.935(c).

c) Sample points shall be determined by the program under which remediation is performed.

d) When collecting soil gas samples:

1) Use rigid-wall tubing made of nylon or Teflon® or other material approved by the Agency;

2) Use gas-tight, inert containers to hold the sample. For light sensitive or halogenated volatile chemicals, these containers shall be opaque or dark-colored;

3) Purge three volumes before obtaining each discrete soil gas sample;

4) Use a helium tracer or other leak apparatus detection system approved by the Agency; and

5) Limit the flow rate to 200 ml/min.

e) Soil gas samples shall be analyzed using a National Environmental Laboratory Accreditation Program (NELAP) certified laboratory.

f) Soil gas remediation objectives shall be compared to concentrations of soil gas collected at a depth at least 3 feet below ground surface and above the saturated zone.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.230 Agency Review and Approval

a) Documents and requests filed with the Agency under this Part shall be submitted in accordance with the procedures applicable to the specific program under which remediation is performed.

b) Agency review and approval of documents and requests under this Part shall be performed in accordance with the procedures applicable to the specific program under which the remediation is performed.

SUBPART C: EXPOSURE ROUTE EVALUATIONS

Section 742.300 Exclusion of Exposure Route

a) This Subpart sets forth requirements to demonstrate that an actual or potential impact to a receptor or potential receptor from a contaminant of concern can be excluded from consideration from one or more exposure routes. If an evaluation under this Subpart demonstrates the applicable requirements for excluding an exposure route are met, then the exposure route is excluded from consideration and no remediation objective(s) need be developed for that exposure route.

b) No exposure route may be excluded from consideration until characterization of the extent and concentrations of contaminants of concern at a site has been performed. The actual steps and methods taken to characterize a site shall be determined by the specific program requirements under which the site remediation is being addressed.

c) As an alternative to the use of the requirements in this Subpart, a person may use the procedures for evaluation of exposure routes under Tier 3 as set forth in Section 742.925.

(Source: Amended at 25 Ill. Reg. 10374, effective August 15, 2001)

Section 742.305 Contaminant Source and Free Product Determination

No exposure route shall be excluded from consideration relative to a contaminant of concern unless the following requirements are met:

a) The sum of the concentrations of all organic contaminants of concern shall not exceed the attenuation capacity of the soil as determined under Section 742.215;

b) The concentrations of any organic contaminants of concern remaining in the soil shall not exceed the soil saturation limit as determined under Section 742.220;

c) Any soil which contains contaminants of concern shall not exhibit any of the characteristics of reactivity for hazardous waste as determined under 35 Ill. Adm. Code 721.123;

d) Any soil which contains contaminants of concern shall not exhibit a pH less than or equal to 2.0 or greater than or equal to 12.5, as determined by SW-846 Method 9040B: pH Electrometric for soils with 20% or greater aqueous (moisture) content or by SW-846 Method 9045C: Soil pH for soils with less than 20% aqueous (moisture) content as incorporated by reference in Section 742.210;

e) Any soil which contains contaminants of concern in the following list of inorganic chemicals or their salts shall not exhibit any of the characteristics of toxicity for hazardous waste as determined by 35 Ill. Adm. Code 721.124: arsenic, barium, cadmium, chromium, lead, mercury, selenium or silver;

f) If contaminants of concern include polychlorinated biphenyls (PCBs), the concentration of any PCBs in the soil shall not exceed 50 parts per million as determined by SW-846 Methods; and

g) The concentration of any contaminant of concern in soil gas shall not exceed 10% of its Lower Explosive Limit (LEL) as measured by a hand held combustible gas indicator that has been calibrated to manufacturer specifications.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.310 Outdoor Inhalation Exposure Route

The outdoor inhalation exposure route may be excluded from consideration if:

a) The requirements in subsection (a)(1) or (a)(2) are met:

1) An approved engineered barrier is in place that meets the requirements of Subpart K; or

2) The only contaminants of concern are benzene, toluene, ethylbenzene, and total xylenes, and a demonstration of active biodegradation has been made for benzene, toluene, ethylbenzene, and total xylenes such that no outdoor inhalation exposure will occur. This demonstration shall be submitted to the Agency for review and approval;

b) The requirements of Sections 742.300 and 742.305 are met;

c) Safety precautions for the construction worker are taken if the Tier 1 construction worker remediation objectives are exceeded; and

d) An institutional control, in accordance with Subpart J, will be placed on the property.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.312 Indoor Inhalation Exposure Route

The indoor inhalation exposure route may be excluded from consideration if:

a) None of the contaminants of concern are listed on Appendix A, Table J and none of the contaminants of concern are volatile chemicals, as defined in Section 742.200; or

b) The requirements in subsections (b)(1)(A), (B) or (C) and (b)(2) and (b)(3) are met:

1) Exclusion options when the contaminants of concern are volatile chemicals:

A) No building or man-made pathway exists or will be placed above contaminated soil gas or groundwater exceeding Tier 1 remediation objectives for residential property (Appendix B, Table H), provided, however, that there is also no soil or groundwater contamination exceeding Tier 1 remediation objectives for residential property (Appendix B, Table A) or Class I groundwater (Appendix B, Table E) located 5 feet or less, horizontally, from any existing or potential building or man-made pathway; or

B) An approved building control technology is in place or will be placed that meets the requirements of Subpart L; or

C) If the contaminants of concern are benzene, toluene, ethylbenzene, and total xylenes only, a demonstration of active biodegradation has been made for benzene, toluene, ethylbenzene, and total xylenes such that no indoor inhalation exposure will occur. This demonstration shall be submitted to the Agency for review and approval;

2) The requirements of Sections 742.300 and 742.305 are met; and

3) An institutional control, in accordance with Subpart J, will be placed on the property.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.315 Soil Ingestion Exposure Route

The soil ingestion exposure route may be excluded from consideration if:

a) The requirements of Sections 742.300 and 742.305 are met;

b) An approved engineered barrier is in place that meets the requirements of Subpart K;

c) Safety precautions for the construction worker are taken if the Tier 1 construction worker remediation objectives are exceeded; and

d) An institutional control, in accordance with Subpart J, will be placed on the property.

(Source: Amended at 25 Ill. Reg. 10374, effective August 15, 2001)

Section 742.320 Groundwater Ingestion Exposure Route

The groundwater ingestion exposure route may be excluded from consideration if:

a) The requirements of Sections 742.300 and 742.305 are met;

b) The corrective action measures have been completed to remove any free product to the maximum extent practicable;

c) The source of the release is not located within the minimum or designated maximum setback zone or within a regulated recharge area of a potable water supply well;

d) As demonstrated in accordance with Section 742.1015, for any area within the measured and modeled extent of groundwater contamination above what would otherwise be the applicable Tier 1 groundwater remediation objectives, an ordinance adopted by a unit of local government is in place that effectively prohibits the installation of potable water supply wells (and the use of such wells);

e) As demonstrated using Equation R26, in Appendix C, Table C, in accordance with Section 742.810, the concentration of any contaminant of concern in groundwater within the minimum or designated maximum setback zone of an existing potable water supply well will meet the applicable Tier 1 groundwater remediation objective; and

f) As demonstrated using Equation R26, in Appendix C, Table C, in accordance with Section 742.810, the concentration of any contaminant of concern in groundwater discharging into a surface water will meet the applicable surface water quality standard under 35 Ill. Adm. Code 302.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

SUBPART D: DETERMINING AREA BACKGROUNDS

Section 742.400 Area Background

This Subpart provides procedures for determining area background concentrations for contaminants of concern. Except as described in Section 742.415(c) and (d) of this Subpart, area background concentrations may be used as remediation objectives for contaminants of concern at a site.

Section 742.405 Determination of Area Background for Soil

a) Soil sampling results shall be obtained for purposes of determining area background levels in accordance with the following procedures:

1) For volatile chemicals, sample results shall be based on discrete samples;

2) Unless an alternative method is approved by the Agency, for contaminants other than volatile chemicals, sample results shall be based on discrete

samples or composite samples. If a person elects to use composite samples, each 0.5 acre of the area to be sampled shall be divided into quadrants and 5 aliquots of equal volume per quadrant shall be composited into 1 sample;

3) Samples shall be collected from similar depths and soil types, which shall be consistent with the depths and soil types in which maximum levels of contaminants are found in the areas of known or suspected releases; and

4) Samples shall be collected from areas of the site or adjacent to the site that are unaffected by known or suspected releases at or from the site. If the sample results show an impact from releases at or from the site, then the sample results shall not be included in determining area background levels under this Part.

b) Area background shall be determined according to one of the following approaches:

1) Statewide Area Background Approach:

A) The concentrations of inorganic chemicals in background soils listed in Appendix A, Table G may be used as the upper limit of the area background concentration for the site. The first column to the right of the chemical name presents inorganic chemicals in background soils for counties within Metropolitan Statistical Areas. Counties within Metropolitan Statistical Areas are identified in Appendix A, Table G, Footnote a. Sites located in counties outside Metropolitan Statistical Areas shall use the concentrations of inorganic chemicals in background soils shown in the second column to the right of the chemical name.

B) Soil area background concentrations determined according to this statewide area background approach shall be used as provided in Section 742.415(b) of this Part. For each parameter whose sampling results demonstrate concentrations above those in Appendix A, Table G, the person shall develop appropriate soil remediation objectives in accordance with this Part, or may determine area background in accordance with subsection (b)(2).

2) A statistically valid approach for determining area background concentrations appropriate for the characteristics of the data set, and approved by the Agency.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.410 Determination of Area Background for Groundwater

a) Groundwater sampling results shall be obtained for purposes of determining area background in accordance with the following procedures:

1) Samples shall be collected from areas of the site or adjacent to the site that are unaffected by releases at the site;

2) The background monitoring wells shall be sufficient in number to account for the spatial and temporal variability, size, and number of known or suspected off-site releases of contaminants of concern, and the hydrogeological setting of the site;

3) The samples shall be collected in consecutive quarters for a minimum of one year for each well unless another sample schedule is approved by the Agency;

4) The samples shall be collected from the same stratigraphic unit(s) as the groundwater contamination at the site; and

5) The background monitoring wells shall be located hydraulically upgradient from the release(s) of contaminants of concern, unless a person demonstrates to the Agency that the upgradient location is undefinable or infeasible.

b) Area background shall be determined according to one of the following approaches:

1) Prescriptive Approach:

A) If more than 15% of the groundwater sampling results for a chemical obtained in accordance with subsection (a) of this Section are less than the appropriate detection limit for that chemical, the Prescriptive Approach may not be used for that chemical. If 15% or less of the sampling results are less than the appropriate detection limit, a concentration equal to one-half the detection limit shall be used for that chemical in the calculations contained in this Prescriptive Approach.

B) The groundwater sampling results obtained in accordance with subsection (a) of this Section shall be used to determine if the sample set is normally distributed. The Shapiro-Wilk Test of Normality shall be used to determine whether the sample set is normally distributed, if the sample set for the background well(s) contains 50 or fewer samples. Values necessary for the Shapiro-Wilk Test of Normality shall be determined using Appendix A,

Tables C and D. If the computed value of W is greater than the 5% Critical Value in Appendix A, Table D, the sample set shall be assumed to be normally distributed, and the Prescriptive Approach is allowed. If the computed value of W is less than 5% Critical Value in Appendix A, Table D, the sample set shall be assumed to not be normally distributed, and the Prescriptive Approach shall not be used.

C) If the sample set contains at least ten sample results, the Upper Tolerance Limit (UTL) of a normally distributed sample set may be calculated using the mean (x) and standard deviation(s), from:

$$UTL = x + (K \bullet s),$$

where K = the one-sided normal tolerance factor for estimating the 95% upper confidence limit of the 95th percentile of a normal distribution. Values for K shall be determined using Appendix A, Table B.

D) If the sample set contains at least ten sample results, the UTL shall be the upper limit of the area background concentration for the site. If the sample set contains fewer than ten sample results, the maximum value of the sample set shall be the upper limit of the area background concentration for the site.

E) This Prescriptive Approach shall not be used for determining area background for the parameter pH.

2) Another statistically valid approach for determining area background concentrations appropriate for the characteristics of the data set, and approved by the Agency.

Section 742.415 Use of Area Background Concentrations

a) A person may request that area background concentration determined pursuant to Sections 742.405 and 742.410 be used according to the provisions of subsection (b) of this Section. Such request shall address the following:

1) The natural or man-made pathways of any suspected off-site contamination reaching the site;

2) Physical and chemical properties of suspected off-site contaminants of concern reaching the site; and

3) The location and justification of all background sampling points.

b) Except as specified in subsections (c) and (d) of this Section, an area background concentration may be used as follows:

1) To support a request to exclude a chemical as a contaminant of concern from further consideration for remediation at a site due to its presence as a result of background conditions; or

2) As a remediation objective for a contaminant of concern at a site in lieu of an objective developed pursuant to the other procedures of this Part.

c) An area background concentration shall not be used *in the event that the Agency has determined in writing that the background level for a regulated substance poses an acute threat to human health or the environment at the site when considering the post-remedial action land use.* (Section 58.5(b)(3) of the Act)

d) *In the event that the concentration of a regulated substance of concern on the site exceeds a remediation objective adopted by the Board for residential land use, the property may not be converted to residential use unless such remediation objective or an alternative risk-based remediation objective for that regulated substance of concern is first achieved.* If the land use is restricted, there shall be an institutional control in place in accordance with Subpart J. (Section 58.5(b)(2) of the Act)

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

SUBPART E: TIER 1 EVALUAION

Section 742.500 Tier 1 Evaluation Overview

Section 742.500 Tier 1 Evaluation Overview

a) A Tier 1 evaluation compares the concentration of each contaminant of concern detected at a site to the baseline remediation objectives provided in Appendix B, Tables A, B, C, D, E, G, H and I. Use of Tier 1 remediation objectives requires only limited site-specific information: concentrations of contaminants of concern, groundwater classification, land use classification, and, if appropriate, soil pH. (See Appendix B, Illustration A.)

b) Although Tier 1 allows for differentiation between residential and industrial/commercial property use of a site, an institutional control under Subpart J is required where remediation objectives are based on an industrial/commercial property use.

c) For the indoor inhalation exposure route:

1) Appendix B, Tables H and I apply only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls; and

2) Institutional controls under Subpart J are required to use remediation objectives in Appendix B, Table H or Table I.

d) Any given exposure route is not a concern if the concentration of each contaminant of concern detected at the site is below the Tier 1 value of that given route. In such a case, no further evaluation of that route is necessary.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.505 Tier 1 Soil, Soil Gas and Groundwater Remediation Objectives

a) Soil

1) Outdoor Inhalation Exposure Route

A) The Tier 1 soil remediation objectives for this exposure route based upon residential property use are listed in Appendix B, Table A.

B) The Tier 1 soil remediation objectives for this exposure route based upon industrial/commercial property use are listed in Appendix B, Table B. Soil remediation objective determinations relying on this table require use of institutional controls in accordance with Subpart J.

C) For this exposure route, it is acceptable to determine compliance by meeting either the soil or soil gas remediation objectives.

2) Ingestion Exposure Route

A) The Tier 1 soil remediation objectives for this exposure route based upon residential property use are listed in Appendix B, Table A.

B) The Tier 1 soil remediation objectives for this exposure route based upon industrial/commercial property use are listed in Appendix B, Table B. Soil remediation objective determinations relying on this table require use of institutional controls in accordance with Subpart J.

3) Soil Component of the Groundwater Ingestion Route

A) The Tier 1 soil remediation objectives for this exposure route based upon residential property use are listed in Appendix B, Table A.

B) The Tier 1 soil remediation objectives for this exposure route based upon industrial/commercial property use are listed in Appendix B, Table B.

C) The pH-dependent Tier 1 soil remediation objectives for identified ionizable organics or inorganics for the soil component of the groundwater ingestion exposure route (based on the total amount of contaminants present in the soil sample results and groundwater classification) are provided in Appendix B, Tables C and D.

D) Values used to calculate the Tier 1 soil remediation objectives for this exposure route are listed in Appendix B, Table F.

4) Evaluation of the dermal contact with soil exposure route is not required under Tier 1.

b) Soil Gas

1) Outdoor Inhalation Exposure Route

A) The Tier 1 soil gas remediation objectives for this exposure route based upon residential property use are listed in Appendix B, Table G.

B) The Tier 1 soil gas remediation objectives for this exposure route based upon industrial/commercial property use, including the construction worker population, are listed in Appendix B, Table G. Soil gas remediation objective determinations relying on an industrial/commercial scenario require use of institutional controls in accordance with Subpart J.

C) For this exposure route, it is acceptable to determine compliance by meeting either the soil or soil gas remediation objectives.

2) Indoor Inhalation Exposure Route

A) The Tier 1 soil gas remediation objectives for this exposure route are listed in Appendix B, Tables H and I.

B) The Tier 1 soil gas remediation objectives for this exposure route are based on a default water-filled soil porosity value of 0.15 cm^3/cm^3 and the assumed presence of a building with a 10-cm thick, full concrete slab-on-grade.

C) Appendix B, Table H shall be used when any soil or groundwater contamination is located 5 feet or less, vertically or horizontally, from the existing or potential building or man-made pathway. In this scenario, the mode of contaminant transport is both diffusion and advection, which sets the Q_{soil} value at 83.33 cm^3/sec. Appendix B, Table H applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Pursuant to Section 742.1000(a)(9), soil gas remediation objective determinations relying on Appendix B, Table H require the use of institutional controls in accordance with Subpart J.

D) Appendix B, Table I may be used only when all soil and groundwater contamination is located more than 5 feet, vertically and horizontally, from the existing or potential building or man-made pathway. In this scenario, the mode of contaminant transport is diffusion only, which sets the Q_{soil} value at 0.0 cm^3/sec. Appendix B, Table I applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Pursuant to Section 742.1000(a)(7) and (a)(9), soil gas remediation objective determinations relying on Appendix B, Table I require the use of institutional controls in accordance with Subpart J. As an alternative to using Appendix B, Table I, it is permissible to use Appendix B, Table H.

E) To determine whether the Q_{soil} value can be set at 0.0 cm^3/sec, the site evaluator shall demonstrate that all soil and groundwater located 5 feet or less, vertically or horizontally, from the existing or potential building or man-made pathway meets the Tier 1 remediation objectives for residential property listed in Appendix B, Table A, and the Tier 1 remediation objectives for Class I groundwater listed in Appendix B, Table E, respectively.

c) Groundwater

1) The Tier 1 groundwater remediation objectives for the groundwater component of the groundwater ingestion route are listed in Appendix B, Table E.

2) The Tier 1 groundwater remediation objectives for this exposure route are given for Class I and Class II groundwaters, respectively.

3) The evaluation of 35 Ill. Adm. Code 620.615 regarding mixtures of similar-acting chemicals shall be considered satisfied for Class I groundwater at the point of human exposure if:

A) No more than one similar-acting noncarcinogenic chemical as listed in Appendix A, Table E is detected in the groundwater at the site; and

B) No carcinogenic contaminant of concern as listed in Appendix A, Table I is detected in any groundwater sample associated with the site, using analytical procedures capable of achieving either the 1 in 1,000,000 cancer risk concentration or the ADL, whichever is greater.

4) If the conditions of subsection (c)(3) of this Section are not met, the Class I groundwater remediation objectives set forth in Appendix B, Table E shall be corrected for the cumulative effect of mixtures of similar-acting chemicals using the following methodologies:

A) For noncarcinogenic chemicals, the methodologies set forth at Section 742.805(c) or Section 742.915(h) shall be used; and

B) For carcinogenic chemicals, the methodologies set forth at Section 742.805(d) or Section 742.915(h) shall be used.

5) For the groundwater component of the indoor inhalation exposure route, the Tier 1 groundwater remediation objectives are listed in Appendix B, Tables H and I.

A) The Tier 1 groundwater remediation objectives for this exposure route are based on a default water-filled soil porosity value of 0.15 cm^3/cm^3 and the assumed presence of a building with a 10-cm thick, full concrete slab-on-grade.

B) Appendix B, Table H shall be used when any soil or groundwater contamination is located 5 feet or less, vertically or horizontally, from the existing or potential building or man-made pathway. In this scenario, the mode of contaminant transport is both diffusion and advection, which sets the Q_{soil} value at 83.33 cm^3/sec. Appendix B, Table H applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Pursuant to Section 742.1000(a)(9), groundwater remediation objective determinations relying on Appendix B, Table H require the use of institutional controls in accordance with Subpart J.

C) Appendix B, Table I may be used only when all soil and groundwater contamination is located more than 5 feet, vertically and horizontally, from the existing or potential building or man-made pathway. In this scenario, the mode of contaminant transport

is diffusion only, which sets the Q_{soil} value at 0.0 cm^3/sec. Appendix B, Table I applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Pursuant to Section 742.1000(a)(7) and (a)(9), groundwater remediation objective determinations relying on Appendix B, Table I require the use of institutional controls in accordance with Subpart J. As an alternative to using Appendix B, Table I, it is permissible to use Appendix B, Table H.

D) To determine whether the Q_{soil} value can be set at 0.0 cm^3/sec, the site evaluator shall demonstrate that all soil and groundwater located 5 feet or less, vertically or horizontally, from the existing or potential building or man-made pathway meets the Tier 1 remediation objectives for residential property listed in Appendix B, Table A, and the Tier 1 remediation objectives for Class I groundwater listed in Appendix B, Table E, respectively.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.510 Tier 1 Remediation Objectives Tables for the Ingestion, Outdoor Inhalation and Soil Component of the Groundwater Ingestion Exposure Routes

a) Soil remediation objectives are listed in Appendix B, Tables A, B, C and D.

1) Appendix B, Table A is based upon residential property use.

A) The first column to the right of the chemical name lists soil remediation objectives for the soil ingestion exposure route.

B) The second column lists the soil remediation objectives for the outdoor inhalation exposure route.

C) The third and fourth columns list soil remediation objectives for the soil component of the groundwater ingestion exposure route for the respective classes of groundwater:

i) Class I groundwater; and

ii) Class II groundwater.

D) The final column lists the Acceptable Detection Limit (ADL), only when applicable.

2) Appendix B, Table B is based upon industrial/commercial property use.

A) The first and third columns to the right of the chemical name list the soil remediation objectives for the soil ingestion exposure route based on two receptor populations:

i) Industrial/commercial; and

ii) Construction worker.

B) The second and fourth columns to the right of the chemical name list the soil remediation objectives for the outdoor inhalation exposure route based on two receptor populations:

i) Industrial/commercial; and

ii) Construction worker.

C) The fifth and sixth columns to the right of the chemical name list the soil remediation objectives for the soil component of the groundwater ingestion exposure route for two classes of groundwater:

i) Class I groundwater; and

ii) Class II groundwater.

D) The final column lists the acceptable detection limit (ADL), only when applicable.

3) Appendix B, Tables C and D set forth pH specific soil remediation objectives for inorganic and ionizing organic chemicals for the soil component of the groundwater ingestion route.

A) Table C sets forth remediation objectives based on Class I groundwater and Table D sets forth remediation objectives based on Class II groundwater.

B) The first column in Tables C and D lists the chemical names.

C) The second through ninth columns to the right of the chemical names list the pH based soil remediation objectives.

4) For the inorganic chemicals listed in Appendix B, Tables A and B, the soil component of the groundwater ingestion exposure route shall be evaluated using TCLP (SW-846 Method 1311) or SPLP (SW-846 Method 1312), incorporated by reference at Section 742.210 unless a person chooses to evaluate the soil component on the basis of the total amount of

contaminant in a soil sample result in accordance with subsection (a)(5) of this Section.

5) For those inorganic and ionizing organic chemicals listed in Appendix B, Tables C and D, if a person elects to evaluate the soil component of the groundwater ingestion exposure route based on the total amount of contaminant in a soil sample result (rather than TCLP or SPLP analysis), the person shall determine the soil pH at the site and then select the appropriate soil remediation objectives based on Class I and Class II groundwaters from Tables C and D, respectively. If the soil pH is less than 4.5 or greater than 9.0, then Tables C and D cannot be used.

6) Unless one or more exposure routes are excluded from consideration under Subpart C, the most stringent soil remediation objective of the exposure routes (i.e., soil ingestion exposure route, outdoor inhalation exposure route, and soil component of the groundwater ingestion exposure route) shall be compared to the concentrations of soil contaminants of concern measured at the site. When using Appendix B, Table B to select soil remediation objectives for the ingestion exposure route and outdoor inhalation exposure routes, the remediation objective shall be the more stringent soil remediation objective of the industrial/commercial populations and construction worker populations.

7) Confirmation sample results may be averaged or soil samples may be composited in accordance with Section 742.225.

8) If a soil remediation objective for a chemical is less than the ADL, the ADL shall serve as the soil remediation objective.

b) Groundwater remediation objectives for the groundwater component of the groundwater ingestion exposure route are listed in Appendix B, Table E. However, Appendix B, Table E must be corrected for cumulative effect of mixtures of similar-acting noncarcinogenic chemicals as set forth in Section 742.505(c)(3) and (c)(4).

1) The first column to the right of the chemical name lists groundwater remediation objectives for Class I groundwater, and the second column lists the groundwater remediation objectives for Class II groundwater.

2) To use Appendix B, Table E of this Part, the 35 Ill. Adm. Code 620 classification for groundwater at the site shall be determined. The concentrations of groundwater contaminants of concern at the site are compared to the applicable Tier 1 groundwater remediation objectives for the groundwater component of the groundwater ingestion exposure route in Appendix B, Table E.

c) Soil gas remediation objectives for the outdoor inhalation exposure route are listed in Appendix B, Table G.

1) The first column to the right of the chemical name lists the soil gas remediation objectives for residential populations.

2) The second and third columns to the right of the chemical names list the soil gas remediation objectives for the outdoor inhalation exposure route based on two receptor populations:

A) Industrial/commercial; and

B) Construction worker.

d) For contaminants of concern not listed in Appendix B, Tables A, B, E, and G, a person may request site-specific remediation objectives from the Agency or propose site-specific remediation objectives in accordance with 35 Ill. Adm. Code 620, Subpart I of this Part, or both.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.515 Tier 1 Remediation Objectives Tables for the Indoor Inhalation Exposure Route

a) For the indoor inhalation exposure route:

1) Appendix B, Tables H and I apply only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls; and

2) Institutional controls under Subpart J are required to use remediation objectives in Appendix B, Table H or Table I.

b) When the mode of contaminant transport is both diffusion and advection as described in Section 742.505 (i.e., any soil or groundwater contamination is located 5 feet or less, vertically or horizontally, from the existing or potential building or man-made pathway), the remediation objectives for soil gas or groundwater listed in Appendix B, Table H shall be used.

1) The first column to the right of the chemical name lists the soil gas remediation objectives for residential receptors.

2) The second column lists the soil gas remediation objectives for industrial/commercial receptors.

3) The third column lists the groundwater remediation objectives for residential receptors.

4) The fourth column lists the groundwater remediation objectives for industrial/commercial receptors.

c) Only when the mode of contaminant transport is diffusion only as described in Section 742.505 (i.e., all soil and groundwater contamination is located more than 5 feet, vertically and horizontally, from the existing or potential building or man-made pathway), the remediation objectives for soil gas and groundwater listed in Appendix B, Table I may be used.

1) The first column to the right of the chemical name lists the soil gas remediation objectives for residential receptors.

2) The second column lists the soil gas remediation objectives for industrial/commercial receptors.

3) The third column lists the groundwater remediation objectives for residential receptors.

4) The fourth column lists the groundwater remediation objectives for industrial/commercial receptors.

d) If using Appendix B, Table H, compliance is determined by meeting either the soil gas remediation objectives or the groundwater remediation objectives.

e) If using Appendix B, Table I, compliance is determined by meeting both the soil gas remediation objectives and the groundwater remediation objectives.

f) For volatile chemicals not listed in Appendix B, Table H or I, a person may request site-specific remediation objectives from the Agency or propose site-specific remediation objectives in accordance with Subpart I, or both.

g) As an alternative to using Appendix B, Table I pursuant to subsection (c), it is permissible to use Appendix B, Table H pursuant to subsection (b).

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

SUBPART F: TIER 2 GENERAL EVALUATION

Section 742.600 Tier 2 Evaluation Overview

a) Tier 2 remediation objectives are developed through the use of equations which allow site-specific data to be used. (See Appendix C, Illustrations A and B.) The

equations, identified in Appendix C, Tables A, C, and L may be used to develop Tier 2 remediation objectives.

b) Tier 2 evaluation is only required for contaminants of concern and corresponding exposure routes (except where excluded from further consideration under Subpart C) exceeding the Tier 1 remediation objectives. When conducting Tier 2 evaluations, the values used in the calculations must have the appropriate units of measure as identified in Appendix C, Tables B, D, and M.

c) Any development of remediation objectives using site-specific information or equations outside the Tier 2 framework shall be evaluated under Tier 3.

d) Any development of a remediation objective under Tier 2 shall not use a target hazard quotient greater than one at the point of human exposure or a target cancer risk greater than 1 in 1,000,000 at the point of human exposure.

e) In conducting a Tier 2 evaluation, the following conditions shall be met:

1) For each discrete sample, the total soil contaminant concentration of either a single contaminant or multiple contaminants of concern shall not exceed the attenuation capacity of the soil as provided in Section 742.215.

2) Remediation objectives for noncarcinogenic compounds which affect the same target organ, organ system or similar mode of action shall meet the requirements of Section 742.720.

3) The soil remediation objectives based on the outdoor inhalation exposure route and the soil component of the groundwater ingestion exposure routes shall not exceed the soil saturation limit as provided in Section 742.220.

4) The soil gas remediation objectives based on the indoor and outdoor inhalation exposure routes shall not exceed the soil vapor saturation limit provided pursuant to Section 742.222.

f) Tier 2 remediation objectives for the indoor inhalation exposure route shall be calculated for either soil gas or groundwater if a Q_{soil} value of 83.33 cm^3/sec is used.

g) Tier 2 remediation objectives for the indoor inhalation exposure route shall be calculated for both soil gas and groundwater if a Q_{soil} value of 0.0 cm^3/sec is used.

h) If the calculated Tier 2 soil remediation objective for an applicable exposure route is more stringent than the corresponding Tier 1 remediation objective, then the Tier 1 remediation objective applies.

i) If the calculated Tier 2 soil remediation objective for an exposure route is more stringent than the Tier 1 soil remediation objectives for the other exposure routes, then the Tier 2 calculated soil remediation objective applies and Tier 2 soil remediation objectives for the other exposure routes are not required.

j) If the calculated Tier 2 soil remediation objective is less stringent than one or more of the soil remediation objectives for the remaining exposure routes, then the Tier 2 values are calculated for the remaining exposure routes and the most stringent Tier 2 calculated value applies.

k) If a contaminant has both carcinogenic and noncarcinogenic effects for any applicable exposure route or receptor, remediation objectives shall be calculated for each effect and the more stringent remediation objective shall apply. The toxicological-specific information is described in Section 742.705(d).

l) For the indoor inhalation exposure route:

1) Appendix C, Table L applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls; and

2) Institutional controls under Subpart J are required to develop remediation objectives pursuant to Appendix C, Table L.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.605 Land Use

a) Present and post-remediation land use is evaluated in a Tier 2 evaluation. Acceptable exposure factors for the Tier 2 evaluation for residential, industrial/commercial, and construction worker populations are provided in the far right column of Appendix C, Tables B, D, and M. Use of exposure factors different from those in Appendix C, Tables B, D, and M must be approved by the Agency as part of a Tier 3 evaluation.

b) If a Tier 2 evaluation is based on an industrial/commercial property use, then:

1) Construction worker populations shall also be evaluated, except for the indoor inhalation exposure route; and

2) Institutional controls are required in accordance with Subpart J.

c) For the indoor inhalation exposure route, institutional controls under Subpart J are required to develop remediation objectives pursuant to Appendix C, Table L.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.610 Chemical and Site Properties

a) Physical and Chemical Properties of Contaminants

Tier 2 evaluations require information on the physical and chemical properties of the contaminants of concern. The physical and chemical properties used in a Tier 2 evaluation are contained in Appendix C, Table E. If the site has contaminants not included in this table, a person may request the Agency to provide the applicable physical and chemical input values or may propose input values under Subpart I. If a person proposes to apply values other than those in Appendix C, Table E, or those provided by the Agency, the evaluation shall be considered under Tier 3.

b) Soil and Groundwater Parameters

1) A Tier 2 evaluation requires examination of soil and groundwater parameters. The parameters that may be varied, and the conditions under which these parameters are determined as part of Tier 2, are summarized in Appendix C, Tables B, D, and M. If a person proposes to vary site-specific parameters outside of the framework of these tables, the evaluation shall be considered under Tier 3.

2) To determine site-specific physical soil parameters, a minimum of one boring per 0.5 acre of contamination shall be collected. This boring must be deep enough to allow the collection of the required field measurements. The site-specific physical soil parameters must be determined from the portion of the boring representing the stratigraphic units being evaluated. For example, if evaluating the soil component of the groundwater ingestion exposure route, two samples from the boring will be required:

A) A sample of the predominant soil type for the vadose zone; and

B) A sample of the predominant soil type for the saturated zone.

3) A site-specific SSL dilution factor (used in developing soil remediation objectives based upon the protection of groundwater) may be determined by substituting site information in Equation S22 in Appendix C, Table A. To make this demonstration, a minimum of three monitoring wells shall be used to determine the hydraulic gradient. As an alternative, the default dilution factor value listed in Appendix C, Table B may be used. If monitoring wells are used to determine the hydraulic gradient, the soil taken from the borings shall be visually inspected to ensure there are no significant differences in the stratigraphy. If there are similar soil types in

the field, one boring shall be used to determine the site-specific physical soil parameters. If there are significant differences, all of the borings shall be evaluated before determining the site-specific physical soil parameters for the site.

4) Not all of the parameters identified in Appendix C, Tables B, D, and M need to be determined on a site-specific basis. A person may choose to collect partial site-specific information and use default values as listed in Appendix C, Tables B, D, and M for the rest of the parameters.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

SUBPART G: TIER 2 SOIL EVALUATION

Section 742.700 Tier 2 Soil and Soil Gas Evaluation Overview

a) Tier 2 remediation objectives are developed through the use of models which allow site-specific data to be considered. Appendix C, Tables A, C, and L list equations that shall be used under a Tier 2 evaluation to calculate soil remediation objectives prescribed by the SSL, RBCA, and modified J&E models, respectively. (See also Appendix C, Illustration A.)

b) Appendix C, Table A lists equations that are used under the SSL model. (See also Appendix C, Illustration A.) The SSL model has equations to evaluate the following human exposure routes:

1) Soil ingestion exposure route;

2) Outdoor Inhalation exposure route; and

3) Soil component of the groundwater ingestion exposure route.

c) Evaluation of the dermal exposure route is not required under the SSL model.

d) Appendix C, Table C lists equations that are used under the RBCA model. (See also Appendix C, Illustration A.) The RBCA model has equations to evaluate human exposure based on the following:

1) The combined exposure routes of outdoor inhalation of vapors and particulates, soil ingestion and dermal contact with soil;

2) The outdoor inhalation exposure route from subsurface soils;

3) Soil component of the groundwater ingestion exposure route; and

4) Groundwater ingestion exposure route.

e) Appendix C, Table L lists equations that are used under the modified J&E model. The modified J&E model has equations to evaluate human exposure by the indoor inhalation exposure route. The modified model allows for the development of soil gas remediation objectives. For the indoor inhalation exposure route:

1) Appendix C, Table L applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls; and

2) Institutional controls under Subpart J are required to develop soil gas remediation objectives pursuant to Appendix C, Table L.

f) The equations in either Appendix C, Table A, C, or L may be used to calculate remediation objectives for each contaminant of concern under Tier 2, if the following requirements are met:

1) The Tier 2 soil or soil gas remediation objectives for the ingestion and outdoor inhalation exposure routes shall use the applicable equations from the same approach (i.e., SSL equations in Appendix C, Table C). For the indoor inhalation exposure route, only the J&E equations can be used.

2) The equations used to calculate soil remediation objectives for the soil component of the groundwater ingestion exposure route are not dependent on the approach utilized to calculate soil remediation objectives for the other exposure routes. For example, it is acceptable to use the SSL equations for calculating Tier 2 soil remediation objectives for the ingestion and outdoor inhalation exposure routes, and the RBCA equations for calculating Tier 2 soil remediation objectives for the soil component of the groundwater ingestion exposure route.

3) Combining equations from Appendix C, Tables A, C, and L to form a new model is not allowed. In addition, Appendix C, Tables A, C, and L must use their own applicable parameters identified in Appendix C, Tables B, D, and M, respectively.

g) In calculating soil or soil gas remediation objectives for industrial/commercial property use, applicable calculations shall be performed twice: once using industrial/commercial population default values and once using construction worker population default values. The more stringent soil or soil gas remediation objectives derived from these calculations must be used for further Tier 2 evaluations. The indoor inhalation exposure route does not apply to the construction worker population.

h) Tier 2 data sheets provided by the Agency shall be used to present calculated Tier 2 remediation objectives, if required by the particular program for which remediation is being performed.

i) The RBCA equations which rely on the parameter Soil Water Sorption Coefficient (k_s) can only be used for ionizing organics and inorganics by substituting values for k_s from Appendix C, Tables I and J, respectively. This will also require the determination of a site-specific value for soil pH.

j) For the outdoor inhalation exposure route, it is acceptable to use either Section 742.710 to develop a soil remediation objective or Section 742.712 to develop a soil gas remediation objective to determine compliance with the pathway.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.705 Parameters for Soil Remediation Objective Equations

a) Appendix C, Tables B, D, and M list the input parameters for the SSL, RBCA, and J&E equations, respectively. The first column lists each symbol as it is presented in the equation. The next column defines the parameters. The third column shows the units for the parameters. The fourth column identifies where information on the parameters can be obtained (i.e., field measurement, applicable equations, reference source, or default value). The last column identifies how the parameters can be generated.

b) Default Values

Default values are numerical values specified for use in the Tier 2 equations. The fourth column of Appendix C, Tables B, D, and M denotes if the default values are from the SSL model, RBCA model, modified J&E model or some other source. The last column of Appendix C, Tables B, D, and M lists the numerical values for the default values used in the SSL, RBCA, and J&E equations, respectively.

c) Site-specific Information

Site-specific information is a parameter measured, obtained, or determined from the site to calculate Tier 2 remediation objectives. The fourth column of Appendix C, Tables B, D, and M identifies those site-specific parameters that may require direct field measurement. For some parameters, numerical default inputs have been provided in the last column of Appendix C, Tables B, D, and M to substitute for site-specific information. In some cases, information on the receptor or soil type is required to select the applicable numerical default inputs. Site-specific information includes:

1) Physical soil parameters identified in Appendix C, Table F. The second column identifies the location where the sample is to be collected. Acceptable methods for measuring or calculating these soil parameters are identified in the last column of Appendix C, Table F;

2) Institutional controls or engineered barriers, pursuant to Subparts J and K, describe applicable institutional controls and engineered barriers under a Tier 2 evaluation; and

3) Land use classification

d) Toxicological-specific Information

1) Toxicological-specific information is used to calculate Tier 2 remediation objectives for the following parameters, if applicable:

A) Oral Chronic Reference Dose (RfD_o, expressed in mg/kg-d);

B) Oral Subchronic Reference Dose (RfD_s, expressed in mg/kg-d, shall be used for construction worker remediation objective calculations);

C) Oral Slope Factor (SF_o, expressed in $(mg/kg\text{-}d)^{-1}$);

D) Inhalation Unit Risk Factor (URF expressed in $(\mu g/m^3)^{-1}$);

E) Inhalation Chronic Reference Concentration (RfC, expressed in mg/m^3);

F) Inhalation Subchronic Reference Concentration (RfC_s, expressed in mg/m^3, shall be used for construction worker remediation objective calculations);

G) Inhalation Chronic Reference Dose (RfD_i, expressed in mg/kg-d);

H) Inhalation Subchronic Reference Dose (RfD_{is}, expressed in mg/kg-d, shall be used for construction worker remediation objective calculations); and

I) Inhalation Slope Factor (SF_i, expressed in $(mg/kg\text{-}d)^{-1}$);

2) Toxicological information can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210, or the program under which the remediation is being performed.

e) Chemical-specific Information

Chemical-specific information used to calculate Tier 2 remediation objectives is listed in Appendix C, Table E.

f) Calculations
Calculating numerical values for some parameters requires the use of equations listed in Appendix C, Tables A, C, and L. The parameters that are calculated are listed in Appendix C, Tables B, D, and M.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.710 SSL Soil Equations

a) This Section sets forth the equations and parameters used to develop Tier 2 soil remediation objectives for the three exposure routes using the SSL approach.

b) Soil Ingestion Exposure Route

1) Equations S1 through S3 form the basis for calculating Tier 2 remediation objectives for the soil ingestion exposure route using the SSL approach. Equation S1 is used to calculate soil remediation objectives for noncarcinogenic contaminants. Equations S2 and S3 are used to calculate soil remediation objectives for carcinogenic contaminants for residential populations and industrial/commercial and construction worker populations, respectively.

2) For Equations S1 through S3, the SSL default values cannot be modified with site-specific information.

c) Outdoor Inhalation Exposure Route

1) Equations S4 through S16, S26 and S27 are used to calculate Tier 2 soil remediation objectives for the outdoor inhalation exposure route using the SSL approach. To address this exposure route, organic contaminants and mercury must be evaluated separately from fugitive dust using their own equations set forth in subsections (c)(2) and (c)(3), respectively.

2) Organic Contaminants

A) Equations S4 through S10 are used to calculate Tier 2 soil remediation objectives for organic contaminants and mercury based on the outdoor inhalation exposure route. Equation S4 is used to calculate soil remediation objectives for noncarcinogenic organic contaminants in soil for residential and industrial/commercial populations. Equation S5 is used to calculate soil remediation objectives for noncarcinogenic organic

contaminants and mercury in soil for construction worker populations. Equation S6 is used to calculate soil remediation objectives for carcinogenic organic contaminants in soil for residential and industrial/commercial populations. Equation S7 is used to calculate soil remediation objectives for carcinogenic organic contaminants in soil for construction worker populations. Equations S8 through S10, S27 and S28 are used for calculating numerical values for some of the parameters in Equations S4 through S7.

B) For Equation S4, a numerical value for the Volatilization Factor (VF) can be calculated in accordance with subsection (c)(2)(F). The remaining parameters in Equation S4 have either SSL default values listed in Appendix C, Table B or toxicological-specific information (i.e., RfC), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

C) For Equation S5, a numerical value for the Volatilization Factor adjusted for Agitation (VF') can be calculated in accordance with subsection (c)(2)(G). The remaining parameters in Equation S5 have either SSL default values listed in Appendix C, Table B or toxicological-specific information (i.e., RfC), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

D) For Equation S6, a numerical value for VF can be calculated in accordance with subsection (c)(2)(F). The remaining parameters in Equation S6 have either default values listed in Appendix C, Table B or toxicological-specific information (i.e., URF), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

E) For Equation S7, a numerical value for VF' can be calculated in accordance with subsection (c)(2)(G). The remaining parameters in Equation S7 have either default values listed in Appendix C, Table B or toxicological-specific information (i.e., URF), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

F) The VF can be calculated for residential and industrial/commercial populations using one of the following equations based on the information known about the contaminant source and receptor population:

i) Equation S8, in conjunction with Equation S10, is used to calculate VF assuming an infinite source of contamination; or

ii) If the area and depth of the contaminant source are known or can be estimated reliably, mass limit considerations may be used to calculate VF using Equation S26.

G) The VF' can be calculated for the construction worker populations using one of the following equations based on the information known about the contaminant source:

i) Equation S9 is used to calculate VF' assuming an infinite source of contamination; or

ii) If the area and depth of the contaminant source are known or can be estimated reliably, mass limit considerations may be used to calculate VF' using Equation S27.

3) Fugitive Dust

A) Equations S11 through S16 are used to calculate Tier 2 soil remediation objectives using the SSL fugitive dust model for the outdoor inhalation exposure route. Equation S11 is used to calculate soil remediation objectives for noncarcinogenic contaminants in fugitive dust for residential and industrial/commercial populations. Equation S12 is used to calculate soil remediation objectives for noncarcinogenic contaminants in fugitive dust for construction worker populations. Equation S13 is used to calculate soil remediation objectives for carcinogenic contaminants in fugitive dust for residential and industrial/commercial populations. Equation S14 is used to calculate soil remediation objectives for carcinogenic contaminants in fugitive dust for construction worker populations. Equations S15 and S16 are used for calculating numerical quantities for some of the parameters in Equations S11 through S14.

B) For Equation S11, a numerical value can be calculated for the Particulate Emission Factor (PEF) using Equation S15. This equation relies on various input parameters from a variety of

sources. The remaining parameters in Equation S11 have either SSL default values listed in Appendix C, Table B or toxicological-specific information (i.e., RfC), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

C) For Equation S12, a numerical value for the Particulate Emission Factor for Construction Worker (PEF') can be calculated using Equation S16. The remaining parameters in Equation S12 have either SSL default values listed in Appendix C, Table B or toxicological-specific information (i.e., RfC), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

D) For Equation S13, a numerical value for PEF can be calculated using Equation S15. The remaining parameters in Equation S13 have either default values listed in Appendix C, Table B or toxicological-specific information (i.e., URF), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

E) For Equation S14, a numerical value for PEF' can be calculated using Equation S16. The remaining parameters in Equation S14 have either default values listed in Appendix C, Table B or toxicological-specific information (i.e., URF), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

d) Soil Component of the Groundwater Ingestion Exposure Route

The Tier 2 remediation objective for the soil component of the groundwater ingestion exposure route can be calculated using one of the following equations based on the information known about the contaminant source and receptor population:

1) Equation S17 is used to calculate the remediation objective assuming an infinite source of contamination.

A) The numerical quantities for four parameters in Equation S17, the Target Soil Leachate Concentration (C_w), Soil-Water Partition Coefficient (K_d) for non-ionizing organics, Water-Filled Soil Porosity Theta w (θ_w) and Air-Filled Soil Porosity Theta a (θ_a), are calculated using Equations S18, S19, S20 and S21,

respectively. Equations S22, S23, S24 and S25 are also needed to calculate numerical values for Equations S18 and S21. The pH-dependent K_d values for ionizing organics can be calculated using Equation S19 and the pH-dependent Koc values in Appendix C, Table I.

B) The remaining parameters in Equation S17 are Henry's Law Constant (H'), a chemical specific value listed in Appendix C, Table E and Dry Soil Bulk Density (ρ_b), a site-specific based value listed in Appendix C, Table B.

C) The default value for GW_{obj} is the Tier 1 groundwater objective. For chemicals for which there is no Tier 1 groundwater remediation objective, the value for GW_{obj} shall be the concentration determined according to the procedures specified in 35 Ill. Adm. Code 620, Subpart F. As an alternative to using Tier 1 groundwater remediation objectives or concentrations determined according to the procedures specified in 35 Ill. Adm. Code 620, Subpart F, GW_{obj} may be developed using Equations R25 and R26, if approved institutional controls are in place as required in Subpart J.

2) If the area and depth of the contaminant source are known or can be estimated reliably, mass limit considerations may be used to calculate the remediation objective for this exposure route using Equation S28. The parameters in Equation S28 have default values listed in Appendix C, Table B.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.712 SSL Soil Gas Equation for the Outdoor Inhalation Exposure Route

a) This Section sets forth the equation and parameters used to develop Tier 2 soil gas remediation objectives for the outdoor inhalation exposure route using the SSL approach.

b) Equation S30 is used to calculate Tier 2 soil gas remediation objectives for the outdoor inhalation exposure route for residential, industrial/commercial, and construction worker populations.

c) Equations S4 through S16, S26 and S27, which calculate Tier 2 soil remediation objectives as described in Section 742.710(c), form the basis for developing the Tier 2 soil gas remediation objectives for the outdoor inhalation exposure route using the SSL model.

d) The remaining parameters used to calculate Equation S30 are listed in Appendix C, Table B, except for Dimensionless Henry's Law Constant (25°C), a chemical specific value listed in Appendix C, Table E.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.715 RBCA Soil Equations

a) This Section presents the RBCA model and describes the equations and parameters used to develop Tier 2 soil remediation objectives.

b) Ingestion, Outdoor Inhalation, and Dermal Contact

1) The two sets of equations in subsections (b)(2) and (b)(3) shall be used to generate Tier 2 soil remediation objectives for the combined ingestion, outdoor inhalation, and dermal contact with soil exposure routes.

2) Combined Exposure Routes of Soil Ingestion, Outdoor Inhalation of Vapors and Particulates, and Dermal Contact with Soil

A) Equations R1 and R2 form the basis for deriving Tier 2 remediation objectives for the set of equations that evaluates the combined exposure routes of soil ingestion, outdoor inhalation of vapors and particulates, and dermal contact with soil using the RBCA approach. Equation R1 is used to calculate soil remediation objectives for carcinogenic contaminants. Equation R2 is used to calculate soil remediation objectives for noncarcinogenic contaminants. Soil remediation objectives for the outdoor inhalation exposure route from subsurface soils must also be calculated in accordance with the procedures outlined in subsection (b)(3) of this Section and compared to the values generated from Equations R1 or R2. The smaller value (i.e., R1 and R2 compared to R7 and R8, respectively) from these calculations is the Tier 2 soil remediation objective for the combined exposure routes of soil ingestion, outdoor inhalation, and dermal contact with soil.

B) In Equation R1, numerical values are calculated for two parameters:

i) The volatilization factor for surficial soils (VF_{ss}) using Equations R3 and R4; and

ii) The volatilization factor for surficial soils regarding particulates (VF_p) using Equation R5.

C) VF_{ss} uses Equations R3 and R4 to derive a numerical value. Equation R3 requires the use of Equation R6. Both equations must be used to calculate the VF_{ss}. The lowest calculated value from these equations must be substituted into Equation R1.

D) The remaining parameters in Equation R1 have either default values listed in Appendix C, Table D or toxicological-specific information (i.e., SF_o, SF_i), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

E) For Equation R2, the parameters VF_{ss} and VF_p are calculated. The remaining parameters in Equation R2 have either default values listed in Appendix C, Table D or toxicological-specific information (i.e., RfD_o, RfD_i), which can be obtained by following the guidelines in OSWER Directive 9285.7-53, as incorporated by reference in Section 742.210 or requested from the program under which the remediation is being performed.

F) For chemicals other than inorganics which do not have default values for the dermal absorption factor (RAF_d) in Appendix C, Table D a dermal absorption factor of 0.5 shall be used for Equations R1 and R2. For inorganics, dermal absorption may be disregarded (i.e., $RAF_d = 0$).

3) Outdoor Inhalation Exposure Route from Subsurface Soils (soil below one meter)

A) Equations R7 and R8 form the basis for deriving Tier 2 remediation objectives for the outdoor inhalation exposure route from subsurface soils using the RBCA approach. Equation R7 is used to calculate soil remediation objectives for carcinogenic contaminants. Equation R8 is used to calculate soil remediation objectives for noncarcinogenic contaminants.

B) For Equation R7, the carcinogenic risk-based screening level for air ($RBSL_{air}$) and the volatilization factor for soils below one meter to ambient air (VF_{samb}) have numerical values that are calculated using Equations R9 and R11, respectively. Both equations rely on input parameters from a variety of sources.

C) The noncarcinogenic risk-based screening level for air ($RBSL_{air}$) and the volatilization factor for soils below one meter to ambient air (VF_{samb}) in Equation R8 have numerical values that can be calculated using Equations R10 and R11, respectively.

c) Soil Component of the Groundwater Ingestion Exposure Route

1) Equation R12 forms the basis for deriving Tier 2 remediation objectives for the soil component of the groundwater ingestion exposure route using the RBCA approach. The parameters, groundwater at the source (GW_{source}) and Leaching Factor (LF_{sw}), have numerical values that are calculated using Equations R13 and R14, respectively.

2) Equation R13 requires numerical values that are calculated using Equation R15.

3) Equation R14 requires numerical values that are calculated using Equations R21, R22, and R24. For non-ionizing organics, the Soil Water Sorption Coefficient (k_s) shall be calculated using Equation R20. For ionizing organics and inorganics, the values for k_s are listed in Appendix C, Tables I and J, respectively. The pH-dependent k_s values for ionizing organics can be calculated using Equation R20 and the pH-dependent K_{oc} values in Appendix C, Table I. The remaining parameters in Equation R14 are field measurements or default values listed in Appendix C, Table D.

d) The default value for GW_{comp} is the Tier 1 groundwater remediation objective. For chemicals for which there is no Tier 1 groundwater remediation objective, the value for GW_{comp} shall be the concentration determined according to the procedures specified in 35 Ill. Adm. Code 620, Subpart F. As an alternative to using the above concentrations, GW_{comp} may be developed using Equations R25 and R26, if approved institutional controls are in place as may be required in Subpart J.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.717 J&E Soil Gas Equations for the Indoor Inhalation Exposure Route

a) This Section sets forth the equations and parameters to be used to develop Tier 2 soil gas remediation objectives for the indoor inhalation exposure route using the modified J&E model.

b) Equations J&E1 and J&E2 calculate, for carcinogens and noncarcinogens, respectively, an acceptable concentration of the contaminant of concern in indoor air that adequately protects humans who inhale this air. Equation J&E3 converts indoor air concentrations from parts per million volume to milligrams per cubic meter.

c) Equation J&E4 calculates an acceptable concentration of the contaminant of concern in the soil gas at the source of contamination. This calculation is made using:

1) an attenuation factor developed in accordance with Equations J&E7 through 18; and

2) the acceptable concentration of the contaminant of concern in indoor air calculated in accordance with Equation J&E1 (for carcinogens) or J&E2 (for noncarcinogens).

d) The attenuation factor (Equation J&E7 or J&E8) accounts for the following processes:

1) Migration of contaminants from the source upwards through the vadose zone;

2) Migration of contaminants through the earthen filled cracks in the building's full concrete slab-on-grade or full concrete basement floor and walls; and

3) Mixing of the contaminants with air inside the building.

e) Equation J&E7 must be used when the mode of contaminant transport is both diffusion and advection. In this scenario, the Q_{soil} value equals 83.33 cm^3/sec as described in Section 742.505.

f) Equation J&E8 may be used only when the mode of contaminant transport is diffusion only. In this scenario, the Q_{soil} value equals 0.0 cm^3/sec as described in Section 742.505. As an alternative to using Equation J&E8 pursuant to this subsection, it is permissible to use Equation J&E7, in which case the Q_{soil} value equals 83.33 cm^3/sec as described in Section 742.505.

g) Equations J&E9a through J&E18 calculate input parameters for either Equation J&E7 or J&E8 (the equations used to calculate an attenuation factor). These equations assume there are "n" different soil layers between the source of the contamination and the floor of the building. Equations J&E11, 16, 17 and 18 shall be used to calculate the needed parameters for each of the n layers (the general soil layer is referred to as soil layer "i" and i = 1, 2, . . . n). Equations J&E16, 17, and 18 shall also be used to calculate needed parameters for the soil in the cracks of the building's full concrete slab-on-grade or full concrete basement floor and walls (it is through these cracks that contaminated soil gas is assumed to flow from the subsurface into the building). As reflected in Equation J&E14, the only crack assumed to be present is the floor-wall seam gap. To calculate the surface area of the enclosed space at or below grade, Equation J&E12a shall be

used for a building with a full concrete slab-on-grade and Equation J&E12b shall be used for a building with a full concrete basement floor and walls.

h) The default representative subsurface temperature for Henry's Law Constant is 13°C. This value shall be used, as appropriate, in all calculations needed to represent the system by which contaminants migrate through the subsurface.

i) The calculated soil gas remediation objective shall be compared with the soil vapor saturation limit (C_v^{sat}, Equation J&E5) for each volatile chemical. The calculated C_v^{sat} shall use the default representative subsurface temperature specified in subsection (h). If the calculated soil gas remediation objective is greater than C_v^{sat}, then C_v^{sat} is used as the soil gas remediation objective.

j) The calculated soil gas remediation objective shall be compared to concentrations of soil gas collected at a depth at least 3 feet below ground surface and above the saturated zone. If a valid sample cannot be collected, a soil gas sampling plan shall be approved by the Agency under Tier 3.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.720 Chemicals with Cumulative Noncarcinogenic Effects

Appendix A, Table E lists the groups of chemicals from Appendix B, Tables A and B that have remediation objectives based on noncarcinogenic toxicity and that affect the same target organ. If more than one chemical detected at a site affects the same target organ (i.e., has the same critical effect as defined by the RfD), the initially calculated remediation value for each chemical in the group shall be corrected for cumulative effects by one of the following two methods:

a) Calculate the weighted average using the following equations:

$$W_{ave} = \frac{x_1}{CUO_{x_1}} + \frac{x_2}{CUO_{x_2}} + \frac{x_3}{CUO_{x_3}} + \ldots + \frac{x_a}{CUO_{x_a}}$$

where:

W_{ave}= Weighted Average

x_1 through x_a = Concentration of each individual contaminant at the location of concern. Note that, depending on the target organ/mode of action, the actual number of contaminants will range from 2 to 14.

$CUOx_a$ = A Tier 2 remediation objective must be developed

for each x_a.

If the value of the weighted average calculated in accordance with the equations above is less than or equal to 1.0, then the remediation objectives are met for those chemicals.

If the value of the weighted average calculated in accordance with the equations above is greater than 1.0, then additional remediation must be carried out until the level of contaminants remaining in the remediated area has a weighted average calculated in accordance with the equation above less than or equal to one.

b) Divide each individual chemical's remediation objective by the number of chemicals in that specific target organ group that were detected at the site. Each of the contaminant concentrations at the site is then compared to the remediation objectives that have been adjusted to account for this potential additivity. For the noncarcinogenic contaminants listed in Appendix A, Table E, a respective soil remediation objective need be no lower than the respective value listed in Appendix B, Table A or B.

SUBPART H: TIER 2 GROUNDWATER EVALUATION

Section 742.800 Tier 2 Groundwater Evaluation Overview

If the contaminant concentrations in the groundwater exceed the applicable Tier 1 remediation objectives, a person has the following options:

a) Demonstrate that the groundwater ingestion exposure route is excluded from consideration pursuant to Subpart C;

b) Demonstrate that the groundwater contamination is at or below area background concentrations in accordance with Subpart D and, if necessary, an institutional control restricting usage of the groundwater is in place in accordance with Subpart J;

c) Remediate to Tier 1 remediation objectives;

d) Propose and obtain approval of Tier 2 groundwater remediation objectives in accordance with Section 742.805 and remediate to that level, if necessary;

e) Conduct a Tier 3 evaluation in accordance with Subpart I; or

f) Obtain approval from the Board to:

1) Reclassify the groundwater pursuant to 35 Ill. Adm. Code 620.260; or

2) Use an adjusted standard pursuant to Section 28.1 of the Act. [415 ILCS 5/28.1].

Section 742.805 Tier 2 Groundwater Remediation Objectives

a) To develop a groundwater remediation objective under this Section that exceeds the applicable Tier 1 groundwater remediation objective, or for which there is no Tier I groundwater remediation objective, a person may request approval from the Agency if the person has performed the following:

1) Identified the horizontal and vertical extent of groundwater for which the Tier 2 groundwater remediation objective is sought;

2) Taken corrective action, to the maximum extent practicable to remove any free product;

3) Using Equation R26 in accordance with Section 742.810, demonstrated that the concentration of any contaminant of concern in groundwater will meet:

A) The applicable Tier 1 groundwater remediation objective at the point of human exposure; or

B) For any contaminant of concern for which there is no Tier 1 groundwater remediation objective, the concentration determined according to the procedures specified in 35 Ill. Adm. Code 620 at the point of human exposure. A person may request the Agency to provide these concentrations or may propose these concentrations under Subpart I;

4) Using Equation R26 in accordance with Section 742.810, demonstrated that the concentration of any contaminant of concern in groundwater within the minimum or designated maximum setback zone of an existing potable water supply well will meet the applicable Tier 1 groundwater remediation objective or, if there is no Tier 1 groundwater remediation objective, the concentration determined according to the procedures specified in 35 Ill. Adm. Code 620. A person may request the Agency to provide these concentrations or may propose these concentrations under Subpart I;

5) Using Equation R26 in accordance with Section 742.810, demonstrated that the concentration of any contaminant of concern in groundwater discharging into a surface water will meet the applicable water quality standard under 35 Ill. Adm. Code 302;

6) Demonstrated that the source of the release is not located within the minimum or designated maximum setback zone or within a regulated recharge area of an existing potable water supply well; and

7) If the selected corrective action includes an engineered barrier as set forth in Subpart K to minimize migration of contaminants of concern from the soil to the groundwater, demonstrated that the engineered barrier will remain in place for post-remediation land use through an institutional control as set forth in Subpart J.

b) A groundwater remediation objective that exceeds the water solubility of that chemical (refer to Appendix C, Table E for solubility values) is not allowed.

c) The contaminants of concern for which a Tier 1 remediation objective has been developed shall be included in any mixture of similar-acting chemicals under consideration in Tier 2. The evaluation of 35 Ill. Adm. Code 620.615 regarding mixtures of similar-acting chemicals shall be considered satisfied for Class I groundwater at the point of human exposure if either of the following requirements are achieved:

1) Calculate the weighted average using the following equations:

$$W_{ave} = \frac{x_1}{CUOx_1} + \frac{x_2}{CUOx_2} + \frac{x_3}{CUOx_3} + \ldots + \frac{x_a}{CUOx_a}$$

where:

W_{ave} = Weighted Average

x_1 through x_a = Concentration of each individual contaminant at the location of concern. Note that, depending on the target organ, the actual number of contaminants will range from 2 to 33.

$CUOx_a$ = A Tier 1 or Tier 2 remediation objective must be developed for each x_a.

A) If the value of the weighted average calculated in accordance with the equations above is less than or equal to 1.0, then the remediation objectives are met for those chemicals.

B) If the value of the weighted average calculated in accordance with the equations above is greater than 1.0, then additional remediation must be carried out until the level of contaminants remaining in the remediated area has a weighted average calculated in accordance with the equation above less than or equal to one; or

2) Divide each individual chemical's remediation objective by the number of chemicals in that specific target organ group that were detected at the site. Each of the contaminant concentrations at the site is then compared to the remediation objectives that have been adjusted to account for this potential additivity.

d) The evaluation of 35 Ill. Adm. Code 620.615 regarding mixtures of similar-acting chemicals is considered satisfied if the cumulative risk from any contaminants of concern listed in Appendix A, Table I, plus any other contaminants of concern detected in groundwater and listed in Appendix A, Table F as affecting the same target organ/organ system as the contaminants of concern detected from Appendix A, Table I, does not exceed 1 in 10,000.

e) Groundwater remediation objectives for the indoor inhalation exposure route shall be developed in accordance with Section 742.812. For the indoor inhalation exposure route:

1) Appendix C, Table L applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls; and

2) Institutional controls under Subpart J are required to develop groundwater remediation objectives pursuant to Appendix C, Table L.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.810 RBCA Calculations to Predict Impacts from Remaining Groundwater Contamination

a) Equation R26 predicts the contaminant concentration along the centerline of a groundwater plume emanating from a vertical planar source in the aquifer (dimensions S_w wide and S_d deep). This model accounts for both three-dimensional dispersion (x is the direction of groundwater flow, y is the other horizontal direction, and z is the vertical direction) and biodegradation.

1) The parameters in this equation are:

$X =$ distance from the planar source to the location of concern, along the centerline of the groundwater plume (i.e., y=0, z=0)

$C_x =$ the concentration of the contaminant at a distance X from the source, along the centerline of the plume

C_{source} = the greatest potential concentration of the contaminant of concern in the groundwater at the source of the contamination, based on the concentrations of contaminants in groundwater due to the release and the projected concentration of the contaminant migrating from the soil to the groundwater. As indicated above, the model assumes a planar source discharging groundwater at a concentration equal to C_{source}.

α_x = dispersivity in the x direction (i.e., Equation R16)

α_y = dispersivity in the y direction (i.e., Equation R17)

α_z = dispersivity in the z direction (i.e., Equation R18)

U = specific discharge (i.e., actual groundwater flow velocity through a porous medium; takes into account the fact that the groundwater actually flows only through the pores of the subsurface materials) where the aquifer hydraulic conductivity (K), the hydraulic gradient (I) and the total soil porosity θ_T must be known (i.e., Equation R19)

λ= first order degradation constant obtained from Appendix C, Table E or from measured groundwater data

S_w = width of planar groundwater source in the y direction

S_d = depth of planar groundwater source in the z direction

2) The following parameters are determined through field measurements: U, K, I, θ_T, S_w, S_d.

A) The determination of values for U, K, I and θ_T can be obtained through the appropriate laboratory and field techniques;

B) From the immediate down-gradient edge of the source of the groundwater contamination values for S_w and S_d shall be determined. S_w is defined as the width of groundwater at the source which exceeds the Tier 1 groundwater remediation objective. S_d is defined as the depth of groundwater at the source which exceeds the Tier 1 groundwater remediation objective; and

C) Total soil porosity can also be calculated using Equation R23.

b) Once values are obtained for all the input parameters identified in subsection (a) of this Section, the contaminant concentration C_x along the centerline of the plume at a distance X from the source shall be calculated so that X is the distance from the down-gradient edge of the source of the contamination at the site to the point where the contaminant concentration is equal to the Tier 1 groundwater remediation objective or concentration determined according to the procedures specified in 35 Ill. Adm. Code 620, Subpart F.

1) If there are any potable water supply wells located within the calculated distance X, then the Tier 1 groundwater remediation objective or concentration shall be met at the edge of the minimum or designated maximum setback zone of the nearest potable water supply down-gradient of the source. To demonstrate that a minimum or maximum setback zone of a potable water supply well will not be impacted above the applicable Tier 1 groundwater remediation objective or concentration determined according to the procedures specified in 35 Ill. Adm. Code 620, Subpart F, X shall be the distance from the C_{source} location to the edge of the setback zone.

2) To demonstrate that no surface water is adversely impacted, X shall be the distance from the down-gradient edge of the source of the contamination site to the nearest surface water body. This calculation must show that the contaminant in the groundwater at this location (C_x) does not exceed the applicable water quality standard.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.812 J&E Groundwater Equations for the Indoor Inhalation Exposure Route

Groundwater remediation objectives for the indoor inhalation exposure route are calculated using the modified J&E model as described in Section 742.717, except as follows:

a) In Equation J&E9a, the total number of layers of soil that contaminants migrate through from the source to the building shall include a capillary fringe layer.

b) The thickness of the capillary fringe layer is 37.5 cm.

c) The volumetric water content of the capillary fringe shall be 90 % of the total porosity of the soil that comprises the capillary fringe.

d) Equations J&E7 and J&E8 calculate an acceptable groundwater remediation objective.

1) This calculation is made using:

A) the soil gas remediation objective calculated in accordance with Equation J&E4; and

B) the assumption that this gas is in equilibrium with any contamination in the groundwater.

2) Equation J&E7 must be used when the mode of contaminant transport is both diffusion and advection. In this scenario, the Q_{soil} value equals 83.33 cm^3/sec as described in Section 742.505.

3) Equation J&E8 may be used only when the mode of contaminant transport is diffusion only. In this scenario, the Q_{soil} value equals 0.0 cm^3/sec as described in Section 742.505. As an alternative to using Equation J&E8 pursuant to this subsection, it is permissible to use Equation J&E7, in which case the Q_{soil} value equals 83.33 cm^3/sec as described in Section 742.505.

e) A groundwater remediation objective that exceeds the water solubility of that chemical (refer to Appendix C, Table E for solubility values) is not allowed. If the calculated groundwater remediation objective is greater than the water solubility of that chemical, then the solubility is used as the groundwater remediation objective.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

SUBPART I: TIER 3 EVALUATION

Section 742.900 Tier 3 Evaluation Overview

a) Tier 3 sets forth a flexible framework to develop remediation objectives outside of the requirements of Tiers 1 and 2. Although Tier 1 and Tier 2 evaluations are not prerequisites to conduct Tier 3 evaluations, data from Tier 1 and Tier 2 can assist in developing remediation objectives under a Tier 3 evaluation.

b) The level of detail required to adequately characterize a site depends on the particular use of Tier 3. Tier 3 can require additional investigative efforts beyond those described in Tier 2 to characterize the physical setting of the site. However, in situations where remedial efforts have simply reached a physical obstruction additional investigation may not be necessary for a Tier 3 submittal.

c) Situations that can be considered for a Tier 3 evaluation include, but are not limited to:

1) Modification of parameters not allowed under Tier 2;

2) Use of models different from those used in Tier 2;

3) Use of additional site data, such as results of indoor air sampling, to improve or confirm predictions of exposed receptors to contaminants of concern;

4) Analysis of site-specific risks using formal risk assessment, probabilistic data analysis, and sophisticated fate and transport models (e.g., requesting a target hazard quotient greater than 1 or a target cancer risk greater than 1 in 1,000,000);

5) Requests for site-specific remediation objectives because an assessment indicates further remediation is not practical;

6) Incomplete human exposure pathways not excluded under Subpart C;

7) Use of toxicological-specific information not available from the sources listed in Tier 2;

8) Land uses which are substantially different from the assumed residential or industrial/commercial property uses of a site (e.g., a site will be used for recreation in the future and cannot be evaluated in Tier 1 or 2);

9) Requests for site-specific remediation objectives that exceed Tier 1 groundwater remediation objectives so long as the following is demonstrated:

   A) *To the extent practical, the exceedance of the groundwater quality standard has been minimized and beneficial use appropriate to the groundwater that was impacted has been returned; and*

   B) *Any threat to human health or the environment has been minimized* [415 ILCS 5/58.5(d)(4)(A)]; and

10) Use of building control technologies, other than those described in Subpart L, to prevent completion of the indoor inhalation exposure route.

d) For requests of a target cancer risk ranging between 1 in 1,000,000 and 1 in 10,000 at the point of human exposure or a target hazard quotient greater than 1 at the point of human exposure, the requirements of Section 742.915 shall be followed. Requests for a target cancer risk exceeding 1 in 10,000 at the point of human exposure are not allowed.

e) Requests for approval of a Tier 3 evaluation must be submitted to the Agency for review under the specific program under which remediation is performed. When reviewing a submittal under Tier 3, the Agency shall consider *whether the interpretations and conclusions reached are supported by the information gathered* [415 ILCS 58.7(e)(1)]. The Agency shall approve a Tier 3 evaluation if

the person submits the information required under this Part and establishes through such information that public health is protected and that specified risks to human health and the environment have been minimized.

f) If contaminants of concern include polychlorinated biphenyls (PCBs), requests for approval of a Tier 3 evaluation must additionally address the applicability of 40 CFR 761.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.905 Modifications of Parameters

Any proposed changes to Tier 2 parameters which are not provided for in Tier 2 shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

a) The justification for the modification; and

b) The technical and mathematical basis for the modification.

Section 742.910 Alternative Models

Any proposals for the use of models other than those specified in Tier 2 shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

a) Physical and chemical properties of contaminants of concern;

b) Contaminant movement properties;

c) Contaminant availability to receptors;

d) Receptor exposure to the contaminants of concern;

e) Mathematical and technical justification for the model proposed;

f) A licensed copy of the model, if the Agency does not have a licensed copy of the model currently available for use; and

g) Demonstration that the models were correctly applied.

Section 742.915 Formal Risk Assessments

A comprehensive site-specific risk assessment shall demonstrate that contaminants of concern at a site do not pose a significant risk to any human receptor. All site-specific risk assessments shall be submitted to the Agency for review and approval. A submittal under this Section shall address the following factors:

a) Whether the risk assessment procedure used is nationally recognized and accepted including, but not limited to, those procedures incorporated by reference in Section 742.210;

b) Whether the site-specific data reflect actual site conditions;

c) The adequacy of the investigation of present and post-remediation exposure routes and risks to receptors identified at the site;

d) The appropriateness of the sampling and analysis;

e) The adequacy and appropriateness of toxicity information;

f) The extent of contamination;

g) Whether the calculations were accurately performed;

h) Similar-acting chemicals shall be specifically addressed. At a minimum, the chemicals subject to this requirement are identified in Appendix A, Tables E and F; and

i) Proposals seeking to modify the target risk consistent with Section 742.900(d) shall address the following factors:

1) the presence of sensitive populations;

2) the number of receptors potentially impacted;

3) the duration of risk at the differing target levels; and

4) the characteristic of the chemicals of concern.

SOURCE: Amended at 21 Ill. Reg. 16391, effective December 8, 1997.

Section 742.920 Impractical Remediation

Any request for site-specific remediation objectives due to impracticality of remediation shall be submitted to the Agency for review and approval. Any request for site-specific remediation objectives due to impracticality of remediation that involves the indoor inhalation exposure route

shall follow Section 742.935 in lieu of this Section. A submittal under this Section shall include the following information:

a) The reasons why the remediation is impractical;

b) The current extent and modeled migration of contamination;

c) Geology, including soil types and parameters;

d) The potential impact to groundwater;

e) Results and locations of sampling events;

f) Map of the area, including all utilities and structures; and

g) Present and post-remediation uses of the area of contamination, including human receptors at risk.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.925 Exposure Routes

Technical information may demonstrate that there is no actual or potential impact of contaminants of concern to receptors from a particular exposure route. In these instances, a demonstration excluding an exposure route shall be submitted to the Agency for review and approval. A demonstration that involves the indoor inhalation exposure route shall follow Section 742.935 in lieu of this Section. A submittal under this Section shall include the following information:

a) A description of the route evaluated;

b) A description of the site and physical site characteristics;

c) A discussion of the result and possibility of the route becoming active in the future; and

d) Technical support that may include, but is not limited to, the following:

1) a discussion of the natural or man-made barriers to that exposure route;

2) calculations and modeling;

3) physical and chemical properties of contaminants of concern; and

4) contaminant migration properties.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.930 Derivation of Toxicological Data

If toxicological-specific information is not available for one or more contaminants of concern from the sources incorporated by reference in Section 742.210, the derivations of toxicological-specific information shall be submitted for Agency review and approval.

Section 742.935 Indoor Inhalation Exposure Route

a) Exclusion of Exposure Route

Site information may demonstrate that there is no actual or potential impact of contaminants of concern to receptors from the indoor inhalation exposure route. In these instances, a demonstration excluding the exposure route shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

1) A description of the site, physical site characteristics, existing and planned buildings, and existing and planned man-made pathways; and

2) A discussion of the possibility of the route becoming active in the future.

b) Exclusion of Exposure Route Using Building Control Technologies

Any proposals to use building control technologies as a means to prevent or mitigate human exposures under the indoor inhalation exposure route that differ from the requirements of Subpart L shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

1) A description of the site and physical site characteristics;

2) The current extent and modeled migration of contamination;

3) Geology, including soil types and parameters;

4) Results and locations of sampling events;

5) Scaled map of the area, including all buildings and man-made pathways;

6) A description of building characteristics and methods of construction, including a description of man-made pathways;

7) Present and post-remediation uses of the land that are at issue due to the area of contamination, including human receptors at risk;

8) A description of any building control technologies currently in place or proposed for installation that can reduce or eliminate the potential for completion of the exposure route, including design and construction specifications;

9) Information regarding the effectiveness of any building control technologies currently in place or proposed for installation and a schedule for performance testing to show the effectiveness of the control technology. For buildings not yet constructed, an approved building control technology shall be in place and operational prior to human occupancy;

10) Identification of documents reviewed and the criteria used in the documents for determining whether building control technologies are effective and how those criteria compare to existing or potential buildings or man-made pathways at the site; and

11) A description as to how the effectiveness of the building control technologies will be operated and maintained for the life of the buildings and man-made pathways, or until soil gas and groundwater contaminant concentrations have reached remediation objectives that are approved by the Agency. This includes provisions for potential extended system inoperability due to power failure or other disruption.

c) Calculations and Modeling Used to Establish Soil Gas Remediation Objectives

The calculations and modeling shall account for contaminant transport through the mechanisms of diffusion and advection. Proposals to use soil gas data, including sub-slab samples, to establish remediation objectives for the indoor inhalation exposure route that differ from the requirements of Section 742.227 shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

1) Scaled map of the area, showing all buildings and man-made pathways (current and planned);

2) The current extent and modeled migration of contamination;

3) Geology, including soil types and parameters;

4) Depth to groundwater (including seasonal variation) and flow direction;

5) Location of soil gas sampling points;

6) A discussion of soil gas sampling procedures that, at a minimum, addresses the following:

A) sampling equipment;

B) soil gas collection protocol, including field tests and weather conditions; and

C) laboratory analytical methods.

d) Calculations and Modeling Used to Establish Soil Remediation Objectives

The calculations and modeling shall account for contaminant transport through the mechanisms of diffusion and advection. Any proposals to use soil data in lieu of soil gas data to establish remediation objectives for the indoor inhalation exposure route shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

1) Scaled map of the area, showing all buildings and man-made pathways (current and planned);

2) The current extent and modeled migration of contamination;

3) Geology, including soil types and parameters;

4) Location of soil sampling points;

5) A discussion of soil sampling procedures that, at a minimum, addresses the following:

A) sampling equipment;

B) soil collection protocol, including field tests and weather conditions; and

C) laboratory analytical methods;

6) Mathematical and technical justification for the model proposed; and

7) Demonstration that the model was correctly applied.

e) Calculations and Modeling Used to Establish Groundwater Remediation Objectives

The calculations and modeling shall account for contaminant transport through the mechanisms of diffusion and advection. Proposals to use groundwater data to establish remediation objectives for the indoor inhalation exposure route that differ from the requirements of Sections 742.805 and 742.812 shall be submitted to the Agency for review and approval. A submittal under this Section shall include the following information:

1) Scaled map of the area, showing all buildings and man-made pathways (current and planned);

2) The current extent and modeled migration of contamination;

3) Geology, including soil types and parameters and the thickness of the capillary fringe;

4) Depth to groundwater (including seasonal variation) and flow direction;

5) Results and locations of groundwater sampling events;

6) Mathematical and technical justification for the model proposed; and

7) Demonstration that the model was correctly applied.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

SUBPART J: INSTITUTIONAL CONTROLS

Section 742.1000 Institutional Controls

a) Institutional controls in accordance with this Subpart must be placed on the property when remediation objectives are based on any of the following assumptions:

1) Industrial/Commercial property use;

2) Target cancer risk greater than 1 in 1,000,000;

3) Target hazard quotient greater than 1;

4) Engineered barriers;

5) The point of human exposure is located at a place other than at the source;

6) Exclusion of exposure routes;

7) A diffusion only mode of contaminant transport for the indoor inhalation exposure route;

8) Use of an indoor inhalation building control technology;

9) For the indoor inhalation exposure route, the presence of a building with a full concrete slab-on-grade or a full concrete basement floor and walls; or

10) Any combination of the above.

b) The Agency shall not approve any remediation objective under this Part that is based on the use of institutional controls unless the person has proposed institutional controls meeting the requirements of this Subpart and the requirements of the specific program under which the institutional control is proposed. A proposal for approval of institutional controls shall provide identification of the selected institutional controls from among the types recognized in this Subpart.

c) The following instruments may be institutional controls subject to the requirements of this Subpart J and the requirements of the specific program under which the institutional control is proposed:

1) No Further Remediation Letters;

2) Environmental Land Use Controls;

3) Land Use Control Memoranda of Agreement;

4) Ordinances adopted and administered by a unit of local government;

5) Agreements between a property owner (or, in the case of a petroleum leaking underground storage tank, the owner or operator of the tank) and a highway authority with respect to any contamination remaining under highways; and

6) Agreements between a highway authority that is also the property owner (or, in the case of a petroleum leaking underground storage tank, the owner or operator of the tank) and the Agency with respect to any contamination remaining under the highways.

d) No Further Remediation Letters and Environmental Land Use Controls that meet the requirements of this Subpart and the recording requirements of the program under which remediation is being performed are transferred with the property.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.1005 No Further Remediation Letters

a) A No Further Remediation Letter issued by the Agency under 35 Ill. Adm. Code 732 or 740 may be used as an institutional control under this Part if the requirements of subsection (b) of this Section are met.

b) A request for approval of a No Further Remediation Letter as an institutional control shall meet the requirements applicable to the specific program under which the remediation is performed.

(Source: Amended at 25 Ill. Reg. 10374, effective August 15, 2001)

Section 742.1010 Environmental Land Use Controls

a) An Environmental Land Use Control (ELUC) is an institutional control that may be used under this Part to impose land use limitations or requirements related to environmental contamination. ELUCs are only effective when approved by the Agency in accordance with this Part. Activities or uses that may be limited or required include, but are not limited to, prohibition of use of groundwater for potable purposes, restriction to industrial/commercial uses, operation or maintenance of engineered barriers, indoor inhalation building control technologies, or worker safety plans. ELUCs may be used in the following circumstances:

1) When No Further Remediation Letters are not available, including but not limited to when contamination has migrated off-site or outside the remediation site; or

2) When No Further Remediation Letters are not issued under the program for which a person is undergoing remediation.

b) Recording requirements:

1) An ELUC approved by the Agency pursuant to this Section must be recorded in the Office of the Recorder or Registrar of Titles for the county in which the property that is the subject of the ELUC is located. A copy of the ELUC demonstrating that it has been recorded must be submitted to the Agency before the Agency will issue a no further remediation determination.

2) An ELUC approved under this Section will not become effective until officially recorded in the chain of title for the property that is the subject of the ELUC in accordance with subsection (b)(1) of this Section.

3) Reference to the recorded ELUC must be made in the instrument memorializing the Agency's no further remediation determination. Recording of the no further remediation determination and confirmation of

recording must be in accordance with the requirements of the program under which the determination was issued.

4) The requirements of this Section do not apply to Federally Owned Property for which the Federal Landholding Entity does not have the authority under federal law to record land use limitations on the chain of title.

5) The requirements of this Section apply only to those sites for which a request for a no further remediation determination has not yet been made to the Agency by January 6, 2001.

c) Duration:

1) Except as provided in this subsection (c), an ELUC shall remain in effect in perpetuity.

2) *At no time shall any site for which an ELUC has been imposed as a result of remediation activities under this Part be used in a manner inconsistent with the land use limitation unless attainment of objectives appropriate for the new land use is achieved and a new* no further remediation determination has been *obtained and recorded in accordance with* the program under which the ELUC was first imposed or the Site Remediation Program (35 Ill. Adm. Code 740) [415 ILCS 58.8(c)]. In addition, the appropriate release or modification of the ELUC must be prepared by the Agency and filed on the chain of title for the property that is the subject of the ELUC.

A) For a Leaking Underground Storage Tank (LUST) site under 35 Ill. Adm. Code 731 or 734 or a Site Remediation Program site under 35 Ill. Adm. Code 740, an ELUC may be released or modified only if the NFR Letter is also modified under the Site Remediation Program to reflect the change;

B) For a RCRA site under 35 Ill. Adm. Code 721-730, an ELUC may be released or modified only if there is also an amended certification of closure or a permit modification.

3) In addition to any other remedies that may be available, a failure to comply with the limitations or requirements of an ELUC may result in voidance of an Agency no further remediation determination in accordance with the program under which the determination was made. The failure to comply with the limitations or requirements of an ELUC may also be grounds for an enforcement action pursuant to Title VIII of the Act.

d) An ELUC submitted to the Agency must match the form and contain the same substance, except for variable elements (e.g., name of property owner), as the model in Appendix F and must contain the following elements:

1) Name of property owners and declaration of property ownership;

2) Identification of the property to which the ELUC applies by common address, legal description, and Real Estate Tax Index/Parcel Index Number;

3) A reference to the Bureau of Land LPC numbers or 10-digit identification numbers under which the remediation was conducted;

4) A statement of the reason for the land use limitation or requirement relative to protecting human health and the surrounding environment from soil, groundwater, and/or other environmental contamination;

5) The language instituting such land use limitations or requirements;

6) A statement that the limitations or requirements apply to the current owners, occupants, and all heirs, successors, assigns, and lessees;

7) A statement that the limitations or requirements apply in perpetuity or until:

A) The Agency determines that there is no longer a need for the ELUC;

B) The Agency, upon written request, issues to the site that received the no further remediation determination that relies on the ELUC a new no further remediation determination approving modification or removal of the limitations or requirements;

C) The new no further remediation determination is filed on the chain of title of the site subject to the no further remediation determination; and

D) A release or modification of the land use limitation is filed on the chain of title for the property that is the subject of the ELUC;

8) Scaled site maps showing:

A) The legal boundary of the property to which the ELUC applies;

B) The horizontal and vertical extent of contaminants of concern above applicable remediation objectives for soil, groundwater, and soil gas to which the ELUC applies;

C) Any physical features to which an ELUC applies (e.g., engineered barriers, monitoring wells, caps, indoor inhalation building control technologies); and

D) The nature, location of the source, and direction of movement of the contaminants of concern;

9) A statement that any information regarding the remediation performed on the property for which the ELUC is necessary may be obtained from the Agency through a request under the Freedom of Information Act [5 ILCS 140] and rules promulgated thereunder; and

10) The dated, notarized signatures of the property owners or authorized agent.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.1012 Federally Owned Property: Land Use Control Memoranda of Agreement

a) A Land Use Control Memorandum of Agreement (LUC MOA) between one or more agencies of the federal government and the Illinois Environmental Protection Agency is the institutional control that shall be used under this Part to impose land use limitations or restrictions related to environmental contamination on Federally Owned Property. A LUC MOA may be used only for Federally Owned Property. Each LUC MOA, at a minimum, must require that the Federal Landholding Entities responsible for the Federally Owned Property do the following:

1) Provide adequate identification of the location on the Federally Owned Property of each site with land use limitations or requirements. Such identification shall be by means of common address, notations in any available facility master land use plan, site specific GIS or GPS coordinates, plat maps, or any other means which identifies the site in question with particularity;

2) Implement periodic site inspection procedures to ensure adequate oversight by the Federal Landholding Entities of such land use limitation or requirement;

3) Implement procedures for the Federal Landholding Entities to periodically advise the Agency of continued compliance with the maintenance of the land use control and site inspection requirements included in the LUC MOA;

4) Implement procedures for the Federal Landholding Entities to notify the Agency of any planned or emergency changes in land use that may adversely impact any site with land use limitations or requirements; and

5) Notify the Agency at least 60 days in advance of a conveyance by deed or fee simple title, by the Federal Landholding Entities, of a site with land use limitations or requirements, to any entity that will not remain or become a Federal Landholding Entity, and provide the Agency with information about how the Federal Landholding Entities will ensure that the requirements of Section 742.1010 are to be satisfied upon conveyance of that site.

a) Any LUC MOA entered into pursuant to this Section remains effective only so long as title to the affected property is retained by the United States.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.1015 Ordinances

a) An ordinance adopted by a unit of local government that effectively prohibits the installation of potable water supply wells (and the use of such wells) may be used as an institutional control to meet the requirements of Section 742.320(d) or 742.805(a)(3) if the requirements of this Section are met. A model ordinance is found in Appendix G. Ordinances prohibiting the installation of potable water supply wells (and the use of such wells) that do not expressly prohibit the installation of potable water supply wells (and the use of such wells) by units of local government may be acceptable as institutional controls if the requirements of this Section are met and a Memorandum of Understanding (MOU) is entered into under subsection (i) of this Section. For purposes of this Section, a unit of local government is considered to be expressly prohibited from installing and using potable water supply wells only if the unit of local government is included in the prohibition provision by name. The prohibition required by this Section shall satisfy the following requirements at a minimum:

1) The prohibition shall not allow exceptions for potable water well installation and use other than for the adopting unit of local government;

2) The prohibition shall apply at all depths and shall not be limited to particular aquifers or other geologic formations;

3) If the prohibition does not apply everywhere within the boundaries of the unit of local government, the limited area to which the prohibition applies shall be easily identifiable and clearly defined by the ordinance (e.g., narrative descriptions accompanied by maps with legends or labels showing prohibition boundaries, or narrative descriptions using fixed, common reference points such as street names). Boundaries of prohibitions limited by area shall be fixed by the terms of the ordinance and shall not be subject to change without amending the ordinance in which the prohibition has been adopted (e.g., no boundaries defined with reference to zoning districts or the availability of the public water supply); and

4) The prohibition shall not in any way restrict or limit the Agency's approval of the use of the ordinance as an institutional control pursuant to this Part (e.g., no restrictions based on remediation program participation, no restrictions on persons performing remediation within the prohibition area who may use the ordinance).

b) A request for approval of a local ordinance as an institutional control shall provide the following:

1) A copy of the ordinance restricting groundwater use certified by an official of the unit of local government in which the site is located that it is a true and accurate copy of the ordinance, unless the Agency and the unit of local government have entered an agreement under subsection (i) of this Section, in which case the request may alternatively reference the MOU. The ordinance must demonstrate that potable use of groundwater from potable water supply wells is prohibited;

2) A scaled map or maps delineating the area and extent of groundwater contamination modeled above the applicable remediation objectives including any measured data showing concentrations of contaminants of concern in which the applicable remediation objectives are exceeded;

3) A scaled map delineating the boundaries of all properties under which groundwater is located that exceeds the applicable groundwater remediation objectives;

4) Information identifying the current owners of each property identified in subsection (b)(3); and

5) A copy of the proposed written notification to the unit of local government that adopted the ordinance and to the current owners identified in subsection (b)(4) that includes the following information:

A) The name and address of the unit of local government that adopted the ordinance;

B) The ordinance's citation;

C) A description of the property being sent notice by adequate legal description, reference to a plat showing the boundaries of the property, or accurate street address;

D) Identification of the party requesting to use the groundwater ordinance as an institutional control, and a statement that the party

has requested approval from the Agency to use the ordinance as an institutional control;

E) A statement that use of the ordinance as an institutional control allows contamination above groundwater ingestion remediation objectives to remain in groundwater beneath the affected properties, and that the ordinance strictly prohibits human and domestic consumption of the groundwater;

F) A statement as to the nature of the release and response action with the site name, site address, and Agency site number or Illinois inventory identification number; and

G) A statement that more information about the remediation site may be obtained by contacting the party requesting the use of the groundwater ordinance as an institutional control or by submitting a FOIA request to the Agency.

c) Written notification proposed pursuant to subsection (b)(5) must be sent to the unit of local government that adopted the ordinance, as well as to all current property owners identified in subsection (b)(4). Written proof that the notification was sent to the unit of local government and the property owners shall be submitted to the Agency within 45 days from the date the Agency's no further remediation determination is recorded. Such proof may consist of the return card from certified mail, return receipt requested, a notarized certificate of service, or a notarized affidavit.

d) Unless the Agency and the unit of local government have entered into a MOU under subsection (i), the current owner or successors in interest of a site who have received approval of use of an ordinance as an institutional control under this Section shall:

1) Monitor activities of the unit of local government relative to variance requests or changes in the ordinance relative to the use of potable groundwater at properties identified in subsection (b)(3); and

2) Notify the Agency of any approved variance requests or ordinance changes within 30 days after the date such action has been approved.

e) The information required in subsections (b)(1) through (b)(5) and the Agency letter approving the groundwater remediation objective shall be submitted to the unit of local government. Proof that the information has been filed with the unit of local government shall be provided to the Agency.

f) Any ordinance or MOU used as an institutional control pursuant to this Section shall be recorded in the Office of the Recorder or Registrar of Titles of the county

in which the site is located together with the instrument memorializing the Agency's no further remediation determination pursuant to the specific program within 45 days after receipt of the Agency's no further remediation determination.

g) An institutional control approved under this Section shall not become effective until officially recorded in accordance with subsection (f). The person receiving the approval shall obtain and submit to the Agency within 30 days after recording a copy of the institutional control demonstrating that it has been recorded.

h) The following shall be grounds for voidance of the ordinance as an institutional control and the instrument memorializing the Agency's no further remediation determination:

1) Modification of the ordinance by the unit of local government to allow potable use of groundwater;

2) Approval of a site-specific request, such as a variance, to allow potable use of groundwater at a site identified in subsection (b)(3);

3) Violation of the terms of an institutional control recorded under Section 742.1005 or Section 742.1010; or

4) Failure to provide notification and proof of such notification pursuant to subsection (c).

i) The Agency and a unit of local government may enter into a MOU under this Section if the unit of local government has adopted an ordinance satisfying subsection (a) and if the requirements of this subsection are met. The MOU submitted to the Agency must match the form and contain the same substance as the model in Appendix H and shall include the following:

1) Identification of the authority of the unit of local government to enter the MOU;

2) Identification of the legal boundaries, or equivalent, under which the ordinance is applicable;

3) A certified copy of the ordinance;

4) A commitment by the unit of local government to notify the Agency of any variance requests or proposed ordinance changes at least 30 days prior to the date the local government is scheduled to take action on the request or proposed change;

5) A commitment by the unit of local government to maintain a registry of all sites within the unit of local government that have received no further remediation determinations pursuant to specific programs; and

6) If the ordinance does not expressly prohibit the installation of potable water supply wells (and the use of such wells) by units of local government, a commitment by the unit of local government:

A) To review the registry of sites established under subsection (i)(5) prior to siting potable water supply wells within the area covered by the ordinance;

B) To determine whether the potential source of potable water may be or has been affected by contamination left in place at those sites; and

C) To take whatever steps are necessary to ensure that the potential source of potable water is protected from the contamination or treated before it is used as a potable water supply.

j) A groundwater ordinance may not be used to exclude the indoor inhalation exposure route.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.1020 Highway Authority Agreements and Highway Authority Agreement Memoranda of Agreement

a) An agreement with a highway authority may be used as an institutional control where the requirements of this Section are met and the Agency has determined that no further remediation is required as to the property(ies) to which the agreement is to apply. Highway Authority Agreements submitted to the Agency, except for those agreements with the Illinois Department of Transportation, must match the form and contain the same substance, except for variable elements, as the model in Appendix D.

b) As part of the agreement the highway authority shall agree to:

1) Prohibit the use of groundwater under the highway right of way that is contaminated above residential Tier 1 remediation objectives from the release as a potable supply of water; and

2) Limit access to soil contamination under the highway right of way that is contaminated above residential Tier 1 or construction worker remediation objectives, whichever is less, from the release. Access to soil contamination may be allowed if, during and after any access, public health and the environment are protected.

c) The agreement shall provide the following:

1) Fully executed signature blocks by the highway authority and the owner of the property (or, in the case of a petroleum leaking underground storage tank, the owner or operator of the tank) from which the release occurred;

2) A scaled map delineating the area and extent of soil and groundwater contamination above the applicable Tier 1 remediation objectives or a statement that either soil or groundwater is not contaminated above the applicable Tier 1 residential remediation objectives;

3) Information showing the concentration of contaminants of concern within the zone in which the applicable Tier 1 remediation objectives are exceeded;

4) A stipulation of the information required by subsections (c)(2) and (3) of this Section in the agreement if it is not practical to obtain the information by sampling the highway right-of-way; and

5) Information identifying the highway authority having jurisdiction.

d) Highway Authority Agreements must be referenced in the instrument that is to be recorded on the chain of title for the remediation property.

e) Violation of the terms of an Agreement approved by the Agency as an institutional control under this Section shall be grounds for voidance of the Agreement as an institutional control and the instrument memorializing the Agency's no further remediation determination.

f) Failure to provide all of the information required in subsections (b) and (c) of this Section will be grounds for denial of the Highway Authority Agreement as an institutional control.

g) In instances in which the highway authority is also the property owner of the site, a Highway Authority Agreement may not be used. In such cases, the highway authority shall instead enter into a Highway Authority Agreement Memorandum of Agreement (HAA MOA) between the highway authority and the Agency. An HAA MOA may be used as an institutional control where the requirements of this Section are met and the Agency has determined that no further remediation is required as to the property(ies) to which the agreement is to apply. HAA MOAs submitted to the Agency must match the form and contain the same substance, except for variable elements, as the model in Appendix E.

h) As part of the HAA MOA the highway authority shall agree to:

1) Prohibit the use of groundwater under the highway right of way that is contaminated above residential Tier 1 or construction worker remediation objectives, whichever are less, from the release as a potable supply of water; and

2) Limit access to soil contamination under the highway right of way that is contaminated above residential Tier 1 or construction worker remediation objectives, whichever are less, from the release. Access to soil

contamination may be allowed if, during and after any access, public health and the environment are protected.

i) The HAA MOA shall provide the following:

1) Information identifying the site by common address or legal description or both;

2) The Illinois Emergency Management Agency's (IEMA) incident number for the site, if one has been assigned;

3) A scaled map delineating the current and estimated future area and extent of soil and groundwater contamination above the applicable Tier 1 or construction worker remediation objectives, whichever are less, or a statement that either soil or groundwater is not contaminated above the applicable Tier 1 residential remediation objectives;

4) Information prepared by the highway authority that lists each contaminant of concern that exceeds its Tier 1 residential or construction worker remediation objective, its Tier 1 residential remediation objective, and its concentrations within the zone where Tier 1 residential or construction worker remediation objectives, whichever is less, are exceeded;

5) A scaled map prepared by the highway authority showing the area of the highway authority's right of way that is governed by the HAA MOA;

6) If samples have not been collected within the right of way because of impracticability, a stipulation by the parties that, based on modeling, soil and groundwater contamination exceeding Tier 1 residential or construction worker remediation objectives, whichever is less, does not and will not extend beyond the boundaries of the right-of-way;

7) A stipulation by the highway authority that it has jurisdiction over the right of way that gives it sole control over the use of the groundwater and access to the soil located within or beneath the right of way;

8) A stipulation by the highway authority that it agrees to limit access by itself and others to soil within the right of way exceeding Tier 1 residential or construction worker remediation objectives, whichever is less. Access may only be allowed if human health (including worker safety) and the environment are protected during and after any access. The highway authority may construct, reconstruct, improve, repair, maintain, and operate a highway upon the right of way, or allow others to do the same by permit. The highway authority and others using or working in the right of way under permit have the right to remove soil or groundwater from the right of way and dispose of the same in accordance with applicable environmental laws and regulations. The highway authority agrees to issue all permits for work in the right of way, and make all existing permits for work in the right of way, subject to the following or substantially similar conditions:

A) As a condition of this permit the permittee shall request the office issuing this permit to identify sites in the right of way where a HAA MOA governs access to soil that exceeds the Tier 1 residential remediation objectives of 35 Ill. Adm. Code 742; and

B) The permittee shall take all measures necessary to protect human health (including worker safety) and the environment during and after any access to such soil;

9) A stipulation that the HAA MOA shall be referenced in the Agency's no further remediation determination issued for the release(s);

10) A stipulation that the highway authority shall notify the Agency of any transfer of jurisdiction over the right of way at least 30 days prior to the date the transfer takes effect. The HAA MOA shall be null and void upon the transfer unless the transferee agrees to be bound by the agreement as if the transferee were an original party to the agreement. The transferee's agreement to be bound by the terms of the agreement shall be memorialized at the time of transfer as a rider to this agreement that references the HAA MOA and is signed by the highway authority, or subsequent transferor, and the transferee;

11) A stipulation that the HAA MOA will become effective on the date the Agency issues a no further remediation determination for the release(s). It shall remain effective until the right of way is demonstrated to be suitable for unrestricted use and the Agency issues a new no further remediation determination to reflect there is no longer a need for the HAA MOA, or until the agreement is otherwise terminated or voided;

12) A stipulation that in addition to any other remedies that may be available, the Agency may bring suit to enforce the terms of the HAA MOA or may, at its sole discretion, declare the HAA MOA null and void if the highway authority or a transferee violates any term of the HAA MOA. The highway authority or transferee shall be notified in writing of any such declaration; and

13) A fully executed signature block by the highway authority and a block for the Agency's Director.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

SUBPART K: ENGINEERED BARRIERS

Section 742.1100 Engineered Barriers

a) Any person who develops remediation objectives under this Part based on engineered barriers shall meet the requirements of this Subpart and the requirements of Subpart J relative to institutional controls.

b) The Agency shall not approve any remediation objective under this Part that is based on the use of engineered barriers unless the person has proposed engineered barriers meeting the requirements of this Subpart.

c) The use of engineered barriers can be recognized in calculating remediation objectives only if the engineered barriers are intended for use as part of the final corrective action.

d) Any no further remediation determination based upon the use of engineered barriers shall require effective maintenance of the engineered barrier. The maintenance requirements shall be included in an institutional control under Subpart J. This institutional control shall address provisions for temporary breaches of the barrier by requiring the following if intrusive construction work is to be performed in which the engineered barrier is to be temporarily breached:

1) The construction workers shall be notified by the site owner/operator in advance of intrusive activities. Such notification shall enumerate the contaminant of concern known to be present; and

2) The site owner/operator shall require construction workers to implement protective measures consistent with good industrial hygiene practice.

e) Failure to maintain an engineered barrier in accordance with that no further remediation determination shall be grounds for voidance of the determination and the instrument memorializing the Agency's no further remediation determination.

Section 742.1105 Engineered Barrier Requirements

a) Natural attenuation, access controls, and point of use treatment shall not be considered engineered barriers. Engineered barriers may not be used to prevent direct human exposure to groundwater without the use of institutional controls.

b) For purposes of determining remediation objectives under Tier 1, engineered barriers are not recognized.

c) The following engineered barriers are recognized for purposes of calculating remediation objectives that exceed residential remediation objectives:

1) For the soil component of the groundwater ingestion exposure route, the following engineered barriers are recognized if they prevent completion of the exposure pathway:

A) Caps or walls constructed of compacted clay, asphalt, concrete or other material approved by the Agency; and

B) Permanent structures such as buildings and highways.

2) For the soil ingestion exposure route, the following engineered barriers are recognized if they prevent completion of the exposure pathway:

A) Caps or walls constructed of compacted clay, asphalt, concrete, or other material approved by the Agency;

B) Permanent structures such as buildings and highways; and

C) Soil, sand, gravel, or other geologic materials that:

i) Cover the contaminated media;

ii) Meet the soil remediation objectives under Subpart E for residential property for contaminants of concern; and

iii) Are a minimum of three feet in depth.

3) For the outdoor inhalation exposure route, the following engineered barriers are recognized if they prevent completion of the exposure pathway:

A) Caps or walls constructed of compacted clay, asphalt, concrete, or other material approved by the Agency;

B) Permanent structures such as buildings and highways; and

C) Soil, sand, gravel, or other geologic materials that:

i) Cover the contaminated media;

ii) Meet the soil remediation objectives under Subpart E for residential property for contaminants of concern; and

iii) Are a minimum of ten feet in depth and not within ten feet of any manmade pathway.

4) For the ingestion of groundwater exposure route, the following engineered barriers are recognized if they prevent completion of the exposure pathway:

A) Slurry walls; and

B) Hydraulic control of groundwater.

d) Unless otherwise prohibited under Section 742.1100, any other type of engineered barrier may be proposed if it will be as effective as the options listed in subsection (c).

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

SUBPART L: BUILDING CONTROL TECHNOLOGIES

Section 742.1200 Building Control Technologies

a) Any person who develops remediation objectives under this Part based on building control technologies shall meet the requirements of this Subpart and the requirements of Subpart J relative to institutional controls.

b) The Agency shall not approve any remediation objective under this Part that is based on the use of building control technologies unless the person has proposed building control technologies meeting the requirements of the following:

1) This Subpart L or Subpart I; and

2) Subpart J relative to institutional controls.

c) The use of building control technologies can be recognized in determining remediation objectives only if the building control technologies are intended for use as part of the final corrective action.

d) An approved building control technology shall be in place and operational prior to human occupancy.

e) Any no further remediation determination based upon the use of building control technologies shall require effective maintenance of the building control technology. The maintenance requirements shall be included in an institutional control under Subpart J. This institutional control shall address provisions for inoperability by requiring the following if the building control technology is rendered inoperable:

1) The site owner/operator shall notify building occupants and workers in advance of intrusive activities. The notification shall enumerate the contaminant of concern known to be present;

2) The site owner/operator shall require building occupants and workers to implement protective measures consistent with good industrial hygiene practice; and

3) For a school, the school administrator shall notify the Agency, the school board, and every parent or legal guardian for all enrolled students when a building control technology is rendered inoperable for a period of five consecutive calendar days during the school year when school is in session. For purposes of the preceding sentence, any occurrence of inoperability, regardless of its duration, results in the date of the occurrence constituting a day of inoperability. For purposes of this subsection (e)(3), the term "school" means any public educational facility in Illinois, including grounds and/or campus, consisting of students, comprising one or more grade groups or other identifiable groups, organized as one unit with one or more teachers to give instruction of a defined type. Public educational facility includes, but is not limited to, primary and secondary (kindergarten-12th grade), charter, vocational, alternative, and special education schools. Public educational facility does not include junior colleges, colleges, or universities. For purposes of this subsection (e)(3), the term "school administrator" means the school's principal, or similar administrator responsible for the school's operations, or his or her designee.

f) Failure to install or maintain a building control technology in accordance with a no further remediation determination shall be grounds for voidance of the determination and the instrument memorializing the Agency's no further remediation determination.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.1205 Building Control Technology Proposals

A proposal to use a building control technology under this Subpart shall include the following information:

a) A description of the site and physical site characteristics;

b) The current extent and modeled migration of contamination;

c) Geology, including soil types and parameters;

d) Results and locations of sampling events;

e) Scaled map of the area, including all buildings and man-made pathways;

f) A description of building characteristics and methods of construction, including a description of man-made pathways; and

g) Present and post-remediation uses of the land that are at issue due to the area of contamination, including human receptors at risk.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.1210 Building Control Technology Requirements

a) Natural attenuation, access controls, and point of use treatment shall not be considered building control technologies.

b) For purposes of determining compliance with remediation objectives under Tier 1, building control technologies are not recognized.

c) The following building control technologies are recognized for purposes of pathway exclusion under Section 742.312.

1) Sub-slab depressurization (SSD) systems meeting the following requirements:

A) A suction pit is installed that is at least two cubic feet and extends at least 6 inches below the slab (larger suction pits may be excavated as needed to achieve the performance criteria in subsection (c)(1)(B));

B) A PVC pipe of at least 3 inches in diameter extends from the suction pit to the intake side of an in-line fan capable of achieving a static vacuum of at least 0.25 inches water column (wc) at the suction point and measureable vacuum at the farthest edges of the area served by the suction pit under worst case conditions (all exhaust fans and heating systems running, during cold weather) as determined by a differential pressure reading of at least -0.003 inches wc below the slab or visible downward flow of air at test holes using chemical or smoke sticks;

C) All visible cracks and joints in the slab (including the place where the pipe exits the slab) and foundation walls are sealed;

D) The pipe exhausts outside the building at least 10 feet above ground and at least 10 feet from any door or window; and

E) Additional suction pits meeting the requirements of subsection (c)(1)(A) shall be installed as necessary to achieve measureable vacuum below the slab in all areas, including in any area where subsurface or foundation conditions (e.g., a sub-slab grade beam) prevent adequate suction field extension.

2) Sub-membrane depressurization (SMD) systems meeting the following requirements:

A) A non-woven geotextile is installed on the exposed earthen material;

B) A cross-laminated polyethylene membrane liner at least 0.10 mm (or 4 mil) thick is placed over the geotextile and sealed to foundation walls using a low volatile adhesive that is recommended by the liner manufacturer (e.g., acrylic latex adhesive);

C) A 3 inch diameter PVC pipe extends from a hole cut in the liner to the intake side of an in-line fan capable of achieving a static vacuum of at least 0.25 inches water column (wc) at the riser pipe and measureable vacuum at the farthest edges of the liner under worst case conditions (all exhaust fans running during cold weather) as determined by a differential pressure reading of at least -0.003 inches wc below the liner or visible downward flow of air in test holes using chemical or smoke sticks;

D) The pipe is sealed to the liner;

E) The pipe exhausts outside the building at least 10 feet above ground and at least 10 feet from any door or window; and

F) No leaks based on smoke stick tests along the entire perimeter of the liner (i.e., at all sealed edges) with the fan running. Where leaks are identified, appropriate repairs are undertaken and smoke stick testing repeated until no leaks are detected.

3) Membrane barrier systems when placed below concrete slabs meeting the following requirements:

A) The membrane is impermeable to volatile chemicals and is not less than 1.5 mm (or 60 mil) thick;

B) The membrane is sealed to foundation walls and any penetrating pipes according to membrane manufacturer/installer recommendations;

C) The membrane is installed in accordance with the manufacturer's requirements and by an applicator trained and approved by the manufacturer;

D) A smoke test of the membrane system (where smoke is injected below the installed liner prior to slab installation), in accordance with the manufacturer's requirements, is performed to ensure no leaks exist. Where leaks are identified, appropriate repairs are undertaken and smoke testing repeated until no leaks are detected;

E) The membrane is puncture resistant to slab installation construction activities and protected by sand layers or geotextiles as recommended by the manufacturer; and

F) Construction activities following membrane installation do not damage, puncture or tear the membrane or otherwise compromise its ability to prevent the migration of volatile chemicals.

4) Vented raised floors meeting the following requirements:

A) An interconnected void system below the slab sufficient to allow free movement of air and communication of negative pressures to all points below the slab;

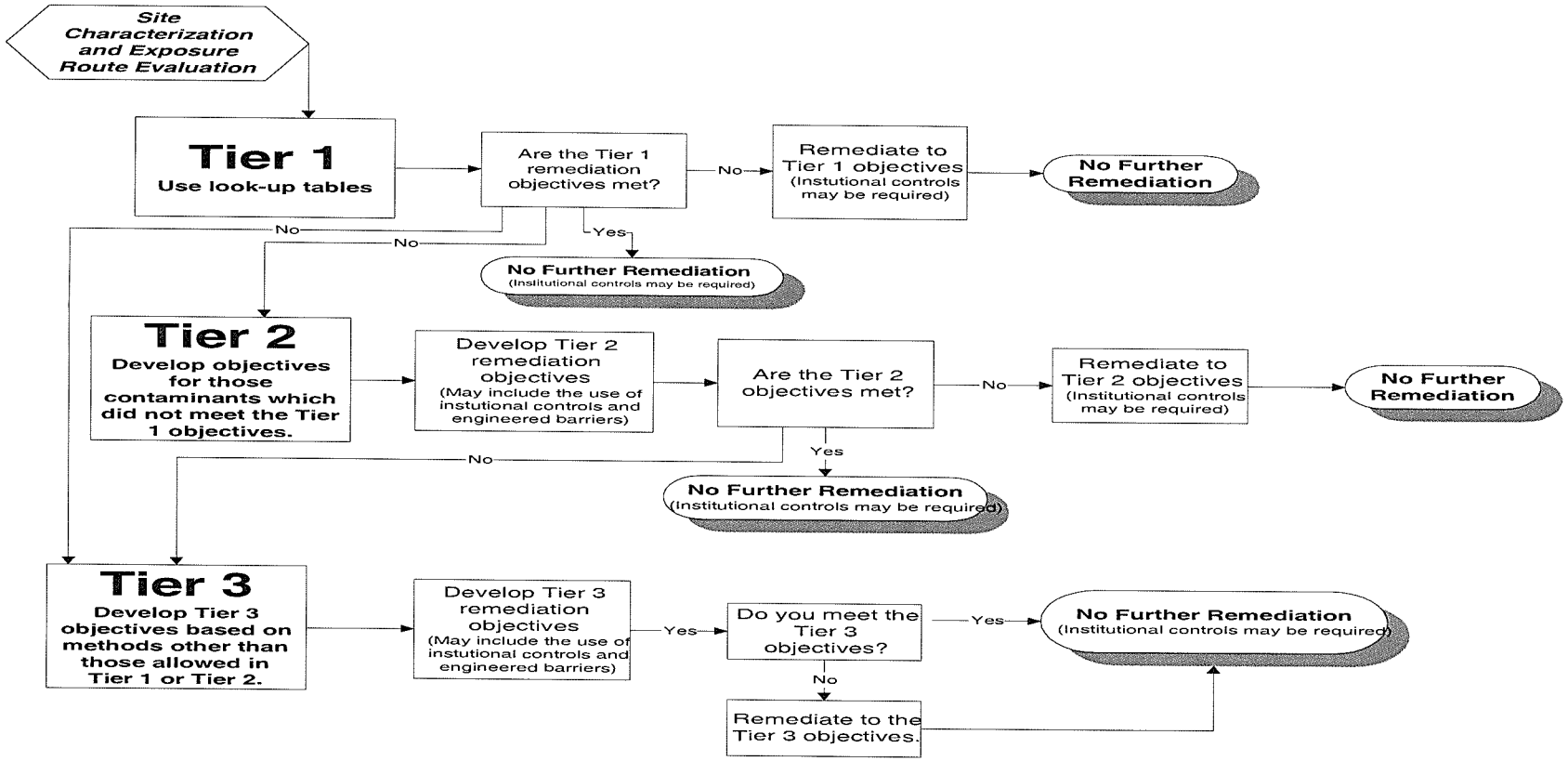
B) Sealing of all construction joints, open cracks, and penetrations through the slab (e.g., for utilities and riser pipes) with a low volatile caulk; and

C) At least one 3 inch diameter riser pipe venting to the atmosphere above the roof line (at least 10 feet from any doors or windows) for each 5000 square feet of membrane area, with the capability of converting passively vented floor systems to actively vented or SSD systems meeting the performance requirements of subsection (c)(1).

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

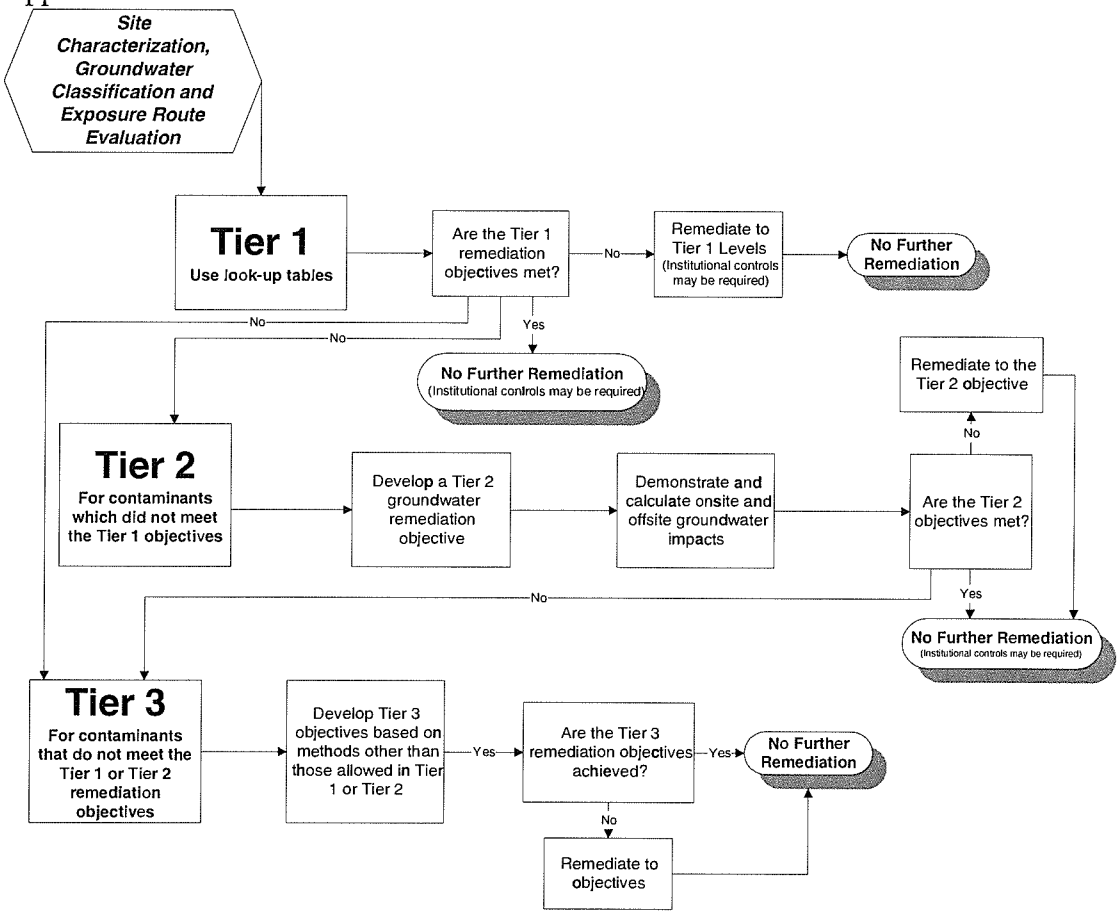
Section 742.APPENDIX A: General

Section 742.Illustration A: Developing Soil Remediation Objectives Under the Tiered Approach



Section 742.APPENDIX A: General

Section 742.Illustration B: Developing Groundwater Remediation Objectives Under the Tiered Approach



Section 742.APPENDIX A: General

Section 742.TABLE A: Soil Saturation Limits (C_{sat}) for Chemicals Whose Melting Point is Less Than 30° C

CAS No.	Chemical Name	For the Outdoor Inhalation Exposure Route[a] C_{sat} (mg/kg)	For the Soil Component of the Groundwater Ingestion Exposure Route[b] C_{sat} (mg/kg)
67-64-1	Acetone	1.00E+05	2.00E+05
71-43-2	Benzene	8.00E+02	5.80E+02
111-44-4	Bis(2-chloroethyl)ether	3.00E+03	3.90E+03
117-81-7	Bis(2-ethylhexyl)phthalate	2.00E+02	6.80E+01
75-27-4	Bromodichloromethane (Dichlorobromomethane)	2.80E+03	2.00E+03
75-25-2	Bromoform	2.00E+03	1.20E+03
71-36-3	Butanol	1.00E+04	1.60E+04
78-93-3	2-Butanone (MEK)	2.50E+04	4.50E+04
85-68-7	Butyl benzyl phthalate	1.00E+03	3.40E+02
75-15-0	Carbon disulfide	8.50E+02	5.20E+02
56-23-5	Carbon tetrachloride	1.20E+03	5.60E+02
108-90-7	Chlorobenzene (Monochlorobenzene)	6.20E+02	2.90E+02
124-48-1	Chlorodibromomethane (Dibromochloromethane)	1.40E+03	8.90E+02
67-66-3	Chloroform	3.40E+03	2.50E+03
95-57-8	2-Chlorophenol [c] (ionizable organic)	1.00E+04	7.10E+03
75-99-0	Dalapon	1.20E+05	1.90E+05
96-12-8	1,2-Dibromo-3-chloropropane	6.90E+02	4.30E+02
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	1.60E+03	1.20E+03

CAS No.	Chemical Name	For the Outdoor Inhalation Exposure Route[a] C_{sat} (mg/kg)	For the Soil Component of the Groundwater Ingestion Exposure Route[b] C_{sat} (mg/kg)
84-74-2	Di-*n*-butyl phthalate	2.60E+03	8.80E+02
95-50-1	1,2-Dichlorobenzene (o-Dichlorobenzene)	5.60E+02	2.10E+02
75-71-8	Dichlorodifluoromethane	8.70E+02	4.30E+02
75-34-3	1,1-Dichloroethane	1.70E+03	1.40E+03
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	1.90E+03	2.10E+03
75-35-4	1,1-Dichloroethylene	1.40E+03	9.10E+02
156-59-2	*cis*-1,2-Dichloroethylene	1.30E+03	1.00E+03
156-60-5	*trans*-1,2-Dichloroethylene	3.00E+03	2.10E+03
78-87-5	1,2-Dichloropropane	1.20E+03	8.70E+02
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	1.00E+03	8.50E+02
84-66-2	Diethyl phthalate	2.20E+03	9.20E+02
105-67-9	2,4-Dimethylphenol	1.00E+04	4.70E+03
117-84-0	Di-*n*-octyl phthalate	1.60E+01	5.20E+00
123-91-1	p-Dioxane	1.00E+05	2.00E+05
100-41-4	Ethylbenzene	3.50E+02	1.50E+02
77-47-4	Hexachlorocyclopentadiene	1.30E+02	4.40E+01
78-59-1	Isophorone	3.00E+03	3.00E+03
98-82-8	Isopropylbenzene (Cumene)	9.40E+02	4.00E+02
7439-97-6	Mercury (elemental)	3.10E+00	N/A
74-83-9	Methyl bromide (Bromomethane)	3.10E+03	3.60E+03
1634-04-4	Methyl tertiary-butyl ether	8.40E+03	1.10E+04
75-09-2	Methylene chloride (Dichloromethane)	2.50E+03	3.00E+03

CAS No.	Chemical Name	For the Outdoor Inhalation Exposure Route[a] C_{sat} (mg/kg)	For the Soil Component of the Groundwater Ingestion Exposure Route[b] C_{sat} (mg/kg)
98-95-3	Nitrobenzene	7.10E+02	5.90E+02
621-64-7	n-Nitrosodi-n-propylamine	1.90E+03	2.30E+03
100-42-5	Styrene	6.30E+02	2.60E+02
127-18-4	Tetrachloroethylene (Perchloroethylene)	8.00E+02	3.10E+02
108-88-3	Toluene	5.80E+02	2.90E+02
120-82-1	1,2,4-Trichlorobenzene	3.40E+02	1.20E+02
71-55-6	1,1,1-Trichloroethane	1.30E+03	6.70E+02
79-00-5	1,1,2-Trichloroethane	1.80E+03	1.30E+03
79-01-6	Trichloroethylene	1.20E+03	6.50E+02
75-69-4	Trichlorofluoromethane	1.80E+03	8.90E+02
108-05-4	Vinyl acetate	2.60E+03	4.20E+03
75-01-4	Vinyl chloride	2.60E+03	2.90E+03
108-38-3	m-Xylene	4.10E+02	1.60E+02
95-47-6	o-Xylene	3.70E+02	1.50E+02
106-42-3	p-Xylene	3.30E+02	1.40E+02
1330-20-7	Xylenes (total)	2.80E+02	1.10E+02

[a] Soil Saturation Limits calculated using an f_{oc} of 0.006 g/g and a system temperature of 25°C.
[b] Soil Saturation Limits calculated using an f_{oc} of 0.002 g/g and a system temperature of 25°C.

[c] C_{sat} for pH of 6.8. If soil pH is other than 6.8, a site-specific C_{sat} should be calculated using equations S19 and S29 and the pH-specific K_{oc} values in Appendix C Table I.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX A: General

Section 742.TABLE B: Tolerance Factor (K)

Tolerance factors (K) for one-sided normal tolerance intervals with probability level (confidence factor) Y = 0.95 and coverage P = 95%. n = number of samples collected.

n	K
3	7.655
4	5.145
5	4.202
6	3.707
7	3.399
8	3.188
9	3.031
10	2.911
11	2.815
12	2.736
13	2.670
14	2.614
15	2.566
16	2.523
17	2.486
18	2.543
19	2.423
20	2.396
21	2.371
22	2.350
23	2.329
24	2.309
25	2.292
30	2.220
35	2.166
40	2.126
45	2.092
50	2.065
55	2.036
60	2.017
65	2.000
70	1.986
75	1.972
100	1.924
125	1.891
150	1.868
175	1.850

200	1.836
225	1.824
250	1.814
275	1.806
300	1.799
325	1.792
350	1.787
375	1.782
400	1.777
425	1.773
450	1.769

n	K
475	1.766
500	1.763
525	1.760
550	1.757
575	1.754
600	1.752
625	1.750
650	1.748
675	1.746
700	1.744
725	1.742
750	1.740
775	1.739
800	1.737
825	1.736
850	1.734
875	1.733
900	1.732
925	1.731
950	1.729
975	1.728
1000	1.727

Section 742.APPENDIX A: General

Section 742.TABLE C: Coefficients $\{A_{N-I+1}\}$ for W Test of Normality, for N=2(1)50

i/n	2	3	4	5	6	7	8	9	10	
1	0.7071	0.7071	0.6872	0.6646	0.6431	0.6233	0.6052	0.5888	0.5739	
2	---	.0000	.1677	.2413	.2806	.3031	.3164	.3244	.3291	
3	---	---	---	.0000	.0875	.1401	.1743	.1976	.2141	
4	---	---	---	---	---	.0000	.0561	.0947	.1224	
5	---	---	---	---	---	---	---	.0000	.0399	
i/n	11	12	13	14	15	16	17	18	19	20
1	0.5601	0.5475	0.5359	0.5251	0.5150	0.5056	0.4968	0.4886	0.4808	0.4734
2	.3315	.3325	.3325	.3318	.3306	.3290	.3273	.3253	.3232	.3211
3	.2260	.2347	.2412	.2460	.2495	.2521	.2540	.2553	.2561	.2565
4	.1429	.1586	.1707	.1802	.1878	.1939	.1988	.2027	.2059	.2085
5	.0695	.0922	.1099	.1240	.1353	.1447	.1524	.1587	.1641	.1686
6	0.0000	0.0303	0.0539	0.0727	0.0880	0.1005	0.1109	0.1197	0.1271	0.1334
7	---	---	.0000	.0240	.0433	.0593	.0725	.0837	.0932	.1013
8	---	---	---	---	.0000	.0196	.0359	.0496	.0612	.0711
9	---	---	---	---	---	---	.0000	.0163	.0303	.0422
10	---	---	---	---	---	---	---	---	.0000	.0140

i/n	21	22	23	24	25	26	27	28	29	30
1	0.4643	0.4590	0.4542	0.4493	0.4450	0.4407	0.4366	0.4328	0.4291	0.4254
2	.3185	.3156	.3126	.3098	.3069	.3043	.3018	.2992	.2968	.2944
3	.2578	.2571	.2563	.2554	.2543	.2533	.2522	.2510	.2499	.2487
4	.2119	.2131	.2139	.2145	.2148	.2151	.2152	.2151	.2150	.2148
5	.1736	.1764	.1787	.1807	.1822	.1836	.1848	.1857	.1864	.1870
6	0.1399	0.1443	0.1480	0.1512	0.1539	0.1563	0.1584	0.1601	0.1616	0.1630
7	.1092	.1150	.1201	.1245	.1283	.1316	.1346	.1372	.1395	.1415
8	.0804	.0878	.0941	.0997	.1046	.1089	.1128	.1162	.1192	.1219
9	.0530	.0618	.0696	.0764	.0823	.0876	.0923	.0965	.1002	.1036
10	.0263	.0368	.0459	.0539	.0610	.0672	.0728	.0778	.0822	.0862
11	0.0000	0.0122	0.0228	0.0321	0.0403	0.0476	0.0540	0.0598	0.0650	0.0697
12	---	---	.0000	.0107	.0200	.0284	.0358	.0424	.0483	.0537
13	---	---	---	---	.0000	.0094	.0178	.0253	.0320	.0381
14	---	---	---	---	---	---	.0000	.0084	.0159	.0227
15	---	---	---	---	---	---	---	---	.0000	.0076

i/n	31	32	33	34	35	36	37	38	39	40
1	0.4220	0.4188	0.4156	0.4127	0.4096	0.4068	0.4040	0.4015	0.3989	0.3964
2	.2921	.2898	.2876	.2854	.2834	.2813	.2794	.2774	.2755	.2737
3	.2475	.2463	.2451	.2439	.2427	.2415	.2403	.2391	.2380	.2368
4	.2145	.2141	.2137	.2132	.2127	.2121	.2116	.2110	.2104	.2098
5	.1874	.1878	.1880	.1882	.1883	.1883	.1883	.1881	.1880	.1878
i/n	31	32	33	34	35	36	37	38	39	40
6	0.1641	0.1651	0.1660	0.1667	0.1673	0.1678	0.1683	0.1686	0.1689	0.1691
7	.1433	.1449	.1463	.1475	.1487	.1496	.1503	.1513	.1520	.1526
8	.1243	.1265	.1284	.1301	.1317	.1331	.1344	.1356	.1366	.1376
9	.1066	.1093	.1118	.1140	.1160	.1179	.1196	.1211	.1225	.1237
10	.0899	.0931	.0961	.0988	.1013	.1036	.1056	.1075	.1092	.1108
11	0.0739	0.0777	0.0812	0.0844	0.0873	0.0900	0.0924	0.0947	0.0967	0.0986
12	.0585	.0629	.0669	.0706	.0739	.0770	.0798	.0824	.0848	.0870
13	.0435	.0485	.0530	.0572	.0610	.0645	.0677	.0706	.0733	.0759
14	.0289	.0344	.0395	.0441	.0484	.0523	.0559	.0592	.0622	.0651
15	.0144	.0206	.0262	.0314	.0361	.0404	.0444	.0481	.0515	.0546

16	0.0000	0.0068	0.0131	0.0187	0.0239	0.0287	0.0331	0.0372	0.0409	0.0444
17	---	---	.0000	.0062	.0119	.0172	.0220	.0264	.0305	.0343
18	---	---	---	---	.0000	.0057	.0110	.0158	.0203	.0244
19	---	---	---	---	---	---	.0000	.0053	.0101	.0146
20	---	---	---	---	---	---	---	---	.0000	.0049
i/n	41	42	43	44	45	46	47	48	49	50
1	0.3940	0.3917	0.3894	0.3872	0.3850	0.3830	0.3808	0.3789	0.3770	0.3751
2	.2719	.2701	.2684	.2667	.2651	.2635	.2620	.2604	.2589	.2574
3	.2357	.2345	.2334	.2323	.2313	.2302	.2291	.2281	.2271	.2260
4	.2091	.2085	.2078	.2072	.2065	.2058	.2052	.2045	.2038	.2032
5	.1876	.1874	.1871	.1868	.1865	.1862	.1859	.1855	.1851	.1847
i/n	41	42	43	44	45	46	47	48	49	50
6	0.1693	0.1694	0.1695	0.1695	0.1695	0.1695	0.1695	0.1693	0.1692	0.1691
7	.1531	.1535	.1539	.1542	.1545	.1548	.1550	.1551	.1553	.1554
8	.1384	.1392	.1398	.1405	.1410	.1415	.1420	.1423`	.1427	.1430
9	.1249	.1259	.1269	.1278	.1286	.1293	.1300	.1306	.1312	.1317
10	.1123	.1136	.1149	.1160	.1170	.1180	.1189	.1197	.1205	.1212

11	0.1004	0.1020	0.1035	0.1049	0.1062	0.1073	0.1085	0.1095	0.1105	0.1113
12	.0891	.0909	.0927	.0943	.0959	.0972	.0986	.0998	.1010	.1020
13	.0782	.0804	.0824	.0842	.0860	.0876	.0892	.0906	.0919	.0932
14	.0677	.0701	.0724	.0745	.0775	.0785	.0801	.0817	.0832	.0846
15	.0575	.0602	.0628	.0651	.0673	.0694	.0713	.0731	.0748	.0764
16	0.0476	0.0506	0.0534	0.0560	0.0584	0.0607	0.0628	0.0648	0.0667	0.0685
17	.0379	.0411	.0442	.0471	.0497	.0522	.0546	.0568	.0588	.0608
18	.0283	.0318	.0352	.0383	.0412	.0439	.0465	.0489	.0511	.0532
19	.0188	.0227	.0263	.0296	.0328	.0357	.0385	.0411	.0436	.0459
20	.0094	.0136	.0175	.0211	.0245	.0277	.0307	.0335	.0361	.0386
21	0.0000	0.0045	0.0087	0.0126	0.0163	0.0197	0.0229	0.0259	0.0288	0.0314
22	---	---	.0000	.0042	.0081	.0118	.0153	.0185	.0215	.0244
23	---	---	---	---	.0000	.0039	.0076	.0111	.0143	.0174
24	---	---	---	---	---	---	.0000	.0037	.0071	.0104
25	---	---	---	---	---	---	---	---	.0000	.0035

Section 742.APPENDIX A: General

Section 742.TABLE D: Percentage Points of the W Test for n=3(1)50

N	0.01	0.05
3	0.753	0.767
4	0.687	0.748
5	0.686	0.762
6	0.713	0.788
7	0.730	0.803
8	0.749	0.818
9	0.764	0.829
10	0.781	0.842
11	0.792	0.850
12	0.805	0.859
13	0.814	0.866
14	0.825	0.874
15	0.835	0.881
16	0.844	0.887
17	0.851	0.892
18	0.858	0.897
19	0.863	0.901
20	0.868	0.905
21	0.873	0.908
22	0.878	0.911
23	0.881	0.914
24	0.884	0.916
25	0.888	0.918
26	0.891	0.920
27	0.894	0.923
28	0.896	0.924
29	0.898	0.926
30	0.900	0.927
31	0.902	0.929
32	0.904	0.930
33	0.906	0.931
34	0.908	0.933

N	0.01	0.05
35	0.910	0.934

(Source: Amended at 25 Ill. Reg. 10374, effective August 15,2001)

Section 742.APPENDIX A General

Section 742.TABLE E Similar-Acting Noncarcinogenic Chemicals

Adrenal Gland
Isopropylbenzene

Cholinesterase Inhibition
Aldicarb
Carbofuran

Circulatory System
Alachlor
Antimony (ingestion only)
Benzene
Cobalt (ingestion only)
2,4-D
cis-1,2-Dichloroethylene (ingestion only)
2,4-Dimethylphenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Ensosulfan
Fluoranthene
Fluorene
Methylene Chloride (inhalation only)
Nickel (Res. & I/C only) (inhalation only)
Nitrate as N
Nitrobenzene (ingestion only)
Selenium
Simazine
Styrene (ingestion only)
1,3,5-Trinitrobenzene
Zinc

Decreased Body Weight Gain
Atrazine
Bis(2-chloroethyl)ether
Cyanide
1,2-Dichlorobenzene (inhalation only)
Diethyl phthalate (ingestion only)
Ensosulfan
2-Methylphenol (o-cresol)
Naphthalene (ingestion only)
Nickel (ingestion only)
n-Nitrosodiphenylamine
Phenol (ingestion only)
Simazine
Tetrachloroethylene (ingestion only)

1,1,1-Trichloroethane (ingestion only)
Vinyl acetate (ingestion only)
Xylenes (Res. & I/C only) (ingestion only)

Endocrine System
Cyanide
1,2-Dibromoethane (ingestion only)
Di-n-octyl phthalate (ingestion only)
Nitrobenzene
1,2,4-Trichlorobenzene (ingestion only)

Eye
2,4-Dinitrophenol
n-Nitrosodiphenylamine
Polychlorinated biphenyls (PCBs)
Trichloroethylene

Gastrointestinal System
Beryllium (ingestion only)
Copper
1,3-Dichloropropene (*cis* + *trans*) (ingestion only)
Endothall
Fluoride
Hexachlorocyclopentadiene (ingestion only)
Iron
Methyl bromide (ingestion only)
Methyl tertiary-butyl ether (ingestion only)

Immune System
4-Chloroaniline
2,4-Dichlorophenol
Mercury (ingestion only)
Polychlorinated biphenyls (PCBs)

Kidney
Acetone (ingestion only)
Aldrin (CW only)
Barium
Bromodichloromethane (ingestion only)
Cadmium
2,4-D
Dalapon
1,1-Dichloroethane
1,2-Dichloroethane (CW only) (ingestion only)
Ensosulfan
Ethylbenzene (ingestion only)
Fluoranthene

gamma-HCH (gamma-BHC)
Hexachloroethane (ingestion only)
Isopropylbenzene
Mecoprop (MCPP)
Methyl tertiary-butyl ether (inhalation only)
Pentachlorophenol
Pyrene
Toluene (ingestion only)
2,4,5-Trichlorophenol
Vinyl acetate (ingestion only)

Liver
Acenapthene
Aldrin (Res. & I/C only)
Bis(2-ethylhexyl)phthalate (Res. & I/C only) (ingestion only)
Bromoform
Butyl Benzyl Phtalate (ingestion only)
Carbon Tetrachloride
Chlordane
Chlorobenzene (ingestion only)
Chlorodibromomethane (ingestion only)
Chloroform
2,4-D
DDT
1,2-Dibromoethane (ingestion only)
1,2-Dichlorobenezene (CW only) (ingestion only)
1,4-Dichlorobenzene
Dichlorodifluoromethane
1,2-Dichloroethane (inhalation only)
1,1-Dichloroethylene
trans-1,2-Dichloroethylene
1,2-Dichloropropane (ingestion only)
Dieldrin (Res. & I/C only)
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-octyl phthalate (ingestion only)
p-Dioxane
Endrin
Ethylbenzene (ingestion only)
Fluoranthene
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
alpha-HCH (alpha-BHC
gamma-HCH (gamma-BHC)
High Melting Explosive, Octogen (HMX)
Isophorone (inhalation only)

Methyl tertiary-butyl ether
Methylene Chloride (ingestion only)
Pentachlorophenol
Phenol (inhalation only)
Picloram
Styrene (ingestion only)
Tetrachloroethylene (ingestion only)
Toxaphene (CW only)
2,4,5-TP (Silvex)
1,2,4-Trichlorobenzene (inhalation only)
1,1,1-Trichloroethane (inhalation only)
1,1,2-Trichloroethane (ingestion only)
2,4,5-Trichlorophenol
2,4,6-Trinitrotoluene (TNT)
Vinyl Chloride

Mortality
Di-n-butyl phthalate (ingestion only)
Xylenes (Res. & I/C only) (ingestion only)

Nervous System
Butanol (ingestion only)
Carbon disulfide (inhalation only)
Cyanide
Dieldrin (CW only)
2,4-Dimethylphenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Endrin
Hexachloroethane (inhalation only) (CW only)
Manganese
Mercury (inhalation only)
2-Methylphenol (o-cresol)
Phenol (inhalation only)
Selenium
Styrene (inhalation only)
Tetrachloroethylene (inhalation only)
Toluene (inhalation only)
Trichloroethylene
Xylenes (CW only) (ingestion only)
Xylenes (inhalation only)

Reproductive System
Arsenic (inhalation only)
Bis(2-ethylhexyl)phthalate (CW only) (ingestion only)
Boron
2-Butanone

Carbofuran
Carbon disulfide (ingestion only)
2-Chlorophenol
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane (ingestion only)
Dicamba
Dinoseb
Ethylbenzene (inhalation only)
Isophorone (inhalation only)
Methoxychlor
Royal Demolition Explosive , Cyclonite (RDX)
2,4,6-Trichlorophenol

Respiratory System
Antimony (inhalation only)
Benzoic Acid (inhalation only)
Berryllium (inhalation only)
Cadmium (inhalation only)
Chromium (hex) (inhalation only)
Cobalt (inhalation only)
1,2-Dibromoethane (inhalation only)
trans-1,2-Dichloroethylene (inhalation only)
1,2-Dichloropropane (inhalation only)
1,3-Dichloropropene (*cis* + *trans*) (inhalation only)
Hexachlorocyclopentadiene (inhalation only)
Methyl bromide (inhalation only)
Naphtalene (inhalation only)
Nickel (inhalation only)
Nitrobenezene (inhalation only)
Vinyl acetate (inhalation only)

Skin
Arsenic (ingestion only)
Polychlorinated biphenyls (PCBs)
Selenium
Silver

Spleen
1,3-Dinotrobenzene
1,3,5-Trinitrobenzene

Notes:
Res. = Residential receptor
I/C = Industrial/Commercial receptor
CW = Construction Worker receptor

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX A: General

Section 742.TABLE F: Similar-Acting Carcinogenic Chemicals

Bladder
1,3-Dichloropropene (*cis* + *trans*) (ingestion only)
n-Nitrosodiphenylamine

Circulatory System
Benzene
1,2-Dibromoethane
1,2-Dichloroethane
Pentachlorophenol
2,4,6-Trichlorophenol

Gall Bladder
p-Dioxane (inhalation only)

Gastrointestinal System
Benzo(a)anthracene (ingestion only)
Benzo(b)fluoranthene (ingestion only)
Benzo(k)flouranthene (ingestion only)
Benzo(a)pyrene (ingestion only)
Bromoform
Chrysene (ingestion only)
Dibenzo(a,h)anthracene (ingestion only)
1,2-Dibromoethane (ingestion only)
Indeno(1,2,3-cd)pyrene (ingestion only)

Kidney
Bromodichloromethane (ingestion only)
Chloroform (ingestion only)
1,2-Dibromo-3-chloropropane (ingestion only)
Nitrobenzene

Liver
Aldrin
Bis(2-chloroethyl)ether
Bis(2-ethylhexyl)phthalate
Carbazole
Carbon Tetrachloride

Respiratory System (continued)
Benzo(k)flouranthene (inhalation only)
Benzo(a)pyrene (inhalation only)
Beryllium
Cadmium

Liver (continued)
Chlordane
Chloroform
DDD
DDE
DDT
1,2-Dichloropropane
Dieldrin
2,4-Dinitrotoluene
2,6-Dinitrotoluene
p-Dioxane
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
alpha-HCH (alpha-BHC)
gamma-HCH (gamma-BHC)
Methylene Chloride
Nitrobenzene
n-Nitrosodiphenylamine (inhalation only)
n-Nitrosodi-n-propylamine
Pentachlorophenol
Polychlorinated biphenyls (PCBs)
Tetrachloroethylene
Toxaphene
Trichloroethylene
Vinyl Chloride (I/C & CW)
Vinyl Chloride (Res.)

Mammary Gland
3,3'-Dichlorobenzidine
2,4-Dinitrotoluene
2,6-Dinitrotoluene

Respiratory System
Arsenic (inhalation only)
Benzo(a)anthracene (inhalation only)
Benzo(b)fluoranthene (inhalation only)

Chromium (hexavalent ion)
Chrysene (inhalation only)
Cobalt
Dibenzo(a,h)anthracene (inhalation only)
1,2-Dibromo-3-chloropropane (inhalation only)
1,2-Dibromoethane (inhalation only)
1,3-Dichloropropene (*cis* + *trans*) (inhalation only)
p-Dioxane (inhalation only)
Trichloroethylene

Notes:
Res. = Residential receptor
I/C = Industrial/Commercial receptor
CW = Construction Worker receptor

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX A General

Section 742.TABLE G Concentrations of Inorganic Chemicals in Background Soils

Chemical Name	Counties Within Metropolitan Statistical Areas (mg/kg)	Counties Outside Metropolitan Statistical Areas (mg/kg)
Aluminum	9,500	9,200
Antimony	4.0	3.3
Arsenic	13.0	11.3
Barium	110`	122
Beryllium	0.59	0.56
Cadmium	0.6	0.50
Calcium	9,300	5,525
Chromium	16.2	13.0
Cobalt	8.9	8.9
Copper	19.6	12.0
Cyanide	0.51	0.50
Iron	15,900	15,000
Lead	36.0	20.9
Magnesium	4,820	2,700
Manganese	636	630
Mercury	0.06	0.05
Nickel	18.0	13.0
Potassium	1,268	1,100
Selenium	0.48	0.37
Silver	0.55	0.50
Sodium	130	130.0
Sulfate	85.5	110
Sulfide	3.1	2.9
Thallium	0.32	0.42
Vanadium	25.2	25.0
Zinc	95.0	60.2

BOARD NOTE: Counties within Metropolitan Statistical Areas: Boone, Champaign, Clinton, Cook, DuPage, Grundy, Henry, Jersey, Kane, Kankakee, Kendall, Lake, Macon, Madison, McHenry, McLean, Menard, Monroe, Peoria, Rock Island, Sangamon, St. Clair, Tazewell, Will, Winnebago and Woodford.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX A: General

Section 742.TABLE H Concentrations of Polynuclear Aromatic Hydrocarbon Chemicals in Background Soils

Chemical Name	Chicago[a] mg/kg	Metropolitan Areas[b] (mg/kg)	Non-Metropolitan Areas[c] (mg/kg)
2-Methylnaphthalene	-----	0.14	0.29
Acenaphthene	0.09	0.13	0.04
Acenaphthylene	0.03	0.07	0.04
Anthracene	0.25	0.40	0.14
Benzo(a)anthracene	1.1	1.8	0.72
Benzo(a)pyrene	1.3	2.1	0.98
Benzo(b)fluoranthene	1.5	2.1	0.70
Benzo(g,h,i)perylene	0.68	1.7	0.84
Benzo(k)fluoranthene	0.99	1.7	0.63
Chrysene	1.2	2.7	1.1
Dibenzo(a,h)anthracene	0.20	0.42	0.15
Fluoranthene	2.7	4.1	1.8
Fluorene	0.10	0.18	0.04
Indeno(1,2,3-c,d)pyrene	0.86	1.6	0.51
Naphthalene	0.04	0.20	0.17
Phenanthrene	1.3	2.5	0.99
Pyrene	1.9	3.0	1.2

[a] Chicago means within the corporate limits of the City of Chicago.

[b] Metropolitan area means a populated area, as defined in Section 742.200, (other than the City of Chicago) that is located within any county in a Metropolitan Statistical Area listed in Appendix A, Table G, footnote a.

[c] Non-Metropolitan area means a populated area, as defined in Section 742.200, that is not located within any county in a Metropolitan Statistical Area listed in Appendix A, Table G, footnote a.

(Source: Appendix A, Table H renumbered to Appendix A, Table I and new Appendix A, Table H Added at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX A General

Section 742.TABLE I Chemicals Whose Tier 1 Class I Groundwater Remediation Objective Exceeds the 1 in 1,000,000 Cancer Risk Concentration

Chemical	**Class I Groundwater Remediation Objective (mg/L)**	**1 in 1,000,000 Cancer Risk Concentration (mg/L)**	**ADL (mg/L)**
Aldrin	0.014	0.000005	0.014
Benzo(a)pyrene	0.0002	0.000012	0.00023
Bis(2-chloroethyl)ether	0.01	0.000077	0.01
Bis(2-ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	0.006	0.0061	0.0027
Carbon Tetrachloride	0.005	0.00066	0.0001
Chlordane	0.002	0.000066	0.00014
DDD	0.014	0.00023	0.014
DDE	0.01	0.00023	0.01
DDT	0.006	0.00023	0.006
Dibenzo(a,h)anthracene	0.0003	0.000012	0.0003
1,2-Dibromo-3-chloropropane	0.0002	0.000061	0.001
1,2-Dibromoethane	0.00005	0.00002	0.001
3,3'-Dichlorobenzidine	0.02	0.00019	0.02
1,2-Dichloroethane	0.005	0.00094	0.0003
Dieldrin	0.009	0.0000053	0.009
2,6-Dinitrotoluene	0.00031	0.0001	0.00031
Heptachlor	0.0004	0.000019	0.013
Heptachlor epoxide	0.0002	0.0000094	0.015
Hexachlorobenzene	0.00006	0.000053	0.00006
Alpha-HCH	0.00011	0.000014	0.000111
Tetrachloroethylene	0.005	0.0016	0.0004
Toxaphene	0.003	0.000077	0.00086
Vinyl chloride	0.002	0.000045	0.0002
Ionizable Organics			
N-Nitrosodi-n-propylamine	0.0018	0.000012	0.0018
Pentachlorophenol	0.001	0.00071	0.000076
2,4,6-Trichlorophenol	0.01	0.007	0.01
Inorganics			
Arsenic	0.05	0.000057	0.001

(Source: Appendix A, Table I renumbered from Appendix A, Table H and amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.Table J: List of TACO Volatile Chemicals for the Indoor Inhalation Exposure Route

CAS No.	Chemical
67-64-1	Acetone
71-43-2	Benzene
111-44-4	Bis(2-chloroethyl)ether
75-27-4	Bromodichloromethane
75-25-2	Bromoform
71-36-3	Butanol
78-93-3	2-Butanone (MEK)
75-15-0	Carbon disulfide
56-23-5	Carbon tetrachloride
108-90-7	Chlorobenzene
124-48-1	Chlorodibromomethane
67-66-3	Chloroform
95-57-8	2-Chlorophenol
75-99-0	Dalapon
96-12-8	1,2-dibromo-3-chloropropane
106-93-4	1,2-Dibromoethane
95-50-1	1,2-Dichlorobenzene
106-46-7	1,4-Dichlorobenzene
75-71-8	Dichlorodifluoromethane
75-34-3	1,1-Dichloroethane
107-06-2	1,2-Dichloroethane
75-35-4	1,1-Dichloroethylene
156-59-2	*cis*-1,2-Dichloroethylene
156-60-5	*trans*-1,2-Dichloroethylene
78-87-5	1,2-Dichloropropane
542-75-6	1,3-Dichloropropylene (*cis* + *trans*)
123-91-1	p-Dioxane
100-41-4	Ethylbenzene
76-44-8	Heptachlor
118-74-1	Hexachlorobenzene
77-47-4	Hexachlorocyclopentadiene
67-72-1	Hexachloroethane
78-59-1	Isophorone
98-82-8	Isopropylbenzene (Cumene)
7439-97-6	Mercury
74-83-9	Methyl bromide
1634-04-4	Methyl tertiary-butyl ether
75-09-2	Methylene chloride
93-65-2	2-Methylnaphthalene
95-48-7	2-Methylphenol (o-cresol)
91-20-3	Naphthalene

CAS No.	Chemical
98-95-3	Nitrobenzene
621-64-7	n-Nitrosodi-n-propylamine
108-95-2	Phenol
1336-36-3	Polychlorinated biphenyls (PCBs)
100-42-5	Styrene
127-18-4	Tetrachloroethylene
108-88-3	Toluene
120-82-1	1,2,4-Trichlorobenzene
71-55-6	1,1,1-Trichloroethane
79-00-5	1,1,2-Trichloroethane
79-01-6	Trichloroethylene
75-69-4	Trichlorofluoromethane
108-05-4	Vinyl acetate
75-01-4	Vinyl chloride
108-38-3	m-Xylene
95-47-6	o-Xylene
106-42-3	p-Xylene
1330-20-7	Xylenes (total)

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX A: General

Section 742.TABLE K: Soil Vapor Saturation Limits (C_v^{sat}) for Volatile Chemicals

CAS No.	Chemical Name	C_v^{sat} (mg/m^3)
67-64-1	Acetone	7.50E+05
71-43-2	Benzene	4.20E+05
111-44-4	Bis(2-chloroethyl)ether	1.20E+04
75-27-4	Bromodichloromethane	4.50E+05
75-25-2	Bromoform	7.80E+04
71-36-3	Butanol	2.90E+04
78-93-3	2-Butanone (MEK)	3.80E+05
75-15-0	Carbon disulfide	1.50E+06
56-23-5	Carbon tetrachloride	1.00E+06
108-90-7	Chlorobenzene	7.40E+04
124-48-1	Chlorodibromomethane	5.70E+04
67-66-3	Chloroform	1.30E+06
95-57-8	2-Chlorophenol (ionizable organic)	1.70E+04
75-99-0	Dalapon	1.50E+03
96-12-8	1,2-Dibromo-3-chloropropane	7.80E+03
106-93-4	1,2-Dibromoethane	1.40E+05
95-50-1	1,2-Dichlorobenzene	1.10E+04
106-46-7	1,4-Dichlorobenzene	8.40E+03
75-71-8	Dichlorodifluoromethane	3.30E+07
75-34-3	1,1-Dichloroethane	1.30E+06
107-06-2	1,2-Dichloroethane	4.40E+05
75-35-4	1,1-Dichloroethylene	3.30E+06
156-59-2	*cis*-1,2-Dichloroethylene	1.10E+06
156-60-5	*trans*-1,2-Dichloroethylene	1.80E+06
78-87-5	1,2-Dichloropropane	3.20E+05

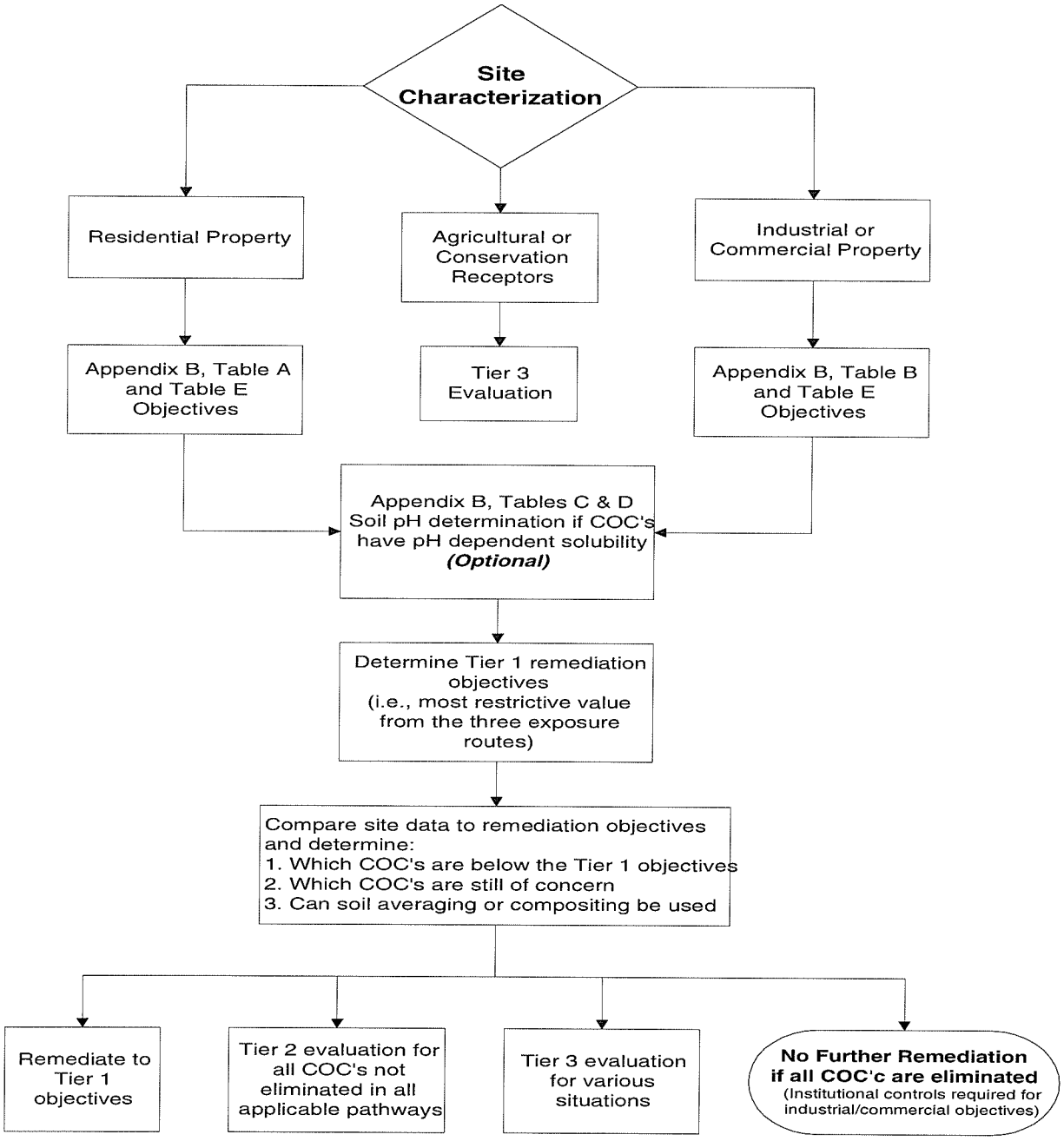
CAS No.	Chemical Name	C_v^{sat} (mg/m^3)
542-75-6	1,3-Dichloropropylene (*cis* + *trans*)	2.10E+05
123-91-1	p-Dioxane	1.90E+05
100-41-4	Ethylbenzene	5.90E+04
76-44-8	Heptachlor	8.30E+00
118-74-1	Hexachlorobenzene	2.80E-01
77-47-4	Hexachlorocyclopentadiene	9.10E+02
67-72-1	Hexachloroethane	2.80E+03
78-59-1	Isophorone	3.40E+03
98-82-8	Isopropylbenzene (Cumene)	3.00E+04
7439-97-6	Mercury (elemental)	2.20E+01
74-83-9	Methyl bromide	8.60E+06
1634-04-4	Methyl tertiary-butyl ether	1.20E+06
75-09-2	Methylene chloride	2.00E+06
93-65-2	2-Methylnaphthalene	5.30E+02
1634-04-4	2-Methylphenol (o-cresol)	1.80E+03
91-20-3	Naphthalene	6.20E+02
98-95-3	Nitrobenzene	1.70E+03
621-64-7	n-Nitrosodi-n-propylamine	9.50E+02
108-95-2	Phenol	1.50E+03
1336-36-3	Polychlorinated biphenyls (PCBs)	9.00E+00
100-42-5	Styrene	3.40E+04
127-18-4	Tetrachloroethylene	1.80E+05
108-88-3	Toluene	1.40E+05
120-82-1	1,2,4-Trichlorobenzene	4.30E+03
71-55-6	1,1,1-Trichloroethane	8.70E+05
79-00-5	1,1,2-Trichloroethane	1.70E+05
79-01-6	Trichloroethylene	5.30E+05

CAS No.	Chemical Name	C_v^{sat} (mg/m^3)
75-69-4	Trichlorofluoromethane	6.30E+06
108-05-4	Vinyl acetate	4.30E+05
75-01-4	Vinyl chloride	1.10E+07
108-38-3	m-Xylene	5.20E+04
95-47-6	o-Xylene	4.10E+04
106-42-3	p-Xylene	5.50E+04
1330-20-7	Xylenes (total)	4.90E+04

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.Illustration A Tier 1 Evaluation



(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.TABLE A Tier 1 Soil Remediation Objectives[a] for Residential Properties

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
83-32-9	Acenaphthene	4,700[b]	---[c]	570[b]	2,900	*
67-64-1	Acetone	70,000[b]	100,000[d]	25[b]	25	*
15972-60-8	Alachlor[o]	8[e]	---[c]	0.04	0.2	NA
116-06-3	Aldicarb[o]	78[b]	---[c]	0.013	0.07	NA
309-00-2	Aldrin	0.04[e]	3[e]	0.5[e]	2.5	0.94
120-12-7	Anthracene	23,000[b]	---[c]	12,000[b]	59,000	*
1912-24-9	Atrazine[o]	2700[b]	---[c]	0.066	0.33	NA
71-43-2	Benzene	12[e]	0.8[e]	0.03	0.17	*
56-55-3	Benzo(*a*)anthracene	0.9[e,w]	---[c]	2	8	*
205-99-2	Benzo(*b*)fluoranthene	0.9[e,w]	---[c]	5	25	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
207-08-9	Benzo(*k*)fluroanthene	9[e]	---[c]	49	250	*
50-32-8	Benzo(*a*)pyrene	0.09[e, w]	---[c]	8	82	*
111-44-4	Bis(2-chloroethyl)ether	0.6[e]	0.2[e,]	0.0004[e,]	0.0004	0.66
117-81-7	Bis(2-ethylhexyl)phthalate	46[e]	31,000[d]	3,600	31,000[d]	*
75-27-4	Bromodichloromethane (Dichlorobromomethane)	10[e]	3,000[d]	0.6	0.6	*
75-25-2	Bromoform	81[e]	53[e]	0.8	0.8	*
71-36-3	Butanol	7,800[b]	10,000[d]	17[b]	17	NA
85-68-7	Butyl benzyl phthalate	16,000[b]	930[d]	930[d]	930[d]	*
86-74-8	Carbazole	32[e]	---[c]	0.6[e]	2.8	NA
1563-66-2	Carbofuran[o]	390[b]	---[c]	0.22	1.1	NA
75-15-0	Carbon disulfide	7,800[b]	720[d, x]	32[b]	160	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
56-23-5	Carbon tetrachloride	5[e]	0.3[e]	0.07	0.33	*
57-74-9	Chlordane	1.8[e]	72[e, x]	10	48	*
106-47-8	4-Chloroaniline (*p*-Chloroaniline)	310[b]	---[c]	0.7[b]	0.7	*
108-90-7	Chlorobenzene (Monochlorobenzene)	1,600[b]	130[b, x]	1	6.5	*
124-48-1	Chlorodibromomethane (Dibromochloromethane)	1,600[b]	1,300[d]	0.4	0.4	*
67-66-3	Chloroform	100[e]	0.3[e]	0.6	2.9	*
218-01-9	Chrysene	88[e]	---[c]	160	800	*
94-75-7	2,4-D[o]	780[b]	---[c]	1.5	7.7	*
75-99-0	Dalapon[o]	2,300[b]	---[c]	0.85	8.5	*
72-54-8	DDD	3[e]	---[c]	16[e]	80	*
72-55-9	DDE	2[e]	---[c]	54[e]	270	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
50-29-3	DDT	2[e]	---[g, x]	32[e]	160	*
53-70-3	Dibenzo(*a,h*)anthracene	0.09[e, w]	---[c]	2	7.6	*
96-12-8	1,2-Dibromo-3-chloropropane	0.46[e]	11[b, x]	0.002	0.02	*
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.32[e]	0.06[e]	0.0004	0.004	0.005
84-74-2	Di-*n*-butyl phthalate	7,800[b]	2,300[d]	2,300[d]	2,300[d]	*
95-50-1	1,2-Dichlorobenzene (*o* – Dichlorobenzene)	7,000[b]	560[d, x]	17	43	*
106-46-7	1,4-Dichlorobenzene (*p* – Dichlorobenzene)	---[c]	11,000[b, x]	2	11	*
91-94-1	3,3'-Dichlorobenzidine	1[e]	---[c]	0.007[e,]	0.033	1.3
75-34-3	1,1-Dichloroethane	7,800[b]	1,300[b, x]	23[b]	110	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	7[e]	0.4[e]	0.02	0.1	*
75-35-4	1,1-Dichloroethylene	3,900[b]	290[b, x]	0.06	0.3	*
156-59-2	*cis*-1,2-Dichloroethylene	780[b]	1,200[d]	0.4	1.1	*
156-60-5	*trans*-1,2-Dichloroethylene	1,600[b]	3,100[d]	0.7	3.4	*
78-87-5	1,2-Dichloropropane	9[e]	15[b, x]	0.03	0.15	*
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	6.4[e]	1.1[e, x]	0.004[e]	0.02	0.005
60-57-1	Dieldrin[n]	0.04[e]	1[e]	0.004[e]	0.02	0.603
84-66-2	Diethyl phthalate	63,000[b]	2,000[d]	470[b]	470	*
105-67-9	2,4-Dimethylphenol	1,600[b]	---[c]	9[b]	9	*
121-14-2	2,4-Dinitrotoluene	0.9[e]	---[c]	0.0008[e,]	0.0008	0.250

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
606-20-2	2,6-Dinitrotoluene	0.9[e]	---[c]	0.0007[e]	0.0007	0.260
117-84-0	Di-*n*-octyl phthalate	1,600[b]	10,000[d]	10,000[d]	10,000[d]	*
115-29-7	Endosulfan[o]	470[b]	---[c]	18[b]	90	*
145-73-3	Endothall[o]	1,600[b]	---[c]	0.4	0.4	NA
72-20-8	Endrin	23[b]	---[c]	1	5	*
100-41-4	Ethylbenzene	7,800[b]	400[d, x]	13	19	*
206-44-0	Fluoranthene	3,100[b]	---[c]	4,300[b]	21,000	*
86-73-7	Fluorene	3,100[b]	---[c]	560[b]	2,800	*
76-44-8	Heptachlor	0.1[e]	0.1[e]	23	110	0.871
1024-57-3	Heptachlor epoxide	0.07[e]	5[e]	0.7	3.3	1.005
118-74-1	Hexachlorobenzene	0.4[e]	1[e]	2	11	*
319-84-6	*Alpha*-HCH (*alpha*-BHC)	0.1[e]	0.8[e]	0.0005[e,]	0.003	0.0074

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
58-89-9	*Gamma*-HCH (Lindane)[n]	0.5[e]	---[c, x]	0.009	0.047	*
77-47-4	Hexachlorocyclopentadiene	550[b]	10[b, x]	400	2,200[d]	*
67-72-1	Hexachloroethane	78[b]	---[c]	0.5[b]	2.6	*
193-39-5	Indeno(1,2,3-*c,d*)pyrene	0.9[e,w]	---[c]	14	69	*
78-59-1	Isophorone	15,600[b]	4,600[d]	8[b]	8	*
72-43-5	Methoxychlor[o]	390[b]	---[c]	160	780	*
74-83-9	Methyl bromide (Bromomethane)	110[b]	10[b, x]	0.2[b]	1.2	*
1634-04-4	Methyl tertiary-butyl ether	780[b]	8,800[d, x]	0.32	0.32	*
75-09-2	Methylene chloride (Dichloromethane)	85[e]	13[e]	0.02[e]	0.2	*
95-48-7	2-Methylphenol (*o* – Cresol)	3,900[b]	---[c]	15[b]	15	*
91-20-3	Naphthalene	1,600[b]	170[b, x]	12[b]	18	*
98-95-3	Nitrobenzene	39[b]	92[b, x]	0.1[b,]	0.1	0.26

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
86-30-6	*N*-Nitrosodiphenylamine	130[e]	---[c]	1[e]	5.6	*
621-64-7	*N*-Nitrosodi-*n*-propylamine	0.09[e,]	---[c]	0.00005[e,]	0.00005	0.0018
108-95-2	Phenol	23,000[b]	---[c]	100[b]	100	*
1918-02-1	Picloram[o]	5,500[b]	---[c]	2	20	NA
1336-36-3	Polychlorinated biphenyls (PCBs)[n]	1[h]	---[c,h]	---[h]	---[h]	*
129-00-0	Pyrene	2,300[b]	---[c]	4,200[b]	21,000	*
122-34-9	Simazine[o]	390[b]	---[c]	0.04	0.37	NA
100-42-5	Styrene	16,000[b]	1,500[d, x]	4	18	*
127-18-4	Tetrachloroethylene (Perchloroethylene)	12[e]	11[e]	0.06	0.3	*
108-88-3	Toluene	16,000[b]	650[d, x]	12	29	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
8001-35-2	Toxaphene[n]	0.6[e]	89[e]	31	150	*
120-82-1	1,2,4-Trichlorobenzene	780[b]	3,200[b, x]	5	53	*
71-55-6	1,1,1-Trichloroethane	---[c]	1,200[d]	2	9.6	*
79-00-5	1,1,2-Trichloroethane	310[b]	1,800[d]	0.02	0.3	*
79-01-6	Trichloroethylene	58[e]	5[e]	0.06	0.3	*
108-05-4	Vinyl acetate	78,000[b]	1,000[b, x]	170[b]	170	*
75-01-4	Vinyl chloride	0.46[e]	0.28[e]	0.01	0.07	*
108-38-3	m-Xylene	16,000[b]	420[d, x]	210	210	*
95-47-6	o-Xylene	16,000[b]	410[d, x]	190	190	*
106-42-3	p-Xylene	16,000[b]	460[d, x]	200	200	*

		Exposure Route-Specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	Class II (mg/kg)	ADL (mg/kg)
1330-20-7	Xylenes (total)	16,000[b]	320[d, x]	150	150	*
	Ionizable Organics					
65-85-0	Benzoic Acid	310,000[b]	---[c]	400[b,i]	400[i]	*
95-57-8	2-Chlorophenol	390[b]	53,000[d]	4[b,i]	4[i]	*
120-83-2	2,4-Dichlorophenol	230[b]	---[c]	1[b,i]	1[i]	*
51-28-5	2,4-Dinitrophenol	160[b]	---[c]	0.2[b,]	0.2	3.3
88-85-7	Dinoseb[o]	78[b]	---[c]	0.34[b,i]	3.4[i]	*
87-86-5	Pentachlorophenol	3[e,j]	---[c]	0.03[i]	0.14[i]	*
93-72-1	2,4,5-TP (Silvex)	630[b]	---[c]	11[i]	55[i]	*
95-95-4	2,4,5-Trichlorophenol	7,800[b]	---[c]	270[b,i]	1,400[i]	*
88-06-2	2,4,6 Trichlorophenol	58[e]	200[e]	0.2[e, i]	0.77[i]	0.66

		Exposure Route-specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
	Inorganics					
7440-36-0	Antimony	31[b]	---[c]	0.006[m]	0.024[m]	*
7440-38-2	Arsenic[l,n]	---[t]	750[e]	0.05[m]	0.2[m]	*
7440-39-3	Barium	5,500[b]	690,000[b]	2.0[m]	2.0[m]	*
7440-41-7	Beryllium	160[b]	1,300[e]	0.004[m]	0.5[m]	*
7440-42-8	Boron	16,000[b]	---[c]	2.0[m]	2.0[m]	*
7440-43-9	Cadmium[l,n]	78[b, r]	1,800[e]	0.005[m]	0.05[m]	*
7440-70-2	Calcium[n]	---[g]	---[c]	---[c]	---[c]	*
16887-00-6	Chloride	---[c]	---[c]	200[m]	200[m]	*
7440-47-3	Chromium, total	230[b]	270[e]	0.1[m]	1.0[m]	*
16065-83-1	Chromium, ion, trivalent	120,000[b]	---[c]	---[g]	---[g]	*
18540-29-9	Chromium, ion, hexavalent	230[b]	270[e]	---	---	*

		Exposure Route-specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-48-4	Cobalt	4,700[b]	---[c]	1.0[m]	1.0[m]	*
7440-50-8	Copper[n]	2,900[b]	---[c]	0.65[m]	0.65[m]	*
57-12-5	Cyanide (amenable)	1,600[b]	---[c]	0.2[q,m]	0.6[q,m]	*
7782-41-4	Fluoride	4,700[b]	---[c]	4.0[m]	4.0[m]	*
15438-31-0	Iron	---[c]	---[c]	5.0[m]	5.0[m]	*
7439-92-1	Lead	400[k]	---[c]	0.0075[m]	0.1[m]	*
7439-95-4	Magnesium[n]	325,000	---[c]	---[c]	---[c]	*
7439-96-5	Manganese	1,600 [b,v]	69,000[b, x]	0.15[m]	10.0[m]	*
7439-97-6	Mercury[l,n,s]	23[b]	10[b, x]	0.002[m]	0.01[m]	*
7440-02-0	Nickel[l]	1,600[b]	13,000[e]	0.1[m]	2.0[m]	*
14797-55-8	Nitrate as N[p]	130,000[b]	---[c]	10.0[q, m]	100[q]	*
7723-14-0	Phosphorus[n]	---[g]	---[c]	---[c]	---[c]	*

		Exposure Route-specific Values for Soils		Soil Component of the Groundwater Ingestion Exposure Route Values		
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-09-7	Potassium[n]	---[g]	---[c]	---[c]	---[c]	*
7782-49-2	Selenium[l,n]	390[b]	---[c]	0.05[m]	0.05[m]	*
7440-22-4	Silver	390[b]	---[c]	0.05[m]	---[c]	*
7440-23-5	Sodium[n]	---[g]	---[c]	---[c]	---[c]	*
14808-79-8	Sulfate	---[c]	---[c]	400[m]	400[m]	*
7440-28-0	Thallium	6.3[b,u]	---[c]	0.002[m]	0.02[m]	*
7440-62-2	Vanadium	550[b]	---[c]	0.049[m]	0.1[m]	*
7440-66-6	Zinc[l]	23,000[b]	---[c]	5.0[m]	10[m]	*

"*" indicates that the ADL is less than or equal to the specified remediation objective.
NA means not available; no PQL or EQL available in USEPA analytical methods.

Chemical Name and Soil Remediation Objective Notations

[a] Soil remediation objectives based on human health criteria only.
[b] Calculated values correspond to a target hazard quotient of 1.
[c] No toxicity criteria available for the route of exposure.
[d] Soil saturation concentration ($C_{[sat]}$) = the concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals which are liquid at ambient soil temperatures) have been violated, and alternative modeling approaches are required.
[e] Calculated values correspond to a cancer risk level of 1 in 1,000,000.
[g] Chemical-specific properties are such that this route is not of concern at any soil contaminant concentration.
[h] 40 CFR 761 contains applicability requirements and methodologies for the development of PCB remediation objectives. Requests for approval of a Tier 3 evaluation must address the applicability of 40 CFR 761.
[I] Soil remediation objective for pH of 6.8. If soil pH is other than 6.8, refer to Appendix B, Tables C and D of this Part.
[j] Ingestion soil remediation objective adjusted by a factor of 0.5 to account for dermal route.
[k] A preliminary remediation goal of 400 mg/kg has been set for lead based on *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*, OSWER Directive #9355.4-12.
[l] Potential for soil-plant-human exposure.
[m] The person conducting the remediation has the option to use: 1) TCLP or SPLP test results to compare with the remediation objectives listed in this Table; 2) where applicable, the total amount of contaminant in the soil sample results to compare with pH specific remediation objectives listed in Appendix B, Table C or D of this Part (see Section 742.510); or 3) the appropriate background value listed in Appendix A, Table G. If the person conducting the remediation wishes to calculate soil remediation objectives based on background concentrations, this should be done in accordance with Subpart D of this Part.
[n] The Agency reserves the right to evaluate the potential for remaining contaminant concentrations to pose significant threats to crops, livestock, or wildlife.
[o] For agrichemical facilities, remediation objectives for surficial soils which are based on field application rates may be more appropriate for currently registered pesticides. Consult the Agency for further information.
[p] For agrichemical facilities, soil remediation objectives based on site-specific background concentrations of Nitrate as N may be more appropriate. Such determinations shall be conducted in accordance with the procedures set forth in Subparts D and I of this Part.
[q] The TCLP extraction must be done using water at a pH of 7.0.
[r] Value based on dietary Reference Dose.

[s] Value for Ingestion based on Reference Dose for Mercuric chloride (CAS No. 7487-94-7); value for Inhalation based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern.

[t] For the ingestion route for arsenic, see 742.Appendix A, Table G.

[u] Value based on Reference Dose for Thallium sulfate (CAS No. 7446-18-6).

[v] Value based on Reference Dose adjusted for dietary intake.

[w] For sites located in any populated area as defined in Section 742.200, Appendix A, Table H may be used.

[x] The remediation objectives for these chemicals must also include the construction worker inhalation objective in Appendix B, Table B.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.Table B Tier 1 Soil Remediation Objectives[a] for Industrial/Commercial Properties

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
83-32-9	Acenaphthene	120,000[b]	-----[c]	120,000[b]	-----[c]	570[b]	2,900	*
67-64-1	Acetone	----[g]	100,000[d]	----[g]	100,000[d]	25[b]	25	*
15972-60-8	Alachlor[o]	72[e]	-----[c]	1,600[e]	-----[c]	0.04	0.2	NA
116-06-3	Aldicarb[o]	2,000[b]	-----[c]	200[b]	-----[c]	0.013	0.07	NA
309-00-2	Aldrin	0.3[e]	6.6[e]	6.1[b]	9.3[e]	0.5[e]	2.5	0.94
120-12-7	Anthracene	610,000[b]	-----[c]	610,000[b]	-----[c]	12,000[b]	59,000	*
1912-24-9	Atrazine[o]	72,000[b]	-----[c]	7,100[b]	-----[c]	0.066	0.33	NA
71-43-2	Benzene	100[e]	1.6[e]	2,300[e]	2.2[e]	0.03	0.17	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
56-55-3	Benzo(*a*)anthracene	8[e]	-----[c]	170[e]	-----[c]	2	8	*
205-99-2	Benzo(*b*)fluoranthene	8[e]	-----[c]	170[e]	-----[c]	5	25	*
207-08-9	Benzo(*k*)fluroanthene	78[e]	-----[c]	1,700[e]	-----[c]	49	250	*
50-32-8	Benzo(*a*)pyrene	0.8[e,x]	-----[c]	17[e]	-----[c]	8	82	*
111-44-4	Bis(2-chloroethyl)ether	5[e]	0.47[e]	75[e]	0.66[e]	0.0004[e,]	0.0004	0.66
117-81-7	Bis(2-ethylhexyl)phthalate	410[e]	31,000[d]	4,100[b]	31,000[d]	3,600	31,000[d]	*
75-27-4	Bromodichloromethane (Dichlorobromomethane)	92[e]	3,000[d]	2,000[e]	3,000[d]	0.6	0.6	*
75-25-2	Bromoform	720[e]	100[e]	16,000[e]	140[e]	0.8	0.8	*
71-36-3	Butanol	200,000[b]	10,000[d]	200,000[b]	10,000[d]	17[b]	17	NA
85-68-7	Butyl benzyl phthalate	410,000[b]	930[d]	410,000[b]	930[d]	930[d]	930[d]	*
86-74-8	Carbazole	290[e]	-----[c]	6,200[e]	-----[c]	0.6[e]	2.8	NA

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1563-66-2	Carbofuran[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.22	1.1	NA
75-15-0	Carbon disulfide	200,000[b]	720[d]	20,000[b]	9.0[b]	32[b]	160	*
56-23-5	Carbon tetrachloride	44[e]	0.64[e]	410[b]	0.90[e]	0.07	0.33	*
57-74-9	Chlordane	16[e]	140[e]	100[b]	22[b]	10	48	*
106-47-8	4 – Chloroaniline (*p*-Chloroaniline)	8,200[b]	-----[c]	820[b]	-----[c]	0.7[b]	0.7	*
108-90-7	Chlorobenzene (Monochlorobenzene)	41,000[b]	210[b]	4,100[b]	1.3[b]	1	6.5	*
124-48-1	Chlorodibromomethane (Dibromochloromethane)	41,000[b]	1,300[d]	41,000[b]	1,300[d]	0.4	0.4	*
67-66-3	Chloroform	940[e]	0.54[e]	2,000[b]	0.76[e]	0.6	2.9	*
218-01-9	Chrysene	780[e]	-----[c]	17,000[e]	-----[e]	160	800	*
94-75-7	2,4-D[o]	20,000[b]	-----[c]	2,000[b]	-----[c]	1.5	7.7	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
75-99-0	Dalapon[o]	61,000[b]	-----[c]	6,100[b]	-----[c]	0.85	8.5	*
72-54-8	DDD	24[e]	-----[c]	520[e]	-----[c]	16[e]	80	*
72-55-9	DDE	17[e]	-----[c]	370[e]	-----[c]	54[e]	270	*
50-29-3	DDT	17[e]	1,500[e]	100[b]	2,100[e]	32[e]	160	*
53-70-3	Dibenzo(*a,h*)anthracene	0.8[e]	-----[c]	17[e]	-----[c]	2	7.6	*
96-12-8	1,2-Dibromo-3-chloropropane	4[e]	17[b]	89[e]	0.11[b]	0.002	0.02	*
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	2.9[e]	0.12[e]	62[e]	0.16[e]	0.0004	0.004	0.005
84-74-2	Di-*n*-butyl phthalate	200,000[b]	2,300[d]	200,000[b]	2,300[d]	2,300[d]	2,300[d]	*
95-50-1	1,2-Dichlorobenzene (*o* – Dichlorobenzene)	180,000[b]	560[d]	18,000[b]	310[b]	17	43	*
106-46-7	1,4-Dichlorobenzene (*p* – Dichlorobenzene)	-----[c]	17,000[b]	-----[c]	340[b]	2	11	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
91-94-1	3,3'-Dichlorobenzidine	13[e]	-----[c]	280[e]	-----[c]	0.007[e,]	0.033	1.3
75-34-3	1,1-Dichloroethane	200,000[b]	1,700[d]	200,000[b]	130[b]	23[b]	110	*
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	63[e]	0.70[e]	1,400[e]	0.99[e]	0.02	0.1	*
75-35-4	1,1-Dichloroethylene	100,000[b]	470[b]	10,000[b]	3.0[b]	0.06	0.3	*
156-59-2	*cis*-1,2-Dichloroethylene	20,000[b]	1,200[d]	20,000[b]	1,200[d]	0.4	1.1	*
156-60-5	*Trans*-1,2-Dichloroethylene	41,000[b]	3,100[d]	41,000[b]	3,100[d]	0.7	3.4	*
78-87-5	1,2-Dichloropropane	84[e]	23[b]	1,800[e]	0.50[b]	0.03	0.15	*
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	57[e]	2.1[e]	1,200[e]	0.39[b]	0.004[e]	0.02	0.005
60-57-1	Dieldrin[n]	0.4[e]	2.2[e]	7.8[e]	3.1[e]	0.004[e]	0.02	0.603
84-66-2	Diethyl phthalate	1,000,000[b]	2,000[d]	1,000,000[b]	2,000[d]	470[b]	470	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
105-67-9	2,4-Dimethylphenol	41,000[b]	-----[c]	41,000[b]	-----[c]	9[b]	9	*
121-14-2	2,4-Dinitrotoluene	8.4[e]	-----[c]	180[e]	-----[c]	0.0008[e,]	0.0008	0.250
606-20-2	2,6-Dinitrotoluene	8.4[e]	-----[c]	180[e]	-----[c]	0.0007[e,]	0.0007	0.260
117-84-0	Di-*n*-octyl phthalate	41,000[e]	10,000[d]	4,100[b]	10,000[d]	10,000[d]	10,000[d]	*
115-29-7	Endosulfan[o]	12,000[b]	-----[c]	1,200[b]	-----[c]	18[b]	90	*
145-73-3	Endothall[o]	41,000[c]	-----[c]	4,100[b]	-----[c]	0.4	0.4	NA
72-20-8	Endrin	610[b]	-----[c]	61[b]	-----[c]	1	5	*
100-41-4	Ethylbenzene	200,000[b]	400[d]	20,000[b]	58[b]	13	19	*
206-44-0	Fluoranthene	82,000[b]	-----[c]	82,000[b]	-----[c]	4,300[b]	21,000	*
86-73-7	Fluorene	82,000[b]	-----[c]	82,000[b]	-----[c]	560[b]	2,800	*
76-44-8	Heptachlor	1[e]	11[e]	28[e]	16[e]	23	110	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1024-57-3	Heptachlor epoxide	0.6[e]	9.2[e]	2.7[b]	13[e]	0.7	3.3	1.005
118-74-1	Hexachlorobenzene	4[e]	1.8[e]	78[e]	2.6[e]	2	11	*
319-84-6	*Alpha*-HCH (*alpha*-BHC)	0.9[e]	1.5[e]	20[e]	2.1[e]	0.0005[e,]	0.003	0.0074
58-89-9	*Gamma*-HCH (Lindane)[n]	4[e]	-----[c]	96[e]	-----[c]	0.009	0.047	*
77-47-4	Hexachlorocyclopentadiene	14,000[b]	16[b]	14,000[b]	1.1[b]	400	2,200[d]	*
67-72-1	Hexachloroethane	2,000[b]	-----[c]	2,000[b]	-----[c]	0.5[b]	2.6	*
193-39-5	Indeno(1,2,3-*c,d*)pyrene	8[e]	-----[c]	170[e]	-----[c]	14	69	*
78-59-1	Isophorone	410,000[b]	4,600[d]	410,000[b]	4,600[d]	8[b]	8	*
72-43-5	Methoxychlor[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	160	780	*
74-83-9	Methyl bromide (Bromomethane)	2,900[b]	15[b]	1,000[b]	3.9[b]	0.2[b]	1.2	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1634-04-4	Methyl tertiary-butyl ether	20,000[b]	8,800[d]	2,000[b]	140[b]	0.32	0.32	*
75-09-2	Methylene chloride (Dichloromethane)	760[e]	24[e]	12,000[b]	34[e]	0.02[e]	0.2	*
95-48-7	2-Methylphenol (*o* – Cresol)	100,000[b]	-----[c]	100,000[b]	-----[c]	15[b]	15	*
86-30-6	*N*-Nitrosodiphenylamine	1,200[e]	-----[c]	25,000[e]	-----[c]	1[e]	5.6	*
621-64-7	*N*-Nitrosodi-*n*-propylamine	0.8[e]	-----[c]	18[e]	-----[c]	0.00005[e]	0.00005	0.0018
91-20-3	Naphthalene	41,000[b]	270[b]	4,100[b]	1.8[b]	12[b]	18	*
98-95-3	Nitrobenzene	1,000[b]	140[b]	1,000[b]	9.4[b]	0.1[b]	0.1	0.26
108-95-2	Phenol	610,000[b]	-----[c]	61,000[b]	-----[c]	100[b]	100	*
1918-02-1	Picloram[o]	140,000[b]	-----[c]	14,000[b]	-----[c]	2	20	NA
1336-36-3	Polychlorinated biphenyls (PCBs)[n]	1[h]	-----[c,h]	1[h]	-----[c,h]	-----[h]	-----[h]	*
129-00-0	Pyrene	61,000[b]	-----[c]	61,000[b]	-----[c]	4,200[b]	21,000	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
122-34-9	Simazine[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.04	0.37	NA
100-42-5	Styrene	410,000[b]	1,500[d]	41,000[b]	430[b]	4	18	*
127-18-4	Tetrachloroethylene (Perchloroethylene)	110[e]	20[e]	2,400[e]	28[e]	0.06	0.3	*
108-88-3	Toluene	410,000[b]	650[d]	410,000[b]	42[b]	12	29	*
8001-35-2	Toxaphene[n]	5.2[e]	170[e]	110[e]	240[e]	31	150	*
120-82-1	1,2,4-Trichlorobenzene	20,000[b]	3,200[d]	2,000[b]	920[b]	5	53	*
71-55-6	1,1,1-Trichloroethane	-----[c]	1,200[d]	-----[c]	1,200[d]	2	9.6	*
79-00-5	1,1,2-Trichloroethane	8,200[b]	1,800[d]	8,200[b]	1,800[d]	0.02	0.3	*
79-01-6	Trichloroethylene	520[e]	8.9[e]	1,200[b]	12[e]	0.06	0.3	*
108-05-4	Vinyl acetate	1,000,000[b]	1,600[b]	200,000[b]	10[b]	170[b]	170	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
75-01-4	Vinyl chloride	7.9[e]	1.1[e]	170[e]	1.1[b]	0.01	0.07	*
108-38-3	m-Xylene	410,000[b]	420[d]	41,000[b]	6.4[b]	210	210	*
95-47-6	o-Xylene	410,000[b]	410[d]	41,000[b]	6.5[b]	190	190	*
106-42-3	p-Xylene	410,000[b]	460[d]	41,000[b]	5.9[b]	200	200	*
1330-20-7	Xylenes (total)	410,000[b]	320[d]	41,000[b]	5.6[b]	150	150	*
	Ionizable Organics							
65-85-0	Benzoic Acid	1,000,000[b]	-----[c]	820,000[b]	-----[c]	400[b,i]	400[i]	*
95-57-8	2-Chlorophenol	10,000[b]	53,000[d]	10,000[b]	53,000[d]	4[b, i]	20[i]	*
120-83-2	2,4-Dichlorophenol	6,100[b]	-----[c]	610[b]	-----[c]	1[b, i]	1[i]	*
51-28-5	2,4-Dinitrophenol	4,100[b]	-----[c]	410[b]	-----[c]	0.2[b, i]	0.2[i]	3.3
88-85-7	Dinoseb[o]	2,000[b]	-----[c]	200[b]	-----[c]	0.34[b, i]	3.4[i]	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
87-86-5	Pentachlorophenol	24[e,j]	-----[c]	520[e,j]	-----[c]	0.03[i]	0.14[i]	*
93-72-1	2,4,5-TP (Silvex)	16,000[b]	-----[c]	1,600[b]	-----[c]	11[i]	55[i]	*
95-95-4	2,4,5-Trichlorophenol	200,000[b]	-----[c]	200,000[b]	-----[c]	270[b, i]	1,400[i]	*
88-06-2	2,4,6- Trichlorophenol	520[e]	390[e]	11,000[e]	540[e]	0.2[e, i]	0.77[i]	0.66

CAS No.	Chemical Name	Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
		Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
	Inorganics							
7440-36-0	Antimony	820[b]	-----[c]	82[b]	-----[c]	0.006[m]	0.024[m]	*
7440-38-2	Arsenic[l,n]	---[t]	1,200[e]	61[b]	25,000[e]	0.05[m]	0.2[m]	*
7440-39-3	Barium	140,000[b]	910,000[b]	14,000[b]	870,000[b]	2.0[m]	2.0[m]	*
7440-41-7	Beryllium	4,100[b]	2,100[e]	410[b]	44,000[e]	0.004[m]	0.5[m]	*
7440-42-8	Boron	410,000[b]	---[c]	41,000[b]	---[c]	2.0[m]	2.0[m]	*
7440-43-9	Cadmium[l,n]	2,000[b,r]	2,800[e]	200[b,r]	59,000[e]	0.005[m]	0.05[m]	*
7440-70-2	Calcium[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*
16887-00-6	Chloride	-------[c]	-----[c]	-----[c]	-----[c]	200[m]	200[m]	*
7440-47-3	Chromium, total	6,100[b]	420[e]	4,100[b]	690[b]	0.1[m]	1.0[m]	*
16065-83-1	Chromium, ion, trivalent	1,000,000[b]	-----[c]	310,000[b]	-----[c]	-----[g]	-----[g]	*
18540-29-9	Chromium, ion, hexavalent	6,100[b]	420[e]	4,100[b]	690[b]	-----	-----	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-48-4	Cobalt	120,000[b]	-----[c]	12,000[b]	-----[c]	1.0[m]	1.0[m]	*
7440-50-8	Copper[n]	82,000[b]	-----[c]	8,200[b]	-----[c]	0.65[m]	0.65[m]	*
57-12-5	Cyanide (amenable)	41,000[b]	-----[c]	4,100[b]	-----[c]	0.2[q,m]	0.6[q,m]	*
7782-41-4	Fluoride	120,000[b]	-----[c]	12,000[b]	-----[c]	4.0[m]	4.0[m]	*
15438-31-0	Iron	-----[c]	-----[c]	-----[c]	-----[c]	5.0[m]	5.0[m]	*
7439-92-1	Lead	800[y]	-----[c]	700[y]	-----[c]	0.0075[m]	0.1[m]	*
7439-95-4	Magnesium[n]	---[g]	---[c]	730,000	---[c]	---[c]	---[c]	*
7439-96-5	Manganese	41,000 [b,w]	91,000[b]	4,100 [b,w]	8,700[b]	0.15[m]	10.0[m]	*
7439-97-6	Mercury[l,n,s]	610[b]	16[b]	61[b]	0.1[b]	0.002[m]	0.01[m]	*
7440-02-0	Nickel[l]	41,000[b]	21,000[e]	4,100[b]	440,000[e]	0.1[m]	2.0[m]	*
14797-55-8	Nitrate as N[p]	1,000,000[b]	-----[c]	330,000[b]	-----[c]	10.0[q, m]	100[q]	*
7723-14-0	Phosphorus[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-09-7	Potassium[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*
7782-49-2	Selenium[l,n]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.05[m]	0.05[m]	*
7440-22-4	Silver	10,000[b]	-----[c]	1,000[b]	-----[c]	0.05[m]	-----	*
7440-23-5	Sodium[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*
14808-79-8	Sulfate	-----[c]	-----[c]	-----[c]	-----[c]	400[m]	400[m]	*
7440-28-0	Thallium	160[b,u]	-----[c]	160[b,u]	-----[c]	0.002[m]	0.02[m]	*
7440-62-2	Vanadium	14,000[b]	-----[c]	1,400[b]	-----[c]	0.049[m]	0.1[m]	*
7440-66-6	Zinc[l]	610,000[b]	-----[c]	61,000[b]	-----[c]	5.0[m]	10[m]	*

"*" indicates that the ADL is less than or equal to the specified remediation objective.

NA means Not Available; no PQL or EQL available in USEPA analytical methods.

Chemical Name and Soil Remediation Objective Notations (2nd, 5th thru 8th Columns)

[a] oil remediation objectives based on human health criteria only.
[b] Calculated values correspond to a target hazard quotient of 1.
[c] No toxicity criteria available for this route of exposure.

[d] Soil saturation concentration ($C_{[sat]}$) = the concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals which are liquid at ambient soil temperatures) have been violated, and alternative modeling approaches are required.

[e] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[g] Chemical-specific properties are such that this route is not of concern at any soil contaminant concentration.

[h] 40 CFR 761 contains applicability requirements and methodologies for the development of PCB remediation objectives. Requests for approval of a Tier 3 evaluation must address the applicability of 40 CFR 761.

[i] Soil remediation objective for pH of 6.8. If soil pH is other than 6.8, refer to Appendix B, Tables C and D in this Part.

[j] Ingestion soil remediation objective adjusted by a factor of 0.5 to account for dermal route.

[l] Potential for soil-plant-human exposure.

[m] The person conducting the remediation has the option to use: (1) TCLP or SPLP test results to compare with the remediation objectives listed in this Table; (2) the total amount of contaminant in the soil sample results to compare with pH specific remediation objectives listed in Appendix B, Table C or D of this Part (see Section 742.510); or (3) the appropriate background value listed in Appendix A, Table G. If the person conducting the remediation wishes to calculate soil remediation objectives based on background concentrations, this should be done in accordance with Subpart D of this Part.

[n] The Agency reserves the right to evaluate the potential for remaining contaminant concentrations to pose significant threats to crops, livestock, or wildlife.

[o] For agrichemical facilities, remediation objectives for surficial soils which are based on field application rates may be more appropriate for currently registered pesticides. Consult the Agency for further information.

[p] For agrichemical facilities, soil remediation objectives based on site-specific background concentrations of Nitrate as N may be more appropriate. Such determinations shall be conducted in accordance with the procedures set forth in Subparts D and I of this Part.

[q] The TCLP extraction must be done using water at a pH of 7.0.

[r] Value based on dietary Reference Dose.

[s] Value for Ingestion based on Reference Dose for Mercuric chloride (CAS No. 7487-94-7); value for Inhalation based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern.

[t] For the ingestion route for arsenic for industrial/commercial, see 742.Appendix A, Table G.

[u] Value based on Reference Dose for Thallium sulfate (CAS No. 7446-18-6).

[w] Value based on Reference Dose adjusted for dietary intake.

[x] For any populated areas as defined in Section 742.200, Appendix A, Table H may be used.

[y] Value based on maintaining fetal blood lead below 10 ug/d1, using the USEPA adults Blood Lead Model.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.Table C pH Specific Soil Remediation Objectives for Inorganics and Ionizing Organics for the Soil Component of the Groundwater Ingestion Route (Class I Groundwater)

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.24	pH 8.25 to 8.74	pH 8.75 to 9.0
Inorganics											
Antimony	5	5	5	5	5	5	5	5	5	5	5
Arsenic	25	26	27	28	29	29	29	30	31	32	33
Barium	260	490	850	1,200	1,500	1,600	1,700	1,800	2,100	__[a]	__[a]
Beryllium	1.1	2.1	3.4	6.6	22	63	140	1,000	8,000	__[a]	__[a]
Cadmium	1.0	1.7	2.7	3.7	5.2	7.5	11	59	430	__[a]	__[a]
Chromium (+6)	70	62	54	46	40	38	36	32	28	24	21
Copper	330	580	2,100	11,000	59,000	130,000	200,000	330,000	330,000	__[a]	__[a]
Cyanide	40	40	40	40	40	40	40	40	40	40	40
Lead	23	23	23	23	107	107	107	107	107	107	282
Mercury	0.01	0.01`	0.03	0.15	0.89	2.1	3.3	6.4	8.0	__[a]	__[a]
Nickel	20	36	56	76	100	130	180	700	3,800	__[a]	__[a]
Selenium	24	17	12	8.8	6.3	5.2	4.5	3.3	2.4	1.8	1.3
Silver	0.24	0.33	0.62	1.5	4.4	8.5	13	39	110	__[a]	__[a]

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.24	pH 8.25 to 8.74	pH 8.75 to 9.0
Thallium	1.6	1.8	2.0	2.4	2.6	2.8	3.0	3.4	3.8	4.4	4.9
Vanadium	980	980	980	980	980	980	980	980	980	980	980
Zinc	1,000	1,800	2,600	3,600	5,100	6,200	7,500	16,000	53,000	—[a]	—[a]
Organics											
Benzoic Acid	440	420	410	400	400	400	400	400	400	400	400
2-Chlorophenol	4.0	4.0	4.0	4.0	3.9	3.9	3.9	3.6	3.1	2.2	1.5
2,4-Dichlorophenol	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.86	0.69	0.56	0.48
Dinoseb	8.4	4.5	1.9	0.82	0.43	0.34	0.31	0.27	0.25	0.25	0.25
Pentachlorophenol	0.54	0.32	0.15	0.07	0.04	0.03	0.02	0.02	0.02	0.02	0.02
2,4,5-TP (Silvex)	26	16	12	11	11	11	11	11	11	11	11
2,4,5-Trichlorophenol	400	390	390	370	320	270	230	130	64	36	26
2,4,6-Trichlorophenol	0.37	0.36	0.34	0.29	0.20	0.15	0.13	0.09	0.07	0.07	0.07

[a] No data available for this pH range.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.Table D pH Specific Soil Remediation Objectives for Inorganics and Ionizing Organics for the Soil Component of the Groundwater Ingestion Route (Class II Groundwater)

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.24	pH 8.25 to 8.74	pH 8.75 to 9.0
Inorganics											
Antimony	20	20	20	20	20	20	20	20	20	20	20
Arsenic	100	100	100	110	110	120	120	120	120	130	130
Barium	260	490	850	1,200	1,500	1,600	1,700	1,800	2,100	__[a]	__[a]
Beryllium	140	260	420	820	2,800	7,900	17,000	130,000	1,000,000	__[a]	__[a]
Cadmium	10	17	27	37	52	75	110	590	4,300	__[a]	__[a]
Chromium (+6)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Copper	330	580	2,100	11,000	59,000	130,000	200,000	330,000	330,000	__[a]	__[a]
Cyanide	120	120	120	120	120	120	120	120	120	120	120
Lead	300	300	300	300	1,420	1,420	1,420	1,420	1,420	1,420	3,760
Mercury	0.05	0.06	0.14	0.75	4.4	10	16	32	40	__[a]	__[a]
Nickel	400	730	1,100	1,500	2,000	2,600	3,500	14,000	76,000	__[a]	__[a]
Selenium	24	17	12	8.8	6.3	5.2	4.5	3.3	2.4	1.8	1.3
Thallium	16	18	20	24	26	28	30	34	38	44	49

Chemical (totals) (mg/kg)	pH 4.5 to 4.74	pH 4.75 to 5.24	pH 5.25 to 5.74	pH 5.75 to 6.24	pH 6.25 to 6.64	pH 6.65 to 6.89	pH 6.9 to 7.24	pH 7.25 to 7.74	pH 7.75 to 8.24	pH 8.25 to 8.74	pH 8.75 to 9.0
Zinc	2,000	3,600	5,200	7,200	10,000	12,000	15,000	32,000	110,000	__[a]	__[a]
Organics											
Benzoic Acid	440	420	410	400	400	400	400	400	400	400	400
2-Chlorophenol	20	20	20	20	20	20	19	3.6	3.1	2.2	1.5
2,4-Dichlorophenol	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.86	0.69	0.56	0.48
Dinoseb	84	45	19	8.2	4.3	3.4	3.1	2.7	2.5	2.5	2.5
Pentachlorophenol	2.7	1.6	0.75	0.33	0.18	0.15	0.12	0.11	0.10	0.10	0.10
2,4,5-TP (Silvex)	130	79	62	57	55	55	55	55	55	55	55
2,4,5-Trichlorophenol	2,000	2,000	1,900	1,800	1,600	1,400	1,200	640	64	36	26
2,4,6-Trichlorophenol	1.9	1.8	1.7	1.4	1.0	0.77	0.13	0.09	0.07	0.07	0.07

[a] No data available for this pH range.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.TABLE E Tier 1 Groundwater Remediation Objectives for the Groundwater Component of the Groundwater Ingestion Route

		Groundwater Remediation Objective	
CAS No.	Chemical Name Organics	Class I (mg/L)	Class II (mg/L)
83-32-9	Acenaphthene	0.42	2.1
67-64-1	Acetone	6.3	6.3
15972-60-8	Alachlor	0.002[c]	0.01[c]
116-06-3	Aldicarb	0.003[c]	0.015[c]
309-00-2	Aldrin	0.014[a]	0.07
120-12-7	Anthracene	2.1	10.5
1912-24-9	Atrazine	0.003[c]	0.015[c]
71-43-2	Benzene	0.005[c]	0.025[c]
56-55-3	Benzo(*a*)anthracene	0.00013[a]	0.00065
205-99-2	Benzo(*b*)fluoranthene	0.00018[a]	0.0009
207-08-9	Benzo(*k*)fluroanthene	0.00017[a]	0.00085
50-32-8	Benzo(*a*)pyrene	0.0002[a,c]	0.002[c]
65-85-0	Benzoic Acid	28	28
111-44-4	Bis(2-chloroethyl)ether	0.01[a]	0.01
117-81-7	Bis(2-ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	0.006[c]	0.06[c]
75-27-4	Bromodichloromethane (Dichlorobromomethane)	0.0002[a]	0.0002
75-25-2	Bromoform	0.001[a]	0.001
71-36-3	Butanol	0.7	0.7
85-68-7	Butyl benzyl phthalate	1.4	7.0
86-74-8	Carbazole	---	---
1563-66-2	Carbofuran	0.04[c]	0.2[c]
75-15-0	Carbon disulfide	0.7	3.5
56-23-5	Carbon tetrachloride	0.005[c]	0.025[c]
57-74-9	Chlordane	0.002[c]	0.01[c]

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
106-47-8	4-Chloroaniline (ρ-Chloroaniline)	0.028	0.028
108-90-7	Chlorobenzene (Monochlorobenzene)	0.1[c]	0.5[c]
124-48-1	Chlorodibromomethane (Dibromochloromethane)	0.14	0.14
67-66-3	Chloroform	0.0002[a]	0.001
95-57-8	2-Chlorophenol (pH 4.9-7.3)	0.035	0.175
	2-Chlorophenol (pH 7.4-8.0)	0.035	0.035
218-01-9	Chrysene	0.0015[a]	0.0075
94-75-7	2,4-D	0.07[c]	0.35[c]
75-99-0	Dalapon	0.2[c]	2.0[c]
72-54-8	DDD	0.014[a]	0.07
72-55-9	DDE	0.01[a]	0.05
50-29-3	DDT	0.006[a]	0.03
53-70-3	Dibenzo(*a,h*)anthracene	0.0003[a]	0.0015
96-12-8	1,2-Dibromo-3-chloropropane	0.0002[c]	0.002 [c]
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.00005[c]	0.0005[c]
84-74-2	Di-*n*-butyl phthalate	0.7	3.5
95-50-1	1,2-Dichlorobenzene (*o* – Dichlorobenzene)	0.6[c]	1.5[c]
106-46-7	1,4-Dichlorobenzene (*p* – Dichlorobenzene)	0.075[c]	0.375[c]
91-94-1	3,3'-Dichlorobenzidine	0.02[a]	0.1
75-34-3	1,1-Dichloroethane	0.7	3.5
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	0.005[c]	0.025[c]
75-35-4	1,1-Dichloroethylene[b]	0.007[c]	0.035[c]
156-59-2	*cis*-1,2-Dichloroethylene	0.07[c]	0.2[c]
156-60-5	*trans*-1,2-Dichloroethylene	0.1[c]	0.5[c]
120-83-2	2,4-Dichlorophenol	0.021	0.021

78-87-5	1,2-Dichloropropane	0.005[c]	0.025[c]
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	0.001[a]	0.005

CAS No.	Chemical Name	Groundwater Remediation Objective	
		Class I (mg/L)	Class II (mg/L)
60-57-1	Dieldrin	0.009[a]	0.045
84-66-2	Diethyl phthalate	5.6	5.6
105-67-9	2,4-Dimethylphenol	0.14	0.14
51-28-5	2,4-Dinitrophenol	0.014	0.014
121-14-2	2,4-Dinitrotoluene	0.00002[a]	0.00002
606-20-2	2,6-Dinitrotoluene	0.00031[a]	0.00031
88-85-7	Dinoseb	0.007[c]	0.07[c]
117-84-0	Di-*n*-octyl phthalate	0.14	0.7
115-29-7	Endosulfan	0.042	0.21
145-73-3	Endothall	0.1[c]	0.1[c]
72-20-8	Endrin	0.002[c]	0.01[c]
100-41-4	Ethylbenzene	0.7[c]	1.0[c]
206-44-0	Fluoranthene	0.28	1.4
86-73-7	Fluorene	0.28	1.4
76-44-8	Heptachlor	0.0004[c]	0.002[c]
1024-57-3	Heptachlor epoxide	0.0002[c]	0.001[c]
118-74-1	Hexachlorobenzene	0.00006[a]	0.0003
319-84-6	*alpha*-HCH (*alpha*-BHC)	0.00011[a]	0.00055
58-89-9	*Gamma*-HCH (Lindane)	0.0002[c]	0.001[c]
77-47-4	Hexachlorocyclopentadiene	0.05[c]	0.5[c]
67-72-1	Hexachloroethane	0.007	0.035
193-39-5	Indeno(1,2,3-*c,d*)pyrene	0.00043[a]	0.00215
78-59-1	Isophorone	1.4	1.4
72-43-5	Methoxychlor	0.04[c]	0.2[c]
74-83-9	Methyl bromide (Bromomethane)	0.0098	0.049
1634-04-4	Methyl tertiary-butyl ether	0.07	0.07
75-09-2	Methylene chloride (Dichloromethane)	0.005[c]	0.05[c]
95-48-7	2-Methylphenol (*o*-Cresol)	0.35	0.35
91-20-3	Naphthalene	0.14	0.22

98-95-3	Nitrobenzene[b]	0.0035	0.0035

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
86-30-6	*N*-Nitrosodiphenylamine	0.0032 [a]	0.016
621-64-7	*N*-Nitrosodi-*n*-propylamine	0.0018 [a]	0.0018
87-86-5	Pentachlorophenol	0.001[c]	0.005[c]
108-95-2	Phenol	0.1[c]	0.1[c]
1918-02-1	Picloram	0.5[c]	5.0[c]
1336-36-3	Polychlorinated biphenyls (PCBs)	0.0005[c]	0.0025[c]
129-00-0	Pyrene	0.21	1.05
122-34-9	Simazine	0.004[c]	0.04[c]
100-42-5	Styrene	0.1[c]	0.5[c]
93-72-1	2,4,5-TP (Silvex)	0.05[c]	0.25[c]
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.005[c]	0.025[c]
108-88-3	Toluene	1.0[c]	2.5[c]
8001-35-2	Toxaphene	0.003[c]	0.015[c]
120-82-1	1,2,4-Trichlorobenzene	0.07[c]	0.7[c]
71-55-6	1,1,1-Trichloroethane[b]	0.2[c]	1.0[c]
79-00-5	1,1,2-Trichloroethane	0.005[c]	0.05[c]
79-01-6	Trichloroethylene	0.005[c]	0.025[c]
95-95-4	2,4,5-Trichlorophenol (pH 4.9-7.8)	0.7	3.5
	2,4,5-Trichlorophenol (pH 7.9-8.0)	0.7	0.7
88-06-2	2,4,6-Trichlorophenol (pH 4.9-6.8)	0.01[a]	0.05
	2,4,6-Trichlorophenol (pH 6.9-8.0)	0.01	0.01
108-05-4	Vinyl acetate	7.0	7.0
75-01-4	Vinyl chloride	0.002[c]	0.01[c]
1330-20-7	Xylenes (total)	10.0[c]	10.0[c]

CAS No.	Chemical Name	Groundwater Remediation Objective	
		Class I (mg/L)	Class II (mg/L)
	Inorganics		
7440-36-0	Antimony	0.006[c]	0.024[c]
7440-38-2	Arsenic	0.05[c]	0.2[c]
7440-39-3	Barium	2.0[c]	2.0[c]
7440-41-7	Beryllium	0.004[c]	0.5[c]
7440-42-8	Boron	2.0[c]	2.0[c]
7440-43-9	Cadmium	0.005[c]	0.05[c]
7440-70-2	Calcium	---[d]	---[d]
16887-00-6	Chloride	200[c]	200[c]
7440-47-3	Chromium, total	0.1[c]	1.0[c]
18540-29-9	Chromium, ion, hexavalent	---	---
7440-48-4	Cobalt	1.0[c]	1.0[c]
7440-50-8	Copper	0.65[c]	0.65[c]
57-12-5	Cyanide	0.2[c]	0.6[c]
7782-41-4	Fluoride	4.0[c]	4.0[c]
15438-31-0	Iron	5.0[c]	5.0[c]
7439-92-1	Lead	0.0075[c]	0.1[c]
7439-95-4	Magnesium	---[d]	---[d]
7439-96-5	Manganese	0.15[c]	10.0[c]
7439-97-6	Mercury	0.002[c]	0.01[c]
7440-02-0	Nickel	0.1[c]	2.0[c]
14797-55-8	Nitrate as N	10.0[c]	100[c]
7723-14-0	Phosphorus	---[d]	---[d]
7440-09-7	Potassium	---[d]	---[d]
7782-49-2	Selenium	0.05[c]	0.05[c]

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
7440-22-4	Silver	0.05[c]	---
7440-23-5	Sodium	---[d]	---[d]
14808-79-8	Sulfate	400[c]	400[c]
7440-28-0	Thallium	0.002[c]	0.02[c]
7440-62-2	Vanadium[b]	0.049	0.1
7440-66-6	Zinc	5.0[c]	10[c]

Chemical Name and Groundwater Remediation Objective Notations

[a] The groundwater remediation objective is equal to the ADL for carcinogens according to the procedures specified in 35 Ill. Adm. Code 620.

[b] Oral Reference Dose and/or Reference Concentration under review by USEPA. Listed values subject to change.

[c] Value listed is also the Groundwater Quality Standard for this chemical pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

[d] This chemical is included in the Total Dissolved Solids (TDS) Groundwater Quality Standard of 1,200 mg/l pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.TABLE F Values Used to Calculate the Tier 1 Soil Remediation Objectives for the Soil Component of the Groundwater Ingestion Route

		GW_{obj} Concentration used to Calculate Tier 1 Soil Remediation Objectives[a]	
CAS No.	Chemical Name Organics	Class I (mg/L)	Class II (mg/L)
83-32-9	Acenaphthene	2.0[b]	10
67-64-1	Acetone	6.3	6.3
15972-60-8	Alachlor	0.002[c]	0.01[c]
116-06-3	Aldicarb	0.003[c]	0.015[c]
309-00-2	Aldrin	5.0E-6[b]	2.5E-5
120-12-7	Anthracene	10[b]	50
1912-24-9	Atrazine	0.003[c]	0.015[c]
71-43-2	Benzene	0.005[c]	0.025[c]
56-55-3	Benzo(*a*)anthracene	0.0001[b]	0.0005
205-99-2	Benzo(*b*)fluoranthene	0.0001[b]	0.0005
207-08-9	Benzo(*k*)fluroanthene	0.001[b]	0.005
50-32-8	Benzo(*a*)pyrene	0.0002[a,c]	0.002[c]
65-85-0	Benzoic Acid	100[b]	100
111-44-4	Bis(2-chloroethyl)ether	8.0E-5[b]	8.0E-5
117-81-7	Bis(2-ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	0.006[a,c]	0.06[c]
75-27-4	Bromodichloromethane (Dichlorobromomethane)	0.1[b]	0.1
75-25-2	Bromoform	0.1[b]	0.01
71-36-3	Butanol	4.0[b]	4.0
85-68-7	Butyl benzyl phthalate	7.0[b]	35
86-74-8	Carbazole	0.004[b]	0.02
1563-66-2	Carbofuran	0.04[c]	0.2[c]
75-15-0	Carbon disulfide	4.0[b]	20
56-23-5	Carbon tetrachloride	0.005[c]	0.025[c]
57-74-9	Chlordane	0.002[c]	0.01[c]

CAS No.	Chemical Name	GW_{obj} Concentration used to Calculate Tier 1 Soil Remediation Objectives[a]	
		Class I (mg/L)	Class II (mg/L)
106-47-8	4-Chloroaniline (ρ-Chloroaniline)	0.1[b]	0.1
108-90-7	Chlorobenzene (Monochlorobenzene)	0.1[c]	0.5[c]
124-48-1	Chlorodibromomethane (Dibromochloromethane)	0.06[b]	0.06
67-66-3	Chloroform	0.1[b]	0.5
95-57-8	2-Chlorophenol (pH 4.9-7.3)	0.2[b]	1.0
	2-Chlorophenol (pH 7.4-8.0)	0.2	0.2
218-01-9	Chrysene	0.1[b]	0.05
94-75-7	2,4-D	0.07[c]	0.35[c]
75-99-0	Dalapon	0.2[c]	2.0[c]
72-54-8	DDD	0.0004[b]	0.002
72-55-9	DDE	0.0003[b]	0.0015
50-29-3	DDT	0.0003[b]	0.0015
53-70-3	Dibenzo(*a,h*)anthracene	1.0E-5[b]	5.0E-5
96-12-8	1,2-Dibromo-3-chloropropane	0.0002[c]	0.002 [c]
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.00005[a,c]	0.0005[c]
84-74-2	Di-*n*-butyl phthalate	4.0[b]	20
95-50-1	1,2-Dichlorobenzene (*o* – Dichlorobenzene)	0.6[c]	1.5[c]
106-46-7	1,4-Dichlorobenzene (*p* – Dichlorobenzene)	0.075[c]	0.375[c]
91-94-1	3,3'-Dichlorobenzidine	0.0002[b]	0.001
75-34-3	1,1-Dichloroethane	4.0[b]	20
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	0.005[c]	0.025[c]
75-35-4	1,1-Dichloroethylene	0.007[c]	0.035[c]
156-59-2	*cis*-1,2-Dichloroethylene	0.07[c]	0.2[c]
156-60-5	*trans*-1,2-Dichloroethylene	0.1[c]	0.5[c]

120-83-2	2,4-Dichlorophenol	0.1[b]	0.1
78-97-5	1,2-Dichloropropane	0.005[c]	0.025[c]
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	0.0005[b]	0.0025

CAS No.	Chemical Name	GW_{obj} Concentration used to Calculate Tier 1 Soil Remediation Objectives[a]	
		Class I (mg/L)	Class II (mg/L)
60-57-1	Dieldrin	5.0E-6[b]	2.5E-5
84-66-2	Diethyl phthalate	30[b]	30
105-67-9	2,4-Dimethylphenol	0.7[b]	0.7
51-28-5	2,4-Dinitrophenol	0.04[b]	0.04
121-14-2	2,4-Dinitrotoluene	0.0001[b]	0.0001
606-20-2	2,6-Dinitrotoluene	0.0001	0.0001
88-85-7	Dinoseb	0.007[c]	0.07[c]
117-84-0	Di-*n*-octyl phthalate	0.7[b]	3.5
115-29-7	Endosulfan	0.2[b]	1.0
145-73-3	Endothall	0.1[c]	0.1[c]
72-20-8	Endrin	0.002[c]	0.01[c]
100-41-4	Ethylbenzene	0.7[c]	1.0[c]
206-44-0	Fluoranthene	1.0[b]	5.0
86-73-7	Fluorene	1.0[b]	5.0
76-44-8	Heptachlor	0.0004[c]	0.002[c]
1024-57-3	Heptachlor epoxide	0.0002[c]	0.001[c]
118-74-1	Hexachlorobenzene	0.001[b]	0.005
319-84-6	*alpha*-HCH (*alpha*-BHC)	1.0E-5[b]	5.0E-5
58-89-9	*Gamma*-HCH (Lindane)	0.0002[c]	0.001[c]
77-47-4	Hexachlorocyclopentadiene	0.05[c]	0.5[c]
67-72-1	Hexachloroethane	0.007	0.035
193-39-5	Indeno(1,2,3-*c,d*)pyrene	0.0001[b]	0.0005
78-59-1	Isophorone	1.4	1.4
72-43-5	Methoxychlor	0.04[c]	0.2[c]
74-83-9	Methyl bromide (Bromomethane)	0.05[b]	0.25
1634-04-4	Methyl tertiary-butyl ether	0.07	0.07
75-09-2	Methylene chloride (Dichloromethane)	0.005[c]	0.05[c]
95-48-7	2-Methylphenol (*o*-Cresol)	2.0[b]	2.0

91-20-3	Naphthalene	0.14	0.22
98-95-3	Nitrobenzene	0.02[b]	0.02

CAS No.	Chemical Name	GW_{obj} Concentration used to Calculate Tier 1 Soil Remediation Objectives[a]	
		Class I (mg/L)	Class II (mg/L)
86-30-6	*N*-Nitrosodiphenylamine	0.02[b]	0.1
621-64-7	*N*-Nitrosodi-*n*-propylamine	1.0E-5[b]	1.0E-5
87-86-5	Pentachlorophenol	0.001[a,c]	0.005[c]
108-95-2	Phenol	0.1[c]	0.1[c]
1918-02-1	Picloram	0.5[c]	5.0[c]
1336-36-3	Polychlorinated biphenyls (PCBs)	---	---
129-00-0	Pyrene	1.0[b]	5.0
122-34-9	Simazine	0.004[c]	0.04[c]
100-42-5	Styrene	0.1[c]	0.5[c]
93-72-1	2,4,5-TP (Silvex)	0.05[c]	0.25[c]
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.005[c]	0.025[c]
108-88-3	Toluene	1.0[c]	2.5[c]
8001-35-2	Toxaphene	0.003[c]	0.015[c]
120-82-1	1,2,4-Trichlorobenzene	0.07[c]	0.7[c]
71-55-6	1,1,1-Trichloroethane	0.2[c]	1.0[c]
79-00-5	1,1,2-Trichloroethane	0.005[c]	0.05[c]
79-01-6	Trichloroethylene	0.005[c]	0.025[c]
95-95-4	2,4,5-Trichlorophenol (pH 4.9-7.8)	4.0[b]	20
	2,4,5-Trichlorophenol (pH 7.9-8.0)	4.0	4.0
88-06-2	2,4,6-Trichlorophenol (pH 4.9-6.8)	0.008[b]	0.04
	2.4.6-Trichlorophenol (pH 6.9-8.0)	0.008	0.008
108-05-4	Vinyl acetate	40[b]	40
75-01-4	Vinyl chloride	0.002[c]	0.01[c]
1330-20-7	Xylenes (total)	10.0[c]	10.0[c]

CAS No.	Chemical Name	GW_{obj} Concentration used to Calculate Tier 1 Soil Remediation Objectives[a]	
		Class I (mg/L)	Class II (mg/L)
	Inorganics		
7440-36-0	Antimony	0.006[c]	0.024[c]
7440-38-2	Arsenic	0.05[c]	0.2[c]
7440-39-3	Barium	2.0[c]	2.0[c]
7440-41-7	Beryllium	0.004[c]	0.5[c]
7440-42-8	Boron	2.0[c]	2.0[c]
7440-43-9	Cadmium	0.005[c]	0.05[c]
7440-70-2	Calcium	---	---
16887-00-6	Chloride	200[c]	200[c]
7440-47-3	Chromium, total	0.1[c]	1.0[c]
18540-29-9	Chromium, ion, hexavalent	---	---
7440-48-4	Cobalt	1.0[c]	1.0[c]
7440-50-8	Copper	0.65[c]	0.65[c]
57-12-5	Cyanide	0.2[c]	0.6[c]
7782-41-4	Fluoride	4.0[c]	4.0[c]
15438-31-0	Iron	5.0[c]	5.0[c]
7439-92-1	Lead	0.0075[c]	0.1[c]
7439-95-4	Magnesium	---	---
7439-96-5	Manganese	0.15[c]	10.0[c]
7439-97-6	Mercury	0.002[c]	0.01[c]
7440-02-0	Nickel	0.1[c]	2.0[c]
14797-55-8	Nitrate as N	10.0[c]	100[c]

CAS No.	Chemical Name	GW_{obj} Concentration used to Calculate Tier 1 Soil Remediation Objectives[a]	
		Class I (mg/L)	Class II (mg/L)
7723-14-0	Phosphorus	---	---
7440-09-7	Potassium	---	---
7782-49-2	Selenium	0.05[c]	0.05[c]
7440-22-4	Silver	0.05[c]	---
7440-23-5	Sodium	---	---
14808-79-8	Sulfate	400[c]	400[c]
7440-28-0	Thallium	0.002[c]	0.02[c]
7440-62-2	Vanadium	0.049	0.1
7440-66-6	Zinc	5.0[c]	10[c]

Chemical Name and Groundwater Remediation Objective Notations

[a] The Equation S17 is used to calculate the Soil Remediation Objective for the Soil Component of the Groundwater Ingestion Route; this equation requires calculation of the Target Soil Leachate Concentration (C_w) from Equation S18: $C_w = DF \times GW_{obj}$.

[b] Value listed is the Water Health Based Limit (HBL) for this chemical from Soil Screening Guidance: User's Guide, incorporated by reference at Section 742.210. The HBL is equal to the non-zero MCLG (if available); the MCL (if available); or, for carcinogens, a cancer risk of 1.0E-6, and for noncarcinogens is equal to a Hazard Quotient of 1.0. NOTE: These GW_{obj} concentrations are not equal to the Tier 1 Groundwater Remediation Objectives for the Direct Ingestion of Groundwater Component of the Groundwater Ingestion Route, listed in Section 742.Appendix B, Table E.

[c] Value listed is also the Groundwater Quality Standard for this chemical pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B: Tier 1 Illustrations and Tables

Section 742.TABLE G: Tier 1 Soil Gas Remediation Objectives for the Outdoor Inhalation Exposure Route[a]

CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Construction Worker (mg/m^3)
67-64-1	Acetone	750,000[e]	750,000[e]	750,000[e]
71-43-2	Benzene	420[c]	800[c]	1,100[c]
111-44-4	Bis(2-chloroethyl)ether	1.3[c]	2.4[c]	3.4[c]
75-27-4	Bromodichloromethane	450,000[e]	450,000[e]	450,000[e]
75-25-2	Bromoform	1,800[c]	3,500[c]	4,900[c]
71-36-3	Butanol	29,000[e]	29,000[e]	29,000[e]
78-93-3	2-Butanone (MEK)	380,000[e]	380,000[e]	15,000[b]
75-15-0	Carbon disulfide	1,500,000[e]	1,500,000[e]	48,000[b]
56-23-5	Carbon tetrachloride	290[c]	550[c]	770[c]
108-90-7	Chlorobenzene	36,000[b]	57,000[b]	3,700[b]
124-48-1	Chlorodibromomethane	57,000[e]	57,000[e]	150[b]
67-66-3	Chloroform	110[c]	200[c]	290[c]
95-57-8	2-Chlorophenol	17,000[e]	17,000[e]	17,000[e]
75-99-0	Dalapon	1,500[e]	1,500[e]	1,500[e]
96-12-8	1,2-Dibromo-3-chloropropane	0.14[c]	0.27[c]	0.38[c]
106-93-4	1,2-Dibromoethane	2.9[c]	5.6[c]	7.9[c]
95-50-1	1,2-Dichlorobenzene	11,000[e]	11,000[e]	6,700[b]
106-46-7	1,4-Dichlorobenzene	8,400[e]	8,400[e]	6,400[b]
75-71-8	Dichlorodifluoromethane	890,000[b]	1,400,000[b]	92,000[b]
75-34-3	1,1-Dichloroethane	870,000[b]	1,300,000[e]	90,000[b]
107-06-2	1,2-Dichloroethane	67[c]	130[c]	180[c]
75-35-4	1,1-Dichloroethylene	520,000[b]	820,000[b]	5,300[b]

CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Construction Worker (mg/m^3)
156-59-2	*cis*-1,2-Dichloroethylene	1,100,000[e]	1,100,000[e]	1,100,000[e]
156-60-5	*trans*-1,2-Dichloroethylene	120,000[b]	190,000[b]	12,000[b]
78-87-5	1,2-Dichloropropane	240[c]	470[c]	110[c]
542-75-6	1,3-Dichloropropylene (*cis* + *trans*)	1,900[c]	3,700[c]	1,400[c]
123-91-1	p-Dioxane	16[c]	30[c]	42[c]
100-41-4	Ethylbenzene	59,000[e]	59,000[e]	8,500[b]
76-44-8	Heptachlor	0.40[c]	0.76[c]	1.1[c]
118-74-1	Hexachlorobenzene	0.26[c]	0.28[e]	0.28[e]
77-47-4	Hexachlorocyclopentadiene	85[b]	140[b]	440[b]
67-72-1	Hexachloroethane	2,800[e]	2,800[e]	2,800[e]
78-59-1	Isophorone	3,400[e]	3,400[e]	1,500[b]
98-82-8	Isopropylbenzene (Cumene)	30,000[e]	30,000[e]	30,000[e]
7439-97-6	Mercury[f]	22[e]	22[e]	0.62[b]
74-83-9	Methyl bromide	12,000[b]	19,000[b]	2,400[b]
1634-04-4	Methyl tertiary-butyl ether	1,200,000[e]	1,200,000[e]	23,000[b]
75-09-2	Methylene chloride	6,100[c]	12,000[c]	5,100[b]
91-57-6	2-Methylnaphthalene	530[e]	530[e]	530[e]
95-48-7	2-Methylphenol (o-cresol)	1,800[e]	1,800[e]	410[b]
91-20-3	Naphthalene	560[b]	620[e]	5.8[b]
98-95-3	Nitrobenzene	6.5[c]	12[c]	10[b]
621-64-7	n-Nitrosodi-n-propylamine	0.056[c]	0.11[c]	0.15[c]
108-95-2	Phenol	1,500[e]	1,500[e]	79[b]
1336-36-3	Polychlorinated biphenyls (PCBs)	---[d]	---[d]	---[d]
100-42-5	Styrene	34,000[e]	34,000[e]	16,000[b]
127-18-4	Tetrachloroethylene	360[c]	690[c]	970[c]
108-88-3	Toluene	140,000[e]	140,000[e]	50,000[b]
120-82-1	1,2,4-Trichlorobenzene	1,000[b]	1,600[b]	110[b]
71-55-6	1,1,1-Trichloroethane	870,000[e]	870,000[e]	89,000[b]

CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Construction Worker (mg/m^3)
79-00-5	1,1,2-Trichloroethane	170,000[e]	170,000[e]	170,000[e]
79-01-6	Trichloroethylene	1,700[c]	3,300[c]	1,500[b]
75-69-4	Trichlorofluoromethane	2,100,000[b]	3,400,000[b]	220,000[b]
108-05-4	Vinyl acetate	160,000[b]	250,000[b]	1,600[b]
75-01-4	Vinyl chloride	780[c]	3,000[c]	3,000[b]
108-38-3	m-Xylene	52,000[e]	52,000[e]	3,100[b]
95-47-6	o-Xylene	41,000[e]	41,000[e]	2,600[b]
106-42-3	p-Xylene	55,000[e]	55,000[e]	3,300[b]
1330-20-7	Xylenes (total)	49,000[e]	49,000[e]	2,900[b]

Chemical Name and Remediation Objective Notations

[a] For the outdoor inhalation exposure route, it is acceptable to determine compliance by meeting either the soil or soil gas remediation objectives. The soil remediation objectives for the outdoor inhalation route are located in Appendix B, Tables A and B.

[b] Calculated values correspond to a target hazard quotient of 1.

[c] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[d] PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with IEPA Bureau of Land (BOL) if calculation of Tier 2 or 3 remediation objectives is desired.

[e] The value shown is the C_v^{sat} value of the chemical in soil gas. The C_v^{sat} of the chemical becomes the remediation objective if the calculated value exceeds the C_v^{sat} value or if there are no toxicity criteria available for the inhalation route of exposure.

[f] Value for the inhalation exposure route is based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objectives only apply at sites where elemental Mercury is a contaminant of concern.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX B: Tier 1 Illustrations and Tables

Section 742.TABLE H: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route – Diffusion and Advection[j]

Q_{soil} equals 83.33 cm^3/sec[a]

		Soil Gas		Groundwater	
CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
67-64-1	Acetone	750,000[f]	750,000[f]	1,000,000[g]	1,000,000[g]
71-43-2	Benzene	0.37[c]	2.8[c]	0.11[c]	0.41[c]
111-44-4	Bis(2-chloroethyl)ether	0.014[c]	0.087[c]	0.083[c]	0.43[c]
75-27-4	Bromodichloromethane	450,000[f]	450,000[f]	6,700[g]	6,700[g]
75-25-2	Bromoform	11[c]	52[c]	3.1[c]	12[c]
71-36-3	Butanol	29,000[f]	29,000[f]	74,000[g]	74,000[g]
78-93-3	2-Butanone (MEK)	6,400[b]	40,000[b]	10,000[b]	48,000[b]
75-15-0	Carbon disulfide	780[b]	5,300[b]	67[b]	210[b]
56-23-5	Carbon tetrachloride	0.21[c]	1.5[c]	0.020[c]	0.076[c]
108-90-7	Chlorobenzene	69[b]	420[b]	26[b]	82[b]
124-48-1	Chlorodibromomethane	57,000[f]	57,000[f]	2,600[g]	2,600[g]
67-66-3	Chloroform	0.11[c]	0.92[c]	0.07[i]	0.15[c]
95-57-8	2-Chlorophenol	17,000[f]	17,000[f]	22,000[g]	22,000[g]
75-99-0	Dalapon[e]	1,500[f]	1,500[f]	900,000[g]	900,000[g]
96-12-8	1,2-Dibromo-3-chloropropane[e]	0.0012[c]	0.0062[c]	0.00065[c]	0.0027[c]
106-93-4	1,2-Dibromoethane	0.0078[c]	0.048[c]	0.0035[c]	0.014[c]
95-50-1	1,2-Dichlorobenzene	290[b]	1,700[b]	140[b]	160[g]
106-46-7	1,4-Dichlorobenzene	1,200[b]	6,800[b]	79[g]	79[g]
75-71-8	Dichlorodifluoromethane	270[b]	1,700[b]	3.0[b]	9.2[b]
75-34-3	1,1-Dichloroethane	690[b]	4,200[b]	180[b]	580[b]

CAS No.	Chemical Name	Soil Gas		Groundwater	
		Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
107-06-2	1,2-Dichloroethane	0.099[c]	0.81[c]	0.054[c]	0.22[c]
75-35-4	1,1-Dichloroethylene	240[b]	1,600[b]	24[b]	74[b]
156-59-2	*cis*-1,2-Dichloroethylene	1,100,000[f]	1,100,000[f]	3,500[g]	3,500[g]
156-60-5	*trans*-1,2-Dichloroethylene	85[b]	510[b]	16[b]	51[b]
78-87-5	1,2-Dichloropropane	0.31[c]	2.3[c]	0.12[c]	0.48[c]
542-75-6	1,3-Dichloropropylene (*cis* + *trans*)	0.90[c]	6.2[c]	0.14[c]	0.52[c]
123-91-1	p-Dioxane	0.22[c]	2.3[c]	2.9[c]	25[c]
100-41-4	Ethylbenzene	1,3[c]	9.3[c]	0.37[c]	1.4[c]
76-44-8	Heptachlor	0.0063[c]	0.032[c]	0.0025[c]	0.0096[c]
118-74-1	Hexachlorobenzene	0.0087[c]	0.057[c]	0.0059[c]	0.0062[g]
77-47-4	Hexachlorocyclopentadiene	0.58[b]	2.6[b]	0.084[b]	0.26[b]
67-72-1	Hexachloroethane	2,800[f]	2,800[f]	50[g]	50[g]
78-59-1	Isophorone	2,900[b]	3,400[f]	12,000[g]	12,000[g]
98-82-8	Isopropylbenzene (Cumene)	600[b]	3,500[b]	2.7[b]	8.4[b]
7439-97-6	Mercury[h]	0.42[b]	2.5[b]	0.053[b]	0.060[g]
74-83-9	Methyl bromide	6.9[b]	42[b]	1.5[b]	4.8[b]
1634-04-4	Methyl tertiary-butyl ether	3,700[b]	24,000[b]	1,900[b]	6,800[b]
75-09-2	Methylene chloride	5.6[c]	45[c]	2.1[c]	8.2[c]
91-57-6	2-Methylnaphthalene	530[f]	530[f]	25[g]	25[g]
95-48-7	2-Methylphenol (o-cresol)	600[b]	1,800[f]	26,000[g]	26,000[g]
91-20-3	Naphthalene	0.11[c]	0.75[c]	0.075[c]	0.32[c]
98-95-3	Nitrobenzene	0.077[c]	0.57[c]	0.34[c]	2.0[c]
621-64-7	n-Nitrosodi-n-propylamine	0.0016[c]	0.012[c]	0.044[c]	0.27[c]
108-95-2	Phenol	140[b]	1,300[b]	28,000[b]	83,000[g]

CAS No.	Chemical Name	Soil Gas		Groundwater	
		Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
1336-36-3	Polychlorinated biphenyls (PCBs)	---[d]	---[d]	---[d]	---[d]
100-42-5	Styrene	1,400[b]	8,500[b]	310[g]	310[g]
127-18-4	Tetrachloroethylene	0.55[c]	4.0[c]	0.091[c]	0.34[c]
108-88-3	Toluene	6,200[b]	40,000[b]	530[g]	530[g]
120-82-1	1,2,4-Trichlorobenzene	5.4[b]	25[b]	1.8[b]	5.9[b]
71-55-6	1,1,1-Trichloroethane	6,600[b]	41,000[b]	1,000[b]	1,300[g]
79-00-5	1,1,2-Trichloroethane	170,000[f]	170,000[f]	4,400[g]	4,400[g]
79-01-6	Trichloroethylene	1.5[c]	12[c]	0.34[c]	1.3[c]
75-69-4	Trichlorofluoromethane	860[b]	5,600[b]	26[b]	82[b]
108-05-4	Vinyl acetate	250[b]	1,600[b]	160[b]	550[b]
75-01-4	Vinyl chloride	0.29[c]	4.8[c]	0.028[c]	0.21[c]
108-38-3	m-Xylene	140[b]	850[b]	43[b]	130[b]
95-47-6	o-Xylene	120[b]	790[b]	40[b]	130[b]
106-42-3	p-Xylene	130[b]	820[b]	38[b]	120[b]
1330-20-7	Xylenes (total)[e]	140[b]	840[b]	30[b]	93[b]

Chemical Name and Remediation Objective Notations

[a] Compliance is determined by meeting either the soil gas remediation objectives or the groundwater remediation objectives. See Sections 742.505 and 742.515.

[b] Calculated values correspond to a target hazard quotient of 1.

[c] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[d] PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired.

[e] Groundwater remediation objective calculated at 25°C. For Dalapon and 1,2-Dibromo-3-chloropropane, the critical temperature (T_c) and enthalpy of vaporization at the normal boiling point ($H_{v,b}$) are not available. For Xylenes (total), the enthalpy of vaporization at the normal boiling point ($H_{v,b}$) is not available.

[f] The value shown is the C_v^{sat} value of the chemical in soil gas. The C_v^{sat} of the chemical becomes the remediation objective if the calculated value exceeds the C_v^{sat} value or if there are no toxicity criteria available for the inhalation route of exposure.

[g] The value shown is the solubility of the chemical in water. The solubility of the chemical becomes the remediation objective if the calculated value exceeds the solubility or if there are no toxicity criteria available for the ingestion route of exposure.

[h] Value for the inhalation exposure route is based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objectives only apply at sites where elemental Mercury is a contaminant of concern.

[i] The value shown is the Groundwater Remediation Objective listed in Appendix B, Table E.

[j] Calculated values for the remediation objectives in this table are based on the assumption that the existing or potential building has a full concrete slab-on-grade, though the remediation objectives in this table are also considered protective of occupants of buildings with full concrete basement floors and walls. This table applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Institutional controls under Subpart J are required to use remediation objectives in this table. This table does not apply when the existing or potential building has neither a full concrete slab-on-grade nor a full concrete basement floor and walls, such as a building with an earthen crawl space, an earthen floor, a stone foundation, a partial concrete floor, or a sump. In such cases, site evaluators have the option of excluding the indoor inhalation exposure route under Section 742.312, meeting the building control technology requirements under Subpart L, or proposing an alternative approach under Tier 3.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX B: Tier 1 Illustrations and Tables

Section 742.TABLE I: Tier 1 Soil Gas and Groundwater Remediation Objectives for the Indoor Inhalation Exposure Route – Diffusion Only[j]

Q_{soil} equals 0.0 cm^3/sec[a,b]

		Soil Gas		Groundwater	
CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
67-64-1	Acetone	750,000[g]	750,000[g]	1,000,000[h]	1,000,000[h]
71-43-2	Benzene	41[d]	300[d]	0.41[d]	2.6[d]
111-44-4	Bis(2-chloroethyl)ether	1.9[d]	14[d]	6.6[d]	48[d]
75-27-4	Bromodichloromethane	450,000[g]	450,000[g]	6,700[h]	6,700[h]
75-25-2	Bromoform	1,800[d]	13,000[d]	170[d]	1,300[d]
71-36-3	Butanol	29,000[g]	29,000[g]	74,000[h]	74,000[h]
78-93-3	2-Butanone (MEK)	380,000[g]	380,000[g]	220,000[h]	220,000[h]
75-15-0	Carbon disulfide	81,000[c]	500,000[c]	170[c]	820[c]
56-23-5	Carbon tetrachloride	24[d]	180[d]	0.052[d]	0.31[d]
108-90-7	Chlorobenzene	8,300[c]	51,000[c]	130[c]	470[h]
124-48-1	Chlorodibromomethane	57,000[g]	57,000[g]	2,600[h]	2,600[h]
67-66-3	Chloroform	12[d]	87[d]	0.17[d]	1.1[d]
95-57-8	2-Chlorophenol	17,000[g]	17,000[g]	22,000[h]	22,000[h]
75-99-0	Dalapon[f]	1,500[g]	1,500[g]	900,000[h]	900,000[h]
96-12-8	1,2-Dibromo-3-chloropropane[f]	0.17[d]	1.3[d]	0.029[d]	0.21[d]
106-93-4	1,2-Dibromoethane	1.1[d]	7.9[d]	0.073[d]	0.52[d]
95-50-1	1,2-Dichlorobenzene	11,000[g]	11,000[g]	160[h]	160[h]
106-46-7	1,4-Dichlorobenzene	8,400[g]	8,400[g]	79[h]	79[h]
75-71-8	Dichlorodifluoromethane	32,000[c]	200,000[c]	6.8[c]	33[c]
75-34-3	1,1-Dichloroethane	81,000[c]	500,000[c]	750[c]	4,100[c]

		Soil Gas		Groundwater	
CAS No.	Chemical Name	Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
107-06-2	1,2-Dichloroethane	10[d]	76[d]	0.50[d]	3.5[d]
75-35-4	1,1-Dichloroethylene	27,000[c]	160,000[c]	61[c]	300[c]
156-59-2	*cis*-1,2-Dichloroethylene	1,100,000[g]	1,100,000[g]	3,500[h]	3,500[h]
156-60-5	*trans*-1,2-Dichloroethylene	10,000[c]	63,000[c]	58[c]	310[c]
78-87-5	1,2-Dichloropropane	36[d]	260[d]	0.67[d]	4.5[d]
542-75-6	1,3-Dichloropropylene (*cis* + *trans*)	110[d]	830[d]	0.42[d]	2.6[d]
123-91-1	p-Dioxane	15[d]	110[d]	140[d]	1,000[d]
100-41-4	Ethylbenzene	150[d]	1,100[d]	1.3[d]	8.1[d]
76-44-8	Heptachlor	0.97[d]	7.1[d]	0.058[d]	0.18[h]
118-74-1	Hexachlorobenzene	0.28[g]	0.28[g]	0.0062[h]	0.0062[h]
77-47-4	Hexachlorocyclopentadiene	86[c]	530[c]	0.29[c]	1.5[c]
67-72-1	Hexachloroethane	2,800[g]	2,800[g]	50[h]	50[h]
78-59-1	Isophorone	3,400[g]	3,400[g]	12,000[h]	12,000[h]
98-82-8	Isopropylbenzene (Cumene)	30,000[g]	30,000[g]	6.2[c]	30[c]
7439-97-6	Mercury[i]	22[g]	22[g]	0.060[h]	0.060[h]
74-83-9	Methyl bromide	830[c]	5,100[c]	6.1[c]	33[c]
1634-04-4	Methyl tertiary-butyl ether	420,000[c]	1,200,000[g]	30,000[c]	51,000[h]
75-09-2	Methylene chloride	590[d]	4,400[d]	12[d]	84[d]
91-57-6	2-Methylnaphthalene	530[g]	530[g]	25[h]	25[h]
95-48-7	2-Methylphenol (o-cresol)	1,800[g]	1,800[g]	26,000[h]	26,000[h]
91-20-3	Naphthalene	14[d]	100[d]	1.8[d]	13[d]
98-95-3	Nitrobenzene	9.0[d]	66[d]	23[d]	170[d]
621-64-7	n-Nitrosodi-n-propylamine	0.18[d]	1.3[d]	3.3[d]	24[d]
108-95-2	Phenol	1,500[g]	1,500[g]	83,000[h]	83,000[h]
1336-36-3	Polychlorinated biphenyls	---[e]	---[e]	---[e]	---[e]

CAS No.	Chemical Name	Soil Gas		Groundwater	
		Residential (mg/m^3)	Industrial/Commercial (mg/m^3)	Residential (mg/L)	Industrial/Commercial (mg/L)
	(PCBs)				
100-42-5	Styrene	34,000[g]	34,000[g]	310[h]	310[h]
127-18-4	Tetrachloroethylene	66[d]	490[d]	0.26[d]	1.6[d]
108-88-3	Toluene	140,000[g]	140,000[g]	530[h]	530[h]
120-82-1	1,2,4-Trichlorobenzene	800[c]	4,300[g]	35[h]	35[h]
71-55-6	1,1,1-Trichloroethane	770,000[c]	870,000[g]	1,300[h]	1,300[h]
79-00-5	1,1,2-Trichloroethane	170,000[g]	170,000[g]	4,400[h]	4,400[h]
79-01-6	Trichloroethylene	180[d]	1,300[d]	1.1[d]	6.7[d]
75-69-4	Trichlorofluoromethane	97,000[c]	600,000[c]	62[c]	300[c]
108-05-4	Vinyl acetate	28,000[c]	170,000[c]	2,500[c]	15,000[c]
75-01-4	Vinyl chloride	30[d]	440[d]	0.065[d]	0.75[d]
108-38-3	m-Xylene	17,000[d]	52,000[c]	160[c]	160[h]
95-47-6	o-Xylene	14,000[d]	41,000[c]	170[c]	180[h]
106-42-3	p-Xylene	16,000[d]	55,000[c]	140[c]	160[h]
1330-20-7	Xylenes (total)[f]	17,000[d]	49,000[c]	96[c]	110[h]

Chemical Name and Remediation Objective Notations

[a] Compliance is determined by meeting both the soil gas remediation objectives and the groundwater remediation objectives. See Sections 742.505 and 742.515.

[b] Remediation objectives relying on this table require use of institutional controls in accordance with Subpart J.

[c] Calculated values correspond to a target hazard quotient of 1.

[d] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[e] PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical and toxicity parameters depend on the congeners present at the site. Persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired

[f] Groundwater remediation objective calculated at 25°C. For Dalapon and 1,2-Dibromo-3-chloropropane, the critical temperature (T_c) and enthalpy of vaporization at the normal boiling point ($H_{v,b}$) are not available. For Xylenes (total), the enthalpy of vaporization at the normal boiling point ($H_{v,b}$) is not available.

[g] The value shown is the C_v^{sat} value of the chemical in soil gas. The C_v^{sat} of the chemical becomes the remediation objective if the calculated value exceeds the C_v^{sat} value or if there are no toxicity criteria available for the inhalation route of exposure.

[h] The value shown is the solubility of the chemical in water. The solubility of the chemical becomes the remediation objective if the calculated value exceeds the solubility or if there are no toxicity criteria available for the inhalation route of exposure.

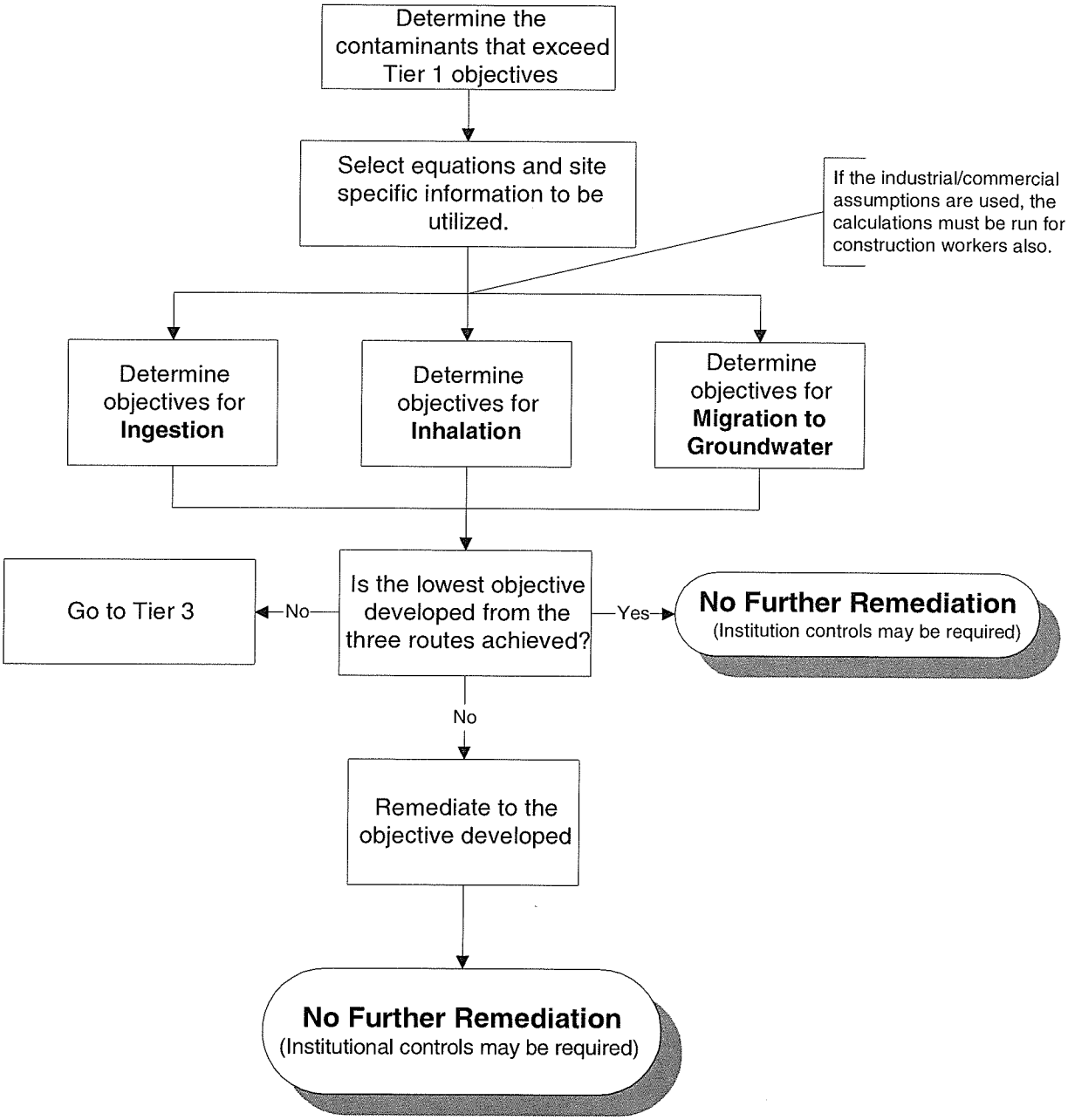
[i] Value for the inhalation exposure route is based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objectives only apply at sites where elemental Mercury is a contaminant of concern.

[j] Calculated values for the remediation objectives in this table are based on the assumption that the existing or potential building has a full concrete slab-on-grade, though the remediation objectives in this table are also considered protective of occupants of buildings with full concrete basement floors and walls. This table applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Institutional controls under Subpart J are required to use remediation objectives in this table. This table does not apply when the existing or potential building has neither a full concrete slab-on-grade nor a full concrete basement floor and walls, such as a building with an earthen crawl space, an earthen floor, a stone foundation, a partial concrete floor, or a sump. In such cases, site evaluators have the option of excluding the indoor inhalation exposure route under Section 742.312, meeting the building control technology requirements under Subpart L, or proposing an alternative approach under Tier 3.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX C Tier 2 Illustrations and Tables

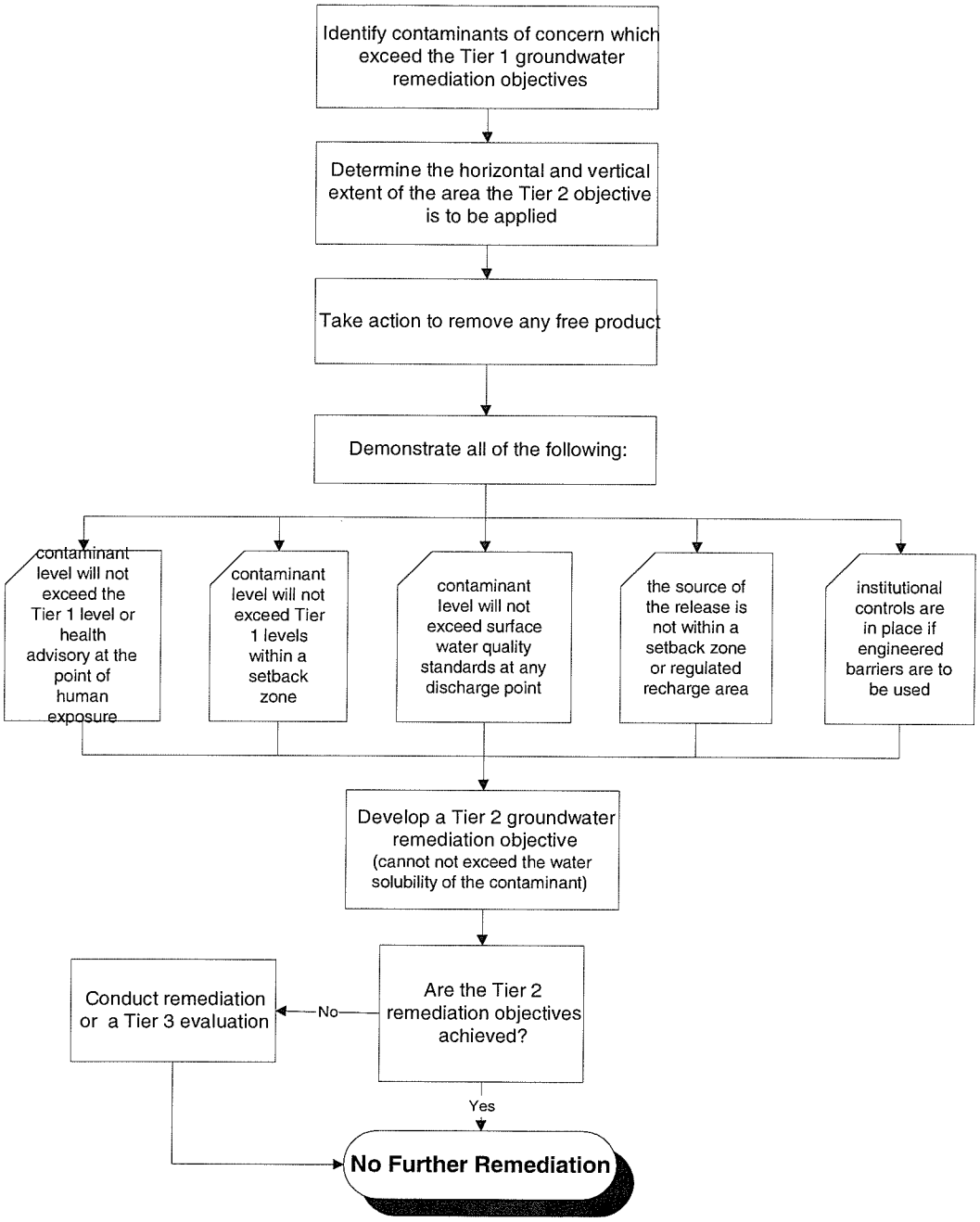
Section 742.Illustration A Tier 2 Evaluation for Soil



(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX C Tier 2 Illustrations and Tables

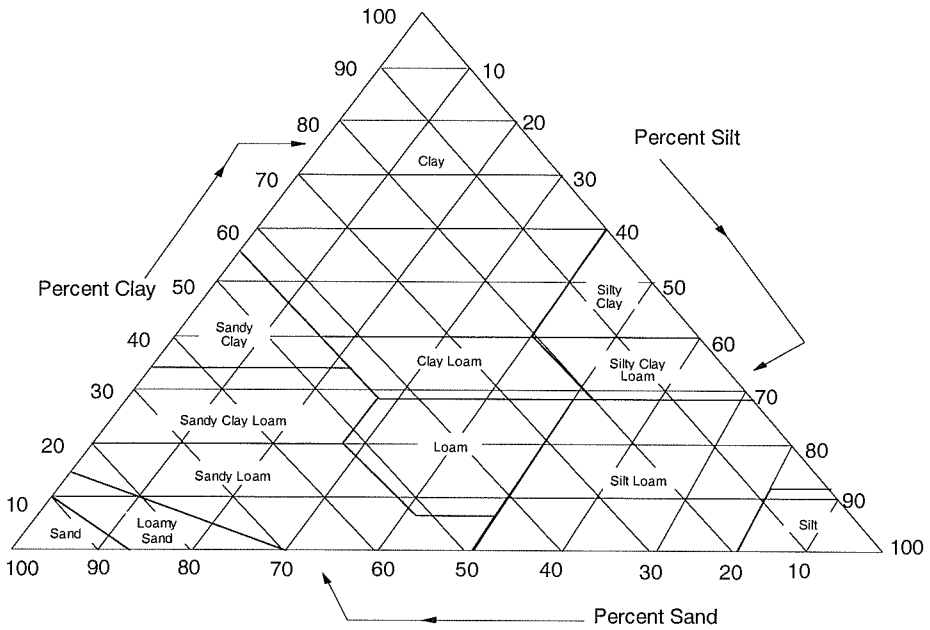
Section 742.Illustration B Tier 2 Evaluation for Groundwater



(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX C Tier 2 Illustrations and Tables

Section 742.Illustration C U.S. Department of Agriculture Soil Texture Classification



Criteria Used with the Field Method for Determining Soil Texture Classes

Criterion	Sand	Sandy loam	Loam	Slit loam	Clay loam	Clay
1. Individual grains visible to eye	Yes	Yes	Some	Few	No	No
2. Stability of dry clods	Do not form	Do not form	Easily broken	Moderately easily broken	Hard and stable	Very hard and stable
3. Stability of wet clods	Unstable	Slightyl stable	Moderately stable	Stable	Very stable	Very stable
4. Stability of "ribbon" when wet soil rubbed between thumb and fingers	Does not form	Does not form	Does not form	Broken appearance	Thin, will break	Very long, flexible

Particle Size, mm

0.002		0.05	0.10	0.25	0.5	1.0	2.0	
Clay	Silt	Very Fine	Fine	Med.	Coarse	Very Coarse		Gravel
		Sand						

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX C: Tier 2 Illustrations and Tables

Section 742.Table A: SSL Equations

Equations for Soil Ingestion Exposure Route	Remediation Objectives for Noncarcinogenic Contaminants (mg/kg)	$\dfrac{THQ \bullet BW \bullet AT \bullet 365 \dfrac{d}{yr}}{\dfrac{1}{RfD_O} \bullet 10^{-6} \dfrac{kg}{mg} \bullet EF \bullet ED \bullet IR_{soil}}$	**S1**
	Remediation Objectives for Carcinogenic Contaminants - Residential (mg/kg)	$\dfrac{TR \bullet AT_c \bullet 365 \dfrac{d}{yr}}{SF_o \bullet 10^{-6} \dfrac{kg}{mg} \bullet EF \bullet IF_{soil-adj}}$	**S2**
	Remediation Objectives for Carcinogenic Contaminants - Industrial/ Commercial, Construction Worker (mg/kg)	$\dfrac{TR \bullet BW \bullet AT_c \bullet 365 \dfrac{d}{yr}}{SF_o \bullet 10^{-6} \dfrac{kg}{mg} \bullet EF \bullet ED \bullet IR_{soil}}$	**S3**

Equations for Inhalation Exposure Route (Organic Contaminants and Mercury)	Remediation Objectives for Noncarcinogenic Contaminants - Residential, Industrial/ Commercial (mg/kg)	$\frac{THQ \bullet AT \bullet 365 \frac{d}{yr}}{EF \bullet ED \bullet \left(\frac{1}{RfC} \bullet \frac{1}{VF}\right)}$	**S4**
	Remediation Objectives for Noncarcinogenic Contaminants - Construction Worker (mg/kg)	$\frac{THQ \bullet AT \bullet 365 \frac{d}{yr}}{EF \bullet ED \bullet \left(\frac{1}{RfC} \bullet \frac{1}{VF'}\right)}$	**S5**
	Remediation Objectives for Carcinogenic Contaminants - Residential, Industrial/ Commercial (mg/kg)	$\frac{TR \bullet AT_c \bullet 365 \frac{d}{yr}}{URF \bullet 1{,}000 \frac{ug}{mg} \bullet EF \bullet ED \bullet \frac{1}{VF}}$	**S6**
	Remediation Objectives for Carcinogenic Contaminants - Construction Worker (mg/kg)	$\frac{TR \bullet AT_c \bullet 365 \frac{d}{yr}}{URF \bullet 1{,}000 \frac{ug}{mg} \bullet EF \bullet ED \bullet \frac{1}{VF'}}$	**S7**

	Equation for Derivation of the Volatilization Factor - Residential, Industrial/ Commercial, VF (m^3/kg)	$VF = \frac{Q}{C} \bullet \frac{(3.14 \bullet D_A \bullet T)^{1/2}}{(2 \bullet \rho_b \bullet D_A)} \bullet 10^{-4} \frac{m^2}{cm^2}$	**S8**
	Equation for Derivation of the Volatilization Factor - Construction Worker, VF′ (m^3/kg)	$VF' = \frac{VF}{10}$	**S9**
	Equation for Derivation of Apparent Diffusivity, D_A (cm^2/s)	$D_A = \frac{(\theta_a^{3.33} \bullet D_i \bullet H') + (\theta_w^{3.33} \bullet D_w)}{\eta^2} \bullet \frac{1}{(\rho_b \bullet K_d) + \theta_w + (\theta_a \bullet H')}$	**S10**
Equations for Inhalation Exposure Route (Fugitive Dusts)	Remediation Objectives for Noncarcinogenic Contaminants - Residential, Industrial/Commercial (mg/kg)	$\frac{THQ \bullet AT \bullet 365 \frac{d}{yr}}{EF \bullet ED \bullet \left(\frac{1}{RfC} \bullet \frac{1}{PEF}\right)}$	**S11**

	Remediation Objectives for Noncarcinogenic Contaminants - Construction Worker (mg/kg)	$\dfrac{THQ \bullet AT \bullet 365 \dfrac{d}{yr}}{EF \bullet ED \bullet \left(\dfrac{1}{RfC} \bullet \dfrac{1}{PEF'} \right)}$	**S12**
	Remediation Objectives for Carcinogenic Contaminants - Residential, Industrial/ Commercial (mg/kg)	$\dfrac{TR \bullet AT_C \bullet 365 \dfrac{d}{yr}}{URF \bullet 1{,}000 \dfrac{ug}{mg} \bullet EF \bullet ED \bullet \dfrac{1}{PEF}}$	**S13**
	Remediation Objectives for Carcinogenic Contaminants - Construction Worker (mg/kg)	$\dfrac{TR \bullet AT_c \bullet 365 \dfrac{d}{yr}}{URF \bullet 1{,}000 \dfrac{ug}{mg} \bullet EF \bullet ED \bullet \dfrac{1}{PEF'}}$	**S14**
	Equation for Derivation of Particulate Emission Factor, PEF (m^3/kg)	$PEF = \dfrac{Q}{C} \bullet \dfrac{3{,}600 \dfrac{s}{hr}}{0.036 \bullet (1 - V) \bullet \left(\dfrac{U_m}{U_t} \right)^3 \bullet F(x)}$	**S15**

	Equation for Derivation of Particulate Emission Factor, PEF′ - Construction Worker (m^3/kg)	$PEF' = \frac{PEF}{10}$ NOTE: PEF must be the industrial/commercial value	**S16**
Equations for the Soil Component of the Groundwater Ingestion Exposure Route	Remediation Objective (mg/kg)	$C_w \bullet \left[K_d + \frac{(\theta_w + \theta_a \bullet H')}{\rho_b} \right]$ NOTE: This equation can only be used to model contaminant migration not in the water bearing unit.	**S17**
	Target Soil Leachate Concentration, C_w (mg/L)	$C_w = DF \bullet GW_{obj}$	**S18**

	Soil-Water Partition Coefficient, K_d (cm^3/g)	$K_d = K_{oc} \bullet f_{oc}$	**S19**
	Water-Filled Soil Porosity, $\underline{\theta}_w$ (L_{water}/L_{soil})	$\theta_w = \eta \bullet \left(\frac{I}{K_s}\right)^{1/(2b+3)}$	**S20**
	Air-Filled Soil Porosity, $\underline{\theta}_a$ (L_{air}/L_{soil})	$\theta_a = \eta - \theta_w$	**S21**
	Dilution Factor, DF (unitless)	$DF = 1 + \frac{K \bullet i \bullet d}{I \bullet L}$	**S22**
	Groundwater Remediation Objective for Carcinogenic Contaminants, GW_{obj} (mg/L)	$\frac{TR \bullet BW \bullet AT_c \bullet 365 \frac{d}{yr}}{SF_o \bullet IR_w \bullet EF \bullet ED}$	**S23**
	Total Soil Porosity, η (L_{pore}/L_{soil})	$\eta = 1 - \frac{\rho_b}{\rho_s}$	**S24**
	Equation for Estimation of Mixing Zone Depth, d (m)	$d = \left(0.0112 \bullet L^2\right)^{0.5} + d_a\left[1 - \exp\frac{(-L \bullet I)}{\left(K \bullet i \bullet d_a\right)}\right]$	**S25**

Mass-Limit Equations for Inhalation Exposure Route and Soil Component of the Groundwater Ingestion Exposure Route	Mass-Limit Volatilization Factor for the Inhalation Exposure Route - Residential, Industrial/ Commercial, VF (m^3/kg)	$$VF_{M-L} = \frac{Q}{C} \bullet \frac{\left[T_{M-L} \bullet \left(3.15 \bullet 10^7 \frac{\mathrm{s}}{\mathrm{yr}}\right)\right]}{\rho_b \bullet d_s \bullet 10^6 \frac{\mathrm{cm}^3}{\mathrm{m}^3}}$$ NOTE: This equation may be used when vertical thickness of contamination is known or can be estimated reliably.	**S26**
	Mass-Limit Volatilization Factor for Inhalation Exposure Route - Construction Worker, VF′ - (m^3/kg)	$$VF'_{M-L} = \frac{VF_{M-L}}{10}$$	**S27**
	Mass-Limit Remediation Objective for Soil Component of the Groundwater Ingestion Exposure Route (mg/kg)	$$\frac{\left(C_W \bullet I_{M-L} \bullet ED_{M-L}\right)}{\rho_b \bullet d_s}$$ NOTE: This equation may be used when vertical thickness is known or can be estimated reliably.	**S28**

Equation for Derivation of the Soil Saturation Limit, C_{sat}	$C_{sat} = \frac{S}{\rho_b} \bullet \left[\left(K_d \bullet \rho_b \right) + \theta_w + \left(H' \bullet \theta_a \right) \right]$	**S29**
Equation for the soil gas component of the Outdoor Inhalation Exposure Route	$RO_{soil\ gas} = \frac{RO_{soil} \times H \times \rho_b \times 1000}{H' \times \theta_a + \theta_w + K_d \times \rho_b}$	**S30**

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX C: Tier 2 Illustrations and Tables

Section 742.Table B: SSL Parameters

Symbol	Parameter	Units	Source	Parameter Value(s)
AT	Averaging Time for Noncarcinogens in Ingestion Equation	yr		Residential = 6 Industrial/Commercial = 25 Construction Worker = 0.115
AT	Averaging Time for Noncarcinogens in Inhalation Equation	yr		Residential = 30 Industrial/Commercial = 25 Construction Worker = 0.115
AT_c	Averaging Time for Carcinogens	yr	SSL	70
BW	Body Weight	kg		Residential = 15, noncarcinogens 70, carcinogens Industrial/Commercial = 70 Construction Worker = 70
C_{sat}	Soil Saturation Concentration	mg/kg	Appendix A, Table A or Equation S29 in Appendix C, Table A	Chemical-Specific or Calculated Value
C_w	Target Soil Leachate Concentration	mg/L	Equation S18 in Appendix C, Table A	Groundwater Standard, Health Advisory concentration, or Calculated Value

Symbol	Parameter	Units	Source	Parameter Value(s)
d	Mixing Zone Depth	m	SSL or Equation S25 in Appendix C, Table A	2 m or Calculated Value
d_a	Aquifer Thickness	m	Field Measurement	Site-Specific
d_s	Depth of Source (Vertical thickness of contamination)	m	Field Measurement or Estimation	Site-Specific
D_A	Apparent Diffusivity	cm^2/s	Equation S10 in Appendix C, Table A	Calculated Value
D_i	Diffusivity in Air	cm^2/s	Appendix C, Table E	Chemical-Specific
D_w	Diffusivity in Water	cm^2/s	Appendix C, Table E	Chemical-Specific
DF	Dilution Factor	unitless	Equation S22 in Appendix C, Table A	20 or Calculated Value
ED	Exposure Duration for Ingestion of Carcinogens	yr		Industrial/Commercial = 25 Construction Worker = 1
ED	Exposure Duration for Inhalation of Carcinogens	yr		Residential = 30 Industrial/Commercial = 25 Construction Worker = 1

Symbol	Parameter	Units	Source	Parameter Value(s)
ED	Exposure Duration for Ingestion of Noncarcinogens	yr		Residential = 6 Industrial/Commercial = 25 Construction Worker = 1
ED	Exposure Duration for Inhalation of Noncarcinogens	yr		Residential = 30 Industrial/Commercial = 25 Construction Worker = 1
ED	Exposure Duration for the Direct Ingestion of Groundwater	yr		Residential = 30 Industrial/Commercial = 25 Construction Worker = 1
ED_{M-L}	Exposure Duration for Migration to Groundwater Mass-Limit Equation S28	yr	SSL	70
EF	Exposure Frequency	d/yr		Residential = 350 Industrial/Commercial = 250 Construction Worker = 30
F(x)	Function dependent on U_m/U_t	unitless	SSL	0.194
f_{oc}	Organic Carbon Content of Soil	g/g	SSL or Field Measurement (See Appendix C, Table F)	Surface Soil = 0.006 Subsurface soil = 0.002, or Site-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
GW_{obj}	Groundwater Remediation Remediation Objective	mg/L	Appendix B, Table E, 35 IAC 620.Subpart F, or Equation S23 in Appendix C, Table A	Chemical-Specific or Calculated
H'	Henry's Law Constant	unitless	Appendix C, Table E	Chemical-Specific
i	Hydraulic Gradient	m/m	Field Measurement (See Appendix C, Table F)	Site-Specific
I	Infiltration Rate	m/yr	SSL	0.3
I_{M-L}	Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28	m/yr	SSL	0.18
$IF_{soil-adj}$ (residential)	Age Adjusted Soil Ingestion Factor for Carcinogens	(mg-yr)/(kg-d)	SSL	114
IR_{soil}	Soil Ingestion Rate	mg/d		Residential = 200 Industrial/Commercial = 50 Construction Worker = 480
IR_W	Daily Water Ingestion Rate	L/d		Residential = 2 Industrial/Commercial = 1

Symbol	Parameter	Units	Source	Parameter Value(s)
K	Aquifer Hydraulic Conductivity	m/yr	Field Measurement (See Appendix C, Table F)	Site-Specific
K_d (Non-ionizing organics)	Soil-Water Partition Coefficient	cm^3/g or L/kg	Equation S19 in Appendix C, Table A	Calculated Value
K_d (Ionizing organics)	Soil-Water Partition Coefficient	cm3/g or L/kg	Equation S19 in Appendix C, Table A	Chemical and pH-Specific (see Appendix C, Table I)
K_d (Inorganics)	Soil-Water Partition Coefficient	cm3/g or L/kg	Appendix C, Table J	Chemical and pH-Specific
K_{oc}	Organic Carbon Partition Coefficient	cm^3/g or L/kg	Appendix C, Table E or Appendix C, Table I	Chemical-Specific
K_s	Saturated Hydraulic Conductivity	m/yr	Appendix C, Table K Appendix C, Illustration C	Site-Specific
L	Source Length Parallel to Groundwater Flow	m	Field Measurement	Site-Specific
PEF	Particulate Emission Factor	m^3/kg	SSL or Equation S15 in Appendix C, Table A	Residential = $1.32 \bullet 10^9$ or Site-Specific Industrial/Commercial = $1.24 \bullet 10^9$ or Site-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
PEF′	Particulate Emission Factor adjusted for Agitation (construction worker)	m^3/kg	Equation S16 in Appendix C, Table A using PEF (industrial/commercial)	$1.24 \bullet 10^8$ or Site-Specific
Q/C (used in VF equations)	Inverse of the mean concentration at the center of a square source	$(g/m^2\text{-}s)/(kg/m^3)$	Appendix C, Table H	Residential = 68.81 Industrial/Commercial = 85.81 Construction Worker = 85.81
Q/C (used in PEF equations)	Inverse of the mean concentration at the center of a square source	$(g/m^2\text{-}s)/(kg/m^3)$	SSL or Appendix C, Table H	Residential = 90.80 Industrial/Commercial = 85.81 Construction Worker = 85.81
RfC	Inhalation Reference Concentration	mg/m^3	Illinois EPA: http://www.epa.state.il.us/land/taco/toxicity-values.xls	Toxicological-Specific (Note: for Construction Workers use subchronic reference concentrations)
RfD_o	Oral Reference Dose	mg/(kg-d)	Illinois EPA: http://www.epa.state.il.us/land/taco/toxicity-values.xls	Toxicological-Specific (Note: for Construction Worker use subchronic reference doses)
RO_{soil}	Soil remediation objective	mg/kg	Equation S30 in Appendix C, Table A	Calculated value

Symbol	Parameter	Units	Source	Parameter Value(s)
$RO_{soil\ gas}$	Soil gas remediation objective	mg/m^3	Equation S30 in Appendix C, Table A	Calculated value
S	Solubility in Water	mg/L	Appendix C, Table E	Chemical-Specific
SF_o	Oral Slope Factor	$(mg/kg\text{-}d)^{-1}$	Illinois EPA: http://www.epa.state.il.us/land/taco/toxicity-values.xls	Toxicological-Specific
T	Exposure Interval	s		Residential = $9.5 \bullet 10^8$ Industrial/Commercial = $7.9 \bullet 10^8$ Construction Worker = $3.6 \bullet 10^6$
$T_{M\text{-}L}$	Exposure Interval for Mass-Limit Volatilization Factor Equation S26	yr	SSL	30
THQ	Target Hazard Quotient	unitless	SSL	1
TR	Target Cancer Risk	unitless		Residential = 10^{-6} at the point of human exposure Industrial/Commercial = 10^{-6} at the point of human exposure Construction Worker = 10^{-6} at the point of human exposure
U_m	Mean Annual Windspeed	m/s	SSL	4.69

Symbol	Parameter	Units	Source	Parameter Value(s)
URF	Inhalation Unit Risk Factor	$(ug/m^3)^{-1}$	Illinois EPA: http://www.epa.state.il.us/land/taco/toxicity-values.xls	Toxicological-Specific
U_t	Equivalent Threshold Value of Windspeed at 7 m	m/s	SSL	11.32
V	Fraction of Vegetative Cover	unitless	SSL or Field Measurement	0.5 or Site-Specific
VF	Volatilization Factor	m^3/kg	Equation S8 in Appendix C, Table A	Calculated Value
VF′	Volatilization Factor adjusted for Agitation	m^3/kg	Equation S9 in Appendix C, Table A	Calculated Value
VF_{M-L}	Mass-Limit Volatilization Factor	m^3/kg	Equation S26 in Appendix C, Table A	Calculated Value
VF'_{M-L}	Mass-Limit Volatilization Factor adjusted for Agitation	m^3/kg	Equation S27 in Appendix C, Table A	Calculated Value

Symbol	Parameter	Units	Source	Parameter Value(s)
η	Total Soil Porosity	L_{pore}/L_{soil}	SSL or Equation S24 in Appendix C, Table A	0.43, or Gravel = 0.25 Sand = 0.32 Silt = 0.40 Clay = 0.36, or Calculated Value
θ_a	Air-Filled Soil Porosity	L_{air}/L_{soil}	SSL or Equation S21 in Appendix C, Table A	Surface Soil (top 1 meter) = 0.28 Subsurface Soil (below 1 meter) = 0.13, or Gravel = 0.05 Sand = 0.14 Silt - 0.24 Clay = 0.19, or Calculated Value
θ_w	Water-Filled Soil Porosity	L_{water}/L_{soil}	SSL or Equation S20 in Appendix C, Table A	Surface Soil (top 1 meter) = 0.15 Subsurface Soil (below 1 meter) = 0.30, or Gravel = 0.20 Sand = 0.18 Silt = 0.16 Clay = 0.17, or Calculated Value

Symbol	Parameter	Units	Source	Parameter Value(s)
ρ_b	Dry Soil Bulk Density	kg/L or g/cm^3	SSL or Field Measurement (See Appendix C, Table F)	1.5, or Gravel = 2.0 Sand = 1.8 Silt = 1.6 Clay = 1.7, or Site-Specific
ρ_s	Soil Particle Density	g/cm^3	SSL or Field Measurement (See Appendix C, Table F)	2.65, or Site-Specific
ρ_w	Water Density	g/cm^3	SSL	1
1/(2b+3)	Exponential in Equation S20	unitless	Appendix C, Table K Appendix C, Illustration C	Site-Specific

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX C Tier 2 Illustrations and Tables

Section 742.Table C RBCA Equations

Equations for the combined exposures routes of soil ingestion inhalation of vapors and particulates, and dermal contact with soil	Remediation Objectives for Carcinogenic Contaminants (mg/kg)	$\dfrac{TR \bullet BW \bullet AT_C \bullet 365 \dfrac{d}{yr}}{EF \bullet ED \bullet \left\{\left[SF_o \bullet 10^{-6} \dfrac{kg}{mg} \bullet \left(\left(IR_{soil} \bullet RAF_o\right) + \left(SA \bullet M \bullet RAF_d\right)\right)\right] + \left[SF_i \bullet IR_{air} \bullet \left(VF_{ss} + VF_p\right)\right]\right\}}$	**R1**
	Remediation Objectives for Non-carcinogenic Contaminants (mg/kg)	$\dfrac{THQ \bullet BW \bullet AT_n \bullet 365 \dfrac{d}{yr}}{EF \bullet ED \bullet \left[\dfrac{10^{-6} \dfrac{kg}{mg}\left[\left(IR_{soil} \bullet RAF_o\right) + \left(SA \bullet M \bullet RAF_d\right)\right]}{RfD_o} + \dfrac{IR_{air} \bullet \left(VF_{ss} + VF_p\right)}{RfD_i}\right]}$	**R2**
	Volatilization Factor for Surficial Soils, VF_{ss} (kg/m^3) Whichever is less between R3 and R4	$VF_{ss} = \dfrac{2 \bullet W \bullet \rho_s \bullet 10^3 \dfrac{cm^3 \cdot kg}{m^3 \cdot g}}{U_{air} \bullet \delta_{air}} \bullet \sqrt{\dfrac{D_s^{eff} \bullet H'}{\pi \bullet \left[\theta_{ws} + \left(k_s \bullet \rho_s\right) + \left(H' \bullet \theta_{as}\right)\right] \bullet \tau}}$	**R3**
		$VF_{ss} = \dfrac{W \bullet \rho_s \bullet d \bullet 10^3 \dfrac{cm^3 \cdot kg}{m^3 \cdot g}}{U_{air} \bullet \delta_{air} \bullet \tau}$	**R4**

	Volatilization Factor for Surficial Soils Regarding Particulates, VF_p (kg/m^3)	$$VF_p = \frac{P_e \bullet W \bullet 10^3 \frac{cm^3 \cdot kg}{m^3 \cdot g}}{U_{air} \bullet \delta_{air}}$$	**R5**
	Effective Diffusion Coefficient in Soil Based on Vapor-Phase Concentration D_s^{eff} (cm^2/s)	$$D_s^{eff} = \frac{D^{air} \bullet \theta_{as}^{3.33}}{\theta_T^2} + \frac{D^{water} \bullet \theta_{ws}^{3.33}}{H' \bullet \theta_T^2}$$	**R6**
Equations for the ambient vapor inhalation (outdoor) route fromsubsurface soils	Remediation Objectives for Carcinogenic Contaminants (mg/kg)	$$\frac{RBSL_{air} \bullet 10^{-3}}{VF_{samb}}$$	**R7**
	Remediation Objectives for Non-carcinogenic Contaminants (mg/kg)	$$\frac{RBSL_{air} \bullet 10^{-3}}{VF_{samb}}$$	**R8**

	Carcinogenic Risk-Based Screening Level for Air, $RBSL_{air}$ (ug/m^3)	$$RBSL_{air} = \frac{TR \bullet BW \bullet AT_c \bullet 365 \frac{d}{yr} \bullet 10^3 \frac{ug}{mg}}{SF_i \bullet IR_{air} \bullet EF \bullet ED}$$	**R9**
	Noncarcinogenic Risk-Based Screening Level for Air, $RBSL_{air}$ (ug/m^3)	$$RBSL_{air} = \frac{THQ \bullet RfD_i \bullet BW \bullet AT_n \bullet 365 \frac{d}{yr} \bullet 10^3 \frac{ug}{mg}}{IR_{air} \bullet EF \bullet ED}$$	**R10**
	Volatilization Factor - Subsurface Soil to Ambient Air, VF_{samb} (mg/m^3)/(mg/kg_{soil})	$$VF_{samb} = \frac{H' \bullet \rho_s \bullet 10^3 \frac{cm^3 \cdot kg}{m^3 \cdot g}}{\left[\theta_{ws} + \left(k_s \bullet \rho_s\right) + \left(H' \bullet \theta_{as}\right)\right] \bullet \left[1 + \frac{\left(U_{air} \bullet \delta_{air} \bullet L_s\right)}{\left(D_s^{eff} \bullet W\right)}\right]}$$	**R11**

Equations for the Soil Component of the Groundwater Ingestion Exposure Route	Remediation Objective (mg/kg)	$$\frac{GW_{source}}{LF_{sw}}$$ NOTE: This equation can only be used to model contaminant migration not in the water bearing unit.	**R12**
	Groundwater at the source, GW_{source} (mg/L)	$$GW_{source} = \frac{GW_{camp}}{C_{(x)} / C_{source}}$$	**R13**
	Leaching Factor, LF_{sw} (mg/L_{water})/(mg/kg_{soil})	$$LF_{sw} = \frac{\rho_s \bullet \frac{cm^3 \cdot kg}{L \cdot g}}{\left[\theta_{ws} + (k_s \bullet \rho_s) + (H' \bullet \theta_{as})\right] \bullet \left[1 + \frac{(U_{gw} \bullet \delta_{gw})}{(I \bullet W)}\right]}$$	**R14**
	Steady-State Attenuation Along the Centerline of a Dissolved Plume, $C_{(x)}/C_{source}$	$$C_{(x)} / C_{source} = \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$$ NOTE: 1. This equation does not predict the contaminant flow within bedrock and may not accurately predict downgradient concentrations in the presence of a confining layer. 2. If the value of the First Order Degradation Constant (λ) is not readily available, then set $\lambda = 0$.	**R15**
	Longitudinal Dispersivity, α_x (cm)	$$\alpha_x = 0.10 \bullet X$$	**R16**

Transverse Dispersivity, α_y (cm)	$\alpha_y = \frac{\alpha_x}{3}$	**R17**
Vertical Dispersivity, α_z (cm)	$\alpha_z = \frac{\alpha_x}{20}$	**R18**
Specific Discharge, U (cm/d)	$U = \frac{K \bullet i}{\theta_T}$	**R19**
Soil-Water Sorption Coefficient, k_s	$k_s = K_{oc} \bullet f_{oc}$	**R20**
Volumetric Air Content in Vadose Zone Soils, θ_{as} (cm^3_{air}/cm^3_{soil})	$\theta_{as} = \theta_T - \frac{(w \bullet \rho_s)}{\rho_w}$	**R21**
Volumetric Water Content in Vadose Zone Soils, θ_{ws} (cm^3_{water}/cm^3_{soil})	$\theta_{ws} = \frac{w \bullet \rho_s}{\rho_w}$	**R22**
Total Soil Porosity, θ_T (cm^3/cm^3_{soil})	$\theta_T = \theta_{as} + \theta_{ws}$	**R23**

	Groundwater Darcy Velocity, U_{gw} (cm/yr)	$U_{gw} = K \bullet i$	**R24**
Equations for the Groundwater Ingestion Exposure Route	Remediation Objective for Carcinogenic Contaminants (mg/L)	$\dfrac{TR \bullet BW \bullet AT_c \bullet 365 \dfrac{d}{yr}}{SF_o \bullet IR_w \bullet EF \bullet ED}$	**R25**
	Dissolved Hydrocarbon Concentration along Centerline, $C_{(x)}$ (mg/L $_{water}$)	$C_{(x)} =$ $C_{source} \bullet \exp\left[\left(\dfrac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \dfrac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\dfrac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\dfrac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$ NOTE: 1. This equation does not predict the contaminant flow within bedrock and may not accurately predict downgradient concentrations in the presence of a confining layer. 2. If the value of the First Order Degradation Constant (λ) is not readily available, then set $\lambda = 0$.	**R26**

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX C Tier 2 Illustrations and Tables

Section 742.Table D RBCA Parameters

Symbol	Parameter	Units	Source	Parameter Value(s)
AT_c	Averaging Time for Carcinogens	yr	RBCA	70
AT_n	Averaging Time for Noncarcinogens	yr	RBCA	Residential = 30 Industrial/Commercial = 25 Construction Worker = 0.115
BW	Adult Body Weight	kg	RBCA	70
C_{source}	The greatest potential concentration of the contaminant of concern in the groundwater at the source of the contamination, based on the concentrations of contaminants in groundwater due to the release and the projected concentration of the contaminant migrating from the soil to the groundwater.	mg/L	Field Measurement	Site-Specific
$C_{(x)}$	Concentration of Contaminant in Groundwater at Distance X from the source	mg/L	Equation R26 in Appendix C, Table C	Calculated Value

Symbol	Parameter	Units	Source	Parameter Value(s)
$C_{(x)}/C_{source}$	Steady-State Attenuation Along the Centerline of a Dissolved Plume	unitless	Equation R15 in Appendix C, Table C	Calculated Value
d	Lower Depth of Surficial Soil Zone	cm	Field Measurement	100 or Site-Specific (not to exceed 100)
D^{air}	Diffusion Coefficient in Air	cm^2/s	Appendix C, Table E	Chemical-Specific
D^{water}	Diffusion Coefficient in Water	cm^2/s	Appendix C, Table E	Chemical-Specific
D_s^{eff}	Effective Diffusion Coefficient in Soil Based on Vapor-Phase Concentration	cm^2/s	Equation R6 in Appendix C, Table C	Calculated Value
ED	Exposure Duration	yr	RBCA	Residential = 30 Industrial/Commercial = 25 Construction Worker = 1
EF	Exposure Frequency	d/yr	RBCA	Residential = 350 Industrial/Commercial = 250 Construction Worker = 30
erf	Error Function	unitless	Appendix C, Table G	Mathematical Function

Symbol	Parameter	Units	Source	Parameter Value(s)
f_{oc}	Organic Carbon Content of Soil	g/g	RBCA or Field Measurement (See Appendix C, Table F)	Surface Soil = 0.006 Subsurface Soil = 0.002 or Site-Specific
GW_{comp}	Groundwater Objective at the Compliance Point	mg/L	Appendix B, Table E, 35 IAC 620.Subpart F, or Equation R25 in Appendix C, Table C	Site-Specific
GW_{source}	Groundwater Concentration at the Source	mg/L	Equation R13 in Appendix C, Table C	Calculated Value
H'	Henry's Law Constant	cm^3_{water}/cm^3_{air}	Appendix C, Table E	Chemical-Specific
i	Hydraulic Gradient	cm/cm (unitless)	Field Measurement (See Appendix C, Table F)	Site-Specific
I	Infiltration Rate	cm/yr	RBCA	30
IR_{air}	Daily Outdoor Inhalation Rate	m^3/d	RBCA	20
IR_{soil}	Soil Ingestion Rate	mg/d	RBCA	Residential = 100 Industrial/Commercial = 50 Construction Worker = 480
IR_w	Daily Water Ingestion Rate	L/d	RBCA	Residential = 2 Industrial/Commercial = 1

Symbol	Parameter	Units	Source	Parameter Value(s)
K	Aquifer Hydraulic Conductivity	cm/d for Equations R15, R19 and R26 cm/yr for Equation R24	Field Measurement (See Appendix C, Table F)	Site-Specific
K_{oc}	Organic Carbon Partition Coefficient	cm^3/g or L/kg	Appendix C, Table E or Appendix C, Table I	Chemical-Specific
k_s (non-ionizing organics)	Soil Water Sorption Coefficient	cm^3_{water}/g_{soil}	Equation R20 in Appendix C,Table C	Calculated Value
k_s (ionizing organics)	Soil Water Sorption Coefficient	cm^3_{water}/g_{soil}	Equation R20 in Appendix C, Table C	Chemical and pH-Specific (See Appendix C, Table I)
k_s (inorganics)	Soil Water Sorption Coefficient	cm^3_{water}/g_{soil}	Appendix C, Table J	Chemical and pH-Specific
L_s	Depth to Subsurface Soil Sources	cm	RBCA	100
LF_{sw}	Leaching Factor	$(mg/L_{water})/(mg/kg_{soil})$	Equation R14 in Appendix C, Table C	Calculated Value
M	Soil to Skin Adherence Factor	mg/cm^2	RBCA	0.5

Symbol	Parameter	Units	Source	Parameter Value(s)
Pe	Particulate Emission Rate	g/cm^2-s	RBCA	$6.9 \bullet 10^{-14}$
RAF_d	Dermal Relative Absorption Factor	unitless	RBCA	0.5
RAF_d (PNAs)	Dermal Relative Absorption Factor	unitless	RBCA	0.05
RAF_d (inorganics)	Dermal Relative Absorption Factor	unitless	RBCA	0
RAF_o	Oral Relative Absorption Factor	unitless	RBCA	1.0
$RBSL_{air}$	Carcinogenic Risk-Based Screening Level for Air	ug/m^3	Equation R9 in Appendix C, Table C	Chemical-, Media-, and Exposure Route-Specific
$RBSL_{air}$	Noncarcinogenic Risk-Based Screening Level for Air	ug/m^3	Equations R10 in Appendix C, Table C	Chemical-, Media-, and Exposure Route-Specific
RfD_i	Inhalation Reference Dose	mg/kg-d	IEPA (IRIS/HEAST[a])	Toxicological-Specific
RfD_o	Oral Reference Dose	mg/(kg-d)	IEPA (IRIS/HEAST[a])	Toxicological-Specific (Note: for Construction Worker use subchronic reference doses)
SA	Skin Surface Area	cm^2/d	RBCA	3,160

Symbol	Parameter	Units	Source	Parameter Value(s)
S_d	Source Width Perpendicular to Groundwater Flow Direction in Vertical Plane	cm	Field Measurement	For Migration to Groundwater Route: Use 200 or Site-Specific For Groundwater remediation objective: Use Site-Specific
S_w	Source Width Perpendicular to Groundwater Flow Direction in Horizontal Plane	cm	Field Measurement	Site-Specific
SF_i	Inhalation Cancer Slope Factor	$(mg/kg\text{-}d)^{-1}$	IEPA (IRIS/HEAST[a])	Toxicological-Specific
SF_o	Oral Slope Factor	$(mg/kg\text{-}d)^{-1}$	IEPA (IRIS/HEAST[a])	Toxicological-Specific
THQ	Target Hazard Quotient	unitless	RBCA	1
TR	Target Cancer Risk	unitless	RBCA	Residential = 10^{-6} at the point of human exposure Industrial/Commercial = 10^{-6} at the point of human exposure Construction Worker = 10^{-6} at the point of human exposure
U	Specific Discharge	cm/d	Equation R19 in Appendix C, Table C	Calculated Value

Symbol	Parameter	Units	Source	Parameter Value(s)
U_{air}	Average Wind Speed Above Ground Surface in Ambient Mixing Zone	cm/s	RBCA	225
U_{gw}	Groundwater Darcy Velocity	cm/yr	Equation R24 in Appendix C, Table C	Calculated Value
VF_p	Volatilization Factor for Surficial Soils Regarding Particulates	kg/m^3	Equation R5 in Appendix C, Table C	Calculated Value
VF_{samb}	Volatilization Factor (Subsurface Soils to Ambient Air)	$(mg/m^3_{air})/(mg/kg_{soil})$ or kg/m^3	Equation R11 in Appendix C, Table C	Calculated Value
VF_{ss}	Volatilization Factor for Surficial Soils	kg/m^3	Use Equations R3 and R4 in Appendix C, Table C	Calculated Value from Equation R3 or R4 (whichever is less)
W	Width of Source Area Parallel to Direction to Wind or Groundwater Movement	cm	Field Measurement	Site-Specific

Symbol	Parameter	Units	Source	Parameter Value(s)
w	Average Soil Moisture Content	g_{water}/g_{soil}	RBCA or Field Measurement (See Appendix C, Table F)	0.1, or Surface Soil (top 1 meter) = 0.1 Subsurface Soil (below 1 meter) = 0.2, or Site-Specific
X	Distance along the Centerline of the Groundwater Plume Emanating from a Source. The x direction is the direction of groundwater flow	cm	Field Measurement	Site-Specific
α_x	Longitudinal Dispersitivity	cm	Equation R16 in Appendix C, Table C	Calculated Value
α_y	Transverse Dispersitivity	cm	Equation R17 in Appendix C, Table C	Calculated Value
α_z	Vertical Dispersitivity	cm	Equation R18 in Appendix C, Table C	Calculated Value
δ_{air}	Ambient Air Mixing Zone Height	cm	RBCA	200

Symbol	Parameter	Units	Source	Parameter Value(s)
δ_{gw}	Groundwater Mixing Zone Thickness	cm	RBCA	200
θ_{as}	Volumetric Air Content in Vadose Zone Soils	cm^3_{air}/cm^3_{soil}	RBCA or Equation R21 in Appendix C, Table C	Surface Soil (top 1 meter) = 0.28 Subsurface Soil (below 1 meter)= 0.13, Or Gravel = 0.05 Sand = 0.14 Silt = 0.16 Clay = 0.17, or Calculated Value
θ_{ws}	Volumetric Water Content in Vadose Zone Soils	cm^3_{water}/cm^3_{soil}	RBCA or Equation R22 in Appendix C, Table C	Surface Soil (top 1 meter) = 0.15 Subsurface Soil (below 1 meter) = 0.30, or Gravel = 0.20 Sand = 0.18 Silt = 0.16 Clay = 0.17, or Calculated Value

Symbol	Parameter	Units	Source	Parameter Value(s)
θ_T	Total Soil Porosity	cm^3/cm^3_{soil}	RBCA or Equation R23 in Appendix C, Table C	0.43, or Gravel = 0.25 Sand = 0.32 Silt = 0.40 Clay = 0.36, or Calculated Value
λ	First Order Degradation Constant	d^{-1}	Appendix C, Table E	Chemical-Specific
π	pi			3.1416
ρ_b	Soil Bulk Density	g/cm^3	RBCA or Field Measurement (See Appendix C, Table F)	1.5, or Gravel = 2.0 Sand = 1.8 Silt = 1.6 Clay = 1.7, or Site-Specific
ρ_w	Water Density	g/cm^3	RBCA	1
τ	Averaging Time for Vapor Flux	s	RBCA	$9.46 \bullet 10^8$

[a] HEAST = Health Effects Assessment Summary Tables. USEPA, Office of Solid Waste and Emergency Response. EPA/540/R-95/036. Updated Quarterly.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX C: Tier 2 Illustrations and Tables

Section 742.Table E: Default Physical and Chemical Parameters[e]

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
Neutral Organics									
83-32-9	Acenaphthene	3.60E+00	4.76E-02	7.69E-06	6.60E-03	-------[b]	6.30E+03	3.40E-03	2.50E-03
67-64-1	Acetone	1.00E+06	1.24E-01	1.14E-05	1.60E-03	9.73E-04	7.80E-01	4.95E-02	2.30E+02
15972-60-8	Alachlor	2.40E+02	2.13E-02	5.28E-06	3.40E-06	-------[b]	3.20E+03	No Data	2.20E-05
116-06-3	Aldicarb	6.03E+03	3.18E-02	7.24E-06	5.90E-08	-------[b]	1.29E+01	1.09E-03	3.47E-05
309-00-2	Aldrin	1.70E-02	1.96E-02	4.86E-06	7.00E-03	-------[b]	2.50E+05	5.90E-04	6.00E-06
120-12-7	Anthracene	4.30E-02	3.85E-02	7.74E-06	2.70E-03	-------[b]	2.50E+04	7.50E-04	2.70E-06
1912-24-9	Atrazine	7.00E+01	2.59E-02	6.67E-06	9.68E-08	-------[b]	3.63E+02	No Data	2.70E-07
71-43-2	Benzene	1.80E+03	8.80E-02	1.02E-05	2.30E-01	1.34E-01	5.00E+01	9.00E-04	9.50E+01
56-55-3	Benzo(a) anthracene	9.40E-03	5.10E-02	9.00E-06	1.39E-04	-------[b]	4.00E+05	5.10E-04	1.10E-07
205-99-2	Benzo(b) fluoranthene	1.50E-03	2.23E-02	5.56E-06	4.55E-03	-------[b]	1.05E+06	5.70E-04	5.00E-07
207-08-9	Benzo(k) fluoranthene	8.00E-04	2.23E-02	5.56E-06	3.40E-05	-------[b]	1.00E+06	1.60E-04	2.00E-09

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
65-85-0	Benzoic Acid	3.40E+03	7.02E-02	7.97E-06	1.56E-06	-------[b]	1.21E+00[d]	No Data	7.00E-04
50-32-8	Benzo(a)pyrene	1.60E-03	4.30E-02	9.49E-06	4.50E-05	-------[b]	7.90E+05	6.50E-04	5.50E-09
111-44-4	Bis(2-chloroethyl)ether	1.72E+04	4.13E-02	7.53E-06	7.40E-04	2.94E-04	1.26E+01	1.90E-03	1.55E+00
117-81-7	Bis(2-ethylhexyl) phthalate	3.40E-01	3.51E-02	3.66E-06	4.10E-06	-------[b]	1.00E+05	1.80E-03	6.80E-08
75-27-4	Bromodichloro-methane	6.70E+03	5.61E-02	1.06E-05	6.60E-02	3.71E-02	5.00E+01	No Data	5.00E+01
75-25-2	Bromoform	3.10E+03	1.49E-02	1.03E-05	2.19E-02	1.06E-02	9.12E+01	1.90E-03	5.51E+00
71-36-3	Butanol	7.40E+04	8.00E-02	9.30E-06	3.61E-04	1.55E-04	6.00E+00	1.28E-02	7.00E+00
78-93-3	2-Butanone (MEK)	2.20E+05	8.08E-02	9.8E-06	2.30E-03	1.32E-03	2.00E+00	4.95E-02	9.50E+01
85-68-7	Butyl Benzyl Phthalate	2.70E+00	1.99E-02	4.89E-06	5.30E-05	-------[b]	6.30E+04	3.85E-03	8.30E-06
86-74-8	Carbazole	1.20E+00	4.17E-02	7.45E-06	3.60E-06	-------[b]	4.00E+03	No Data	7.00E-04
1563-66-2	Carbofuran	3.20E+02	2.37E-02	5.95E-06	1.27E-07	-------[b]	1.91E+02	No Data	4.85E-06
75-15-0	Carbon Disulfide	1.20E+03	1.04E-01	1.00E-05	1.23E+00	8.06E-01	6.30E+01	No Data	3.60E+02
56-23-5	Carbon Tetrachloride	7.90E+02	7.80E-02	8.80E-06	1.23E+00	7.48E-01	2.00E+02	1.90E-03	1.20E+02
57-74-9	Chlordane	5.60E-02	1.79E-02	4.37E-06	2.00E-03	-------[b]	2.50E+05	2.50E-04	9.80E-06

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
106-47-8	p-Chloroaniline	5.30E+03	6.99E-02	1.01E-05	4.76E-05	--------[b]	6.31E+01	No Data	1.23E-02
108-90-7	Chlorobenzene	4.70E+02	7.30E-02	8.70E-06	1.50E-01	7.93E-02	2.00E+02	2.30E-03	1.20E+01
124-48-1	Chlorodibromo-methane	2.60E+03	3.66E-02	1.05E-05	3.20E-02	2.07E-02	6.92E+01	3.85E-03	4.90E+00
67-66-3	Chloroform	7.90E+03	1.04E-01	1.00E-05	1.50E-01	9.18E-02	5.00E+01	3.90E-04	2.00E+02
95-57-8	2-Chlorophenol	2.20E+04	6.61E-02	9.46E-06	1.60E-02	7.28E-03	5.93E+01[d]	No Data	2.34E+00
218-01-9	Chrysene	6.30E-03	2.44E-02	6.21E-06	3.90E-03	--------[b]	4.00E+05	3.50E-04	6.20E-09
94-75-7	2,4-D	6.77E+02	5.88E-02	6.49E-06	4.18E-07	--------[b]	5.75E+02	3.85E-03	6.00E-07
72-54-8	4,4'-DDD	9.00E-02	2.27E-02	5.79E-06	1.60E-04	--------[b]	7.90E+05	6.20E-05	6.70E-07
72-55-9	4,4'-DDE	1.20E-01	2.38E-02	5.87E-06	8.60E-04	--------[b]	4.00E+05	6.20E-05	6.00E-06
50-29-3	4,4'-DDT	2.50E-02	1.99E-02	4.95E-06	3.30E-04	--------[b]	2.00E+06	6.20E-05	1.60E-07
75-99-0	Dalapon	9.00E+05	6.08E-02	9.45E-06	2.64E-06	NA	4.80E+00	5.78E-03	1.90E-01
53-70-3	Dibenzo(a,h) anthracene	2.50E-03	2.11E-02	5.24E-06	6.10E-07	--------[b]	2.50E+06	3.70E-04	1.00E-10
96-12-8	1,2-Dibromo-3-chloropropane	1.20E+03	2.68E-02	7.02E-06	6.20E-03[c]	NA	7.90E+01	1.93E-03	5.80E-01
106-93-4	1,2-Dibromoethane	4.00E+03	4.37E-02	8.44E-06	3.00E-02	1.54E-02	5.00E+01	5.78E-03	1.30E+01

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
84-74-2	Di-n-butyl Phthalate	1.10E+01	4.38E-02	7.86E-06	7.40E-05	-------[a]	4.00E+04	3.01E-02	7.30E-05
1918-00-9	Dicamba	4.50E+03	2.37E-02	5.95E-06	2.18E-09	-------[a]	2.95E+00	No Data	3.38E-05
95-50-1	1,2-Dichlorobenzene	1.56E+02	6.90E-02	7.90E-06	7.79E-02	3.56E-02	5.75E+02	1.90E-03	1.36E+00
106-46-7	1,4-Dichlorobenzene	7.90E+01	6.90E-02	7.90E-06	9.80E-02	4.69E-02	7.90E+02	1.90E-03	1.00E+00
91-94-1	3,3-Dichloro-benzidine	3.10E+00	2.59E-02	6.74E-06	1.60E-07	-------[a]	2.82E+03	1.90E-03	3.71E-08
75-71-8	Dichlorodifluoro-methane	2.80E+02	7.60E-02	1.08E-05	1.41E+01	8.14E+00	6.17E+01	1.92E-03	4.85E+03
75-34-3	1,1-Dichloroethane	5.10E+03	7.42E-02	1.05E-05	2.30E-01	1.42E-01	3.20E+01	1.90E-03	2.30E+02
107-06-2	1,2-Dichloroethane	8.50E+03	1.04E-02	9.90E-06	4.00E-02	2.29E-02	2.00E+01	1.90E-03	7.90E+01
75-35-4	1,1-Dichloroethylene	2.30E+03	9.00E-02	1.04E-05	1.10E+00	7.10E-01	5.00E+01	5.30E-03	6.00E+02
156-59-2	*cis*-1,2-Dichloroethylene	3.50E+03	8.86E-02	1.13E-05	1.70E-01	1.00E-01	4.00E+01	2.40E-04	2.00E+02
156-60-5	*trans*-1,2-Dichloroethylene	6.30E+03	7.03E-02	1.19E-05	3.90E-01	2.43E-01	5.00E+01	2.40E-04	3.30E+02
120-83-2	2,4-Dichlorophenol	4.50E+03	4.89E-02	8.77E-06	1.30E-04	-------[a]	7.32E+02[d]	2.70E-04	6.70E-02

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
78-87-5	1,2-Dichloropropane	2.80E+03	7.82E-02	8.73E-06	1.10E-01	6.52E-02	5.00E+01	2.70E-04	5.20E+01
542-75-6	1,3-Dichloro-propylene (*cis* + *trans*)	2.80E+03	6.26E-02	1.00E-05	7.40E-01	3.98E-01	2.00E+01	6.10E-02	3.40E+01
60-57-1	Dieldrin	2.00E-01	1.92E-02	4.74E-06	6.2E-04	-------[a]	2.50E+04	3.20E-04	5.9E-06
84-66-2	Diethyl Phthalate	1.10E+03	2.49E-02	6.35E-06	1.80E-05	-------[a]	3.20E+02	6.19E-03	1.60E-03
105-67-9	2,4-Dimethylphenol	7.90E+03	6.43E-02	8.69E-06	8.20E-05	-------[a]	2.00E+02	4.95E-02	9.80E-02
75-71-8	1,3-Dinitrobenzene	8.60E+02	4.55E-02	8.46E-06	2.30E-07	-------[a]	3.20E+01	1.92E-03	9.00E-04
51-28-5	2,4-Dinitrophenol	2.79E+03	2.73E-02	9.06E-06	1.82E-05	-------[a]	3.24E+01	1.32E-03	5.10E-03
121-14-2	2,4-Dinitrotoluene	2.70E+02	2.03E-01	7.06E-06	3.80E-06	-------[a]	8.90E+01	1.92E-03	1.47E-04
606-20-2	2,6-Dinitrotoluene	1.82E+02	3.70E-02	7.76E-06	3.06E-05	-------[a]	4.90E+01	1.92E-03	5.67E-04
88-85-7	Dinoseb	5.20E+01	2.45E-02	6.25E-06	1.87E-05	-------[a]	9.17E+01[d]	2.82E-03	7.50E-05
117-84-0	Di-n-octyl Phthalate	2.00E-02	1.73E-02	4.17E-06	2.74E-03	-------[a]	1.30E+05	1.90E-03	2.60E-06
123-91-1	p-Dioxane	1.00E+06	2.29E-01	1.02E-05	1.97E-04	1.07E-04	7.20E-01	1.92E-03	3.81E+01
115-29-7	Endosulfan	5.10E-01	1.85E-02	4.55E-06	4.51E-04	-------[a]	5.00E+03	7.63E-02	1.00E-05

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
145-73-3	Endothall	2.10E+04	2.91E-02	8.07E-06	1.58E-14	-------[a]	7.59E+01	No Data	1.57E-10
72-20-8	Endrin	2.50E-01	1.92E-02	4.74E-6	3.08E-04	-------[a]	3.20E+04	3.20E-04	3.00E-06
100-41-4	Ethylbenzene	1.70E+02	7.50E-02	7.80E-06	3.24E-01	1.64E-01	3.20E+02	3.00E-03	9.60E+00
206-44-0	Fluoranthene	2.06E-01	2.51E-02	6.35E-06	6.60E-04	-------[a]	7.40E+04	1.90E-04	1.23E-08
86-73-7	Fluorene	2.00E+00	4.40E-02	7.88E-06	2.62E-03	-------[a]	1.30E+04	6.91E-04	6.30E-04
76-44-8	Heptachlor	1.80E-01	2.23E-02	5.69E-06	6.07E-02	1.73E-02	3.00E+03	1.30E-01	4.00E-04
1024-57-3	Heptachlor epoxide	2.00E-01	2.19E-02	5.57E-06	3.90E-04	-------[a]	2.00E+05	6.30E-04	1.90E-05
118-74-1	Hexachloro-benzene	6.20E-03	5.42E-02	5.91E-06	5.33E-02	1.35E-02	2.00E+04	1.70E-04	1.80E-05
319-84-6	Alpha-HCH (alpha-BHC)	2.00E+00	2.04E-02	5.04E-06	4.51E-04	-------[a]	5.00E+03	2.50E-03	4.50E-05
58-89-9	Gamma-HCH (Lindane)	7.30E+00	2.75E-02	7.34E-06	5.74E-04	-------[a]	3.00E+03	2.90E-03	4.10E-04
2691-41-0	High Melting Explosive, Octogen (HMX)	5.00E+00	2.69E-02	7.15E-06	8.67E-10	3.55E-08	1.40E+00	No Data	3.30E-14
77-47-4	Hexachlorocyclo-Pentadiene	1.80E+00	2.79E-02	7.21E-06	1.11E+00	4.22E-01	1.20E+04	1.20E-02	5.96E-02
67-72-1	Hexachloroethane	5.00E+01	2.50E-03	6.80E-06	1.59E-01	7.26E-02	1.50E+03	1.92E-03	2.10E-01

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
193-39-5	Indeno(1,2,3-c,d)pyrene	2.20E-05	2.25E-02	5.66E-06	6.56E-05	-------[a]	3.10E+06	4.70E-04	1.00E-10
78-59-1	Isophorone	1.20E+04	6.23E-02	6.76E-06	2.72E-04	1.12E-04	2.50E+01	1.24E-02	4.38E-01
98-82-8	Isopropylbenzene (Cumene)	6.10E+01	6.50E-02	7.10E-06	4.92E+01	2.10E+01	1.02E+03	4.33E-02	4.50E+00
93-65-2	Mecoprop (MCPP)	8.95E+02	2.40E-02	6.05E-06	7.70E-09	-------[a]	1.84E+01[d]	3.85E-03	2.44E-05
7439-97-6	Mercury	6.00E-02	7.14E-02	3.01E-05	4.51E-01	1.59E-01	8.70E+03	No Data	2.00E-03
72-43-5	Methoxychlor	4.50E-02	1.84E-02	4.46E-06	6.56E-04	-------[a]	5.00E+04	1.90E-03	6.00E-07
74-83-9	Methyl Bromide	1.50E+04	7.28E-02	1.21E-05	2.56E-01	1.79E-01	1.00E+01	1.82E-02	1.62E+03
1634-04-4	Methyl tertiary-butyl ether	5.10E+04	8.59E-02	1.10E-05	2.42E-02	1.50E-02	1.00E+01	No Data	2.50E+02
75-09-2	Methylene Chloride	1.30E+04	1.01E-01	1.17E-05	9.02E-02	5.70E-02	1.30E+01	1.20E-02	4.30E+02
93-65-2	2-Methyl-naphthalene	2.50E+01	5.22E-02	7.75E-06	2.10E-02	6.95E-03	1.60E+03	No Data	6.80E-02
95-48-7	2-Methylphenol (o-cresol)	2.60E+04	7.40E-02	8.30E-06	4.92E-05	2.00E-05	4.20E+01	4.95E-02	2.99E-01
91-20-3	Naphthalene	3.10E+01	5.90E-02	7.50E-06	1.97E-02	8.29E-03	5.00E+02	2.70E-03	8.50E-02
98-95-3	Nitrobenzene	2.09E+03	7.60E-02	8.60E-06	9.84E-04	3.99E-04	4.00E+01	1.76E-03	2.40E-01

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
86-30-6	N-Nitrosodiphenyl-amine	3.50E+01	2.83E-02	7.19E-06	2.10E-04	-------[a]	1.00E+03	1.00E-02	6.70E-04
621-64-7	N-Nitrosodi-n-propylamine	9.89E+03	5.87E-02	8.17E-06	9.20E-05	5.48E-05	1.45E+01	1.90E-03	1.30E-01
87-86-5	Pentachloro-phenol	2.00E+03	5.60E-02	6.10E-06	9.84E-07	-------[a]	2.77E+03[d]	4.50E-04	3.20E-05
108-95-2	Phenol	8.30E+04	8.20E-02	9.10E-06	1.64E-05	6.67E-06	2.00E+01	9.90E-02	2.80E-01
1918-02-1	Picloram	4.30E+02	2.26E-02	5.64E-06	2.19E-12	-------[a]	2.00E+00	No Data	7.21E-11
1336-36-3	Polychlorinated biphenyls (PCBs)	-------[a]	-------[a]	-------[a]	-------[a]	-------[a]	-------[a]	-------[a]	-------[a]
129-00-0	Pyrene	1.40E+00	2.77E-02	7.24E-06	4.51E-04	-------[a]	6.31E+04	1.80E-04	4.60E-06
121-82-4	Royal Demolition Explosive, Cyclonite (RDX)	5.97E+01	3.11E-02	8.49E-06	2.01E-11	-------[a]	7.20E+00	No Data	4.10E-09
122-34-9	Simazine	6.20E+00	2.48E-02	6.28E-06	3.80E-08	-------[a]	1.32E+02	No Data	2.21E-08
100-42-5	Styrene	3.10E+02	7.10E-02	8.00E-06	1.11E-01	5.48E-03	3.16E+02	3.30E-03	6.10E+00
93-72-1	2,4,5-TP (Silvex)	7.10E+01	2.30E-02	5.83E-06	3.71E-07	-------[a]	5.50E+03	No Data	9.97E-06
127-18-4	Tetrachloro-ethylene	2.00E+02	7.20E-02	8.20E-06	7.38E-01	4.00E-01	6.31E+02	9.60E-04	1.90E+01
108-88-3	Toluene	5.30E+02	8.70E-02	8.60E-06	2.71E-01	1.49E-01	1.58E+02	1.10E-02	2.80E+01

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
8001-35-2	Toxaphene	7.40E-01	2.16E-02	5.51E-06	2.46E-04	-------[a]	5.01E+04	No Data	9.80E-07
120-82-1	1,2,4-Trichlorobenzene	3.50E+01	3.00E-02	8.23E-06	5.74E-02	2.38E-02	1.58E+03	1.90E-03	4.30E-01
71-55-6	1,1,1-Trichloroethane	1.30E+03	7.80E-02	8.80E-06	6.97E-01	4.21E-01	1.26E+02	1.30E-03	1.20E+02
79-00-5	1,1,2-Trichloroethane	4.40E+03	7.80E-02	8.80E-06	3.73E-02	1.98E-02	5.01E+01	9.50E-04	2.30E+01
79-01-6	Trichloroethylene	1.50E+03	7.90E-02	9.10E-06	4.10E-01	2.41E-01	1.00E+02	4.20E-04	7.30E+01
75-69-4	Trichlorofluoro-methane	1.10E+03	8.70E-02	9.70E-06	3.98E+00	2.69E+00	1.30E+02	9.63E-04	8.00E+02
95-95-4	2,4,5-Trichlorophenol	1.20E+03	2.91E-02	7.03E-06	1.78E-04	-------[a]	2.68E+03[d]	3.80E-04	2.40E-02
88-06-2	2,4,6-Trichlorophenol	8.00E+02	2.61E-02	6.36E-06	3.53E-04	-------[a]	8.78E+02[d]	3.80E-04	2.00E-02
108-05-4	Vinyl Acetate	2.00E+04	8.50E-02	9.20E-06	2.09E-02	1.18E-02	4.57E+00	No Data	9.00E+01
99-35-4	1,3,5-Trinitrobenzene	2.80E+02	2.41E-02	6.08E-06	3.30E-10	-------[a]	1.60E+01	No Data	6.40E-06
118-96-7	2,4,6-Trinitrotoluene (TNT)	1.24E+02	2.94E-02	7.90E-06	4.87E-09	-------[a]	3.72E+01	1.92E-03	2.02E-06
57-01-4	Vinyl Chloride	8.80E+03	1.06E-01	1.23E-06	1.11E+00	8.14E-01	1.58E+01	2.40E-04	3.00E+03
108-38-3	m-Xylene	1.60E+02	7.00E-02	7.80E-06	2.99E-01	1.52E-01	3.98E+02	1.90E-03	8.50E+00

CAS No.	Chemical	Solubility in Water (S) (mg/L)	Diffusivity in Air (D_i) (cm^2/s)	Diffusivity in Water (D_w) (cm^2/s)	Dimensionless Henry's Law Constant (H') (25°C)	Dimensionless Henry's Law Constant (H') (13°C) For the indoor inhalation exposure route	Organic Carbon Partition Coefficient (K_{oc}) (L/kg)	First Order Degradation Constant (λ) (d^{-1})	Vapor Pressure (mm/Hg)
95-47-6	o-Xylene	1.80E+02	8.70E-02	1.00E-05	2.13E-01	1.07E-01	3.16E+02	1.90E-03	6.60E+00
106-42-3	p-Xylene	1.60E+02	7.69E-02	8.44E-06	3.16E-01	1.59E-01	3.16E+02	1.90E-03	8.90E+00
1330-20-7	Xylenes (total)	1.10E+02	7.35E-02	9.23E-06	2.71E-01	NA	3.98E+02	1.90E-03	8.00E+00

Chemical Abstracts Service (CAS) registry number. This number in the format xxx-xx-x, is unique for each chemical and allows efficient searching on computerized data bases.

[a] Soil remediation objectives are determined pursuant to 40 CFR 761, as incorporated by reference at Section 742.210(b) (the USEPA "PCB Spill Cleanup Policy"), for most sites; persons remediating sites should consult with BOL if calculation of Tier 2 or 3 remediation objectives is desired. PCBs are a mixture of different congeners. The appropriate values to use for the physical/chemical parameters depend on congeners present at the site.

[b] Dimensionless Henry's Law Constant at 13°C is not calculated because the chemical is not volatile and does not require evaluation under the indoor inhalation exposure route.

[c] Dimensionless Henry's Law Constant = 20°C

[d] These chemicals are ionizing and its K_{oc} value will change with pH. The K_{oc} values listed in this table is the effective K_{oc} at pH of 6.8. If the site-specific pH is values other than 6.8, the K_{oc} value listed in Section 742, Appendix C, Table I should be used.

[e] The values in this table were taken from the following sources (in order of preference): SCDMS online database (http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm); CHEMFATE online database (http://www.srcinc.com/what-we-do/databaseforms.aspx?id=381); PhysProp online database (http://www.srcinc.com/what-we-do/databaseforms.aspx?id-386); Water9

(http://www.epa.gov/ttn/chief/software/water/) for diffusivity values; and Handbook of Environmental Degradation Rates by P.H. Howard (1991) for first order degradation constant values.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX C: Tier 2 Illustrations and Tables

Section 742.Table F: Methods for Determining Physical Soil Parameters

Methods for Determining Physical Soil Parameters		
Parameter	Sampling Location[a]	Method
ρ_b (soil bulk density)	Surface	ASTM - D 1556-90 Sand Cone Method[b]
		ASTM - D 2167-94 Rubber Balloon Method[b]
		ASTM - D 2922-91 Nuclear Method[b]
	Subsurface	ASTM - D 2937-94 Drive Cylinder Method[b]
ρ_s (soil particle density)	Surface or Subsurface	ASTM - D 854-92 Specific Gravity of Soil[b]
w (moisture content)	Surface or Subsurface	ASTM - D 4959-89 (Reapproved 1994) Standard[b]
		ASTM - D 4643-93 Microwave Oven[b]
		ASTM - D2216-92 Laboratory Determination[b]
		ASTM - D3017-88 (Reapproved 1993) Nuclear Method[b]
		Equivalent USEPA Method (e.g., sample preparation procedures described in methods 3541 or 3550)
f_{oc} (fraction organic carbon content)	Surface or Subsurface	ASTM - D 2974-00 Moisture, Ash, and Organic Matter appropriately adjusted to estimate the fraction of organic carbon as stated in Nelson and Sommers (1982)[b]

Methods for Determining Physical Soil Parameters		
Parameter	Sampling Location[a]	Method
η or θ_T (total soil porosity)	Surface or Subsurface (calculated)	Equation S24 in Appendix C, Table A for SSL Model, or Equation R23 in Appendix C, Table C for RBCA Model, or Equation J&E 16 in Appendix C, Table L for J&E Model
θ_a or θ_{as} (air-filled soil porosity)	Surface or Subsurface (calculated)	Equation S21 in Appendix C, Table A for SSL Model, or Equation R21 in Appendix C, Table C for RBCA Model, or Equation J&E 18 in Appendix C, Table L for J&E Model
θ_w or θ_{ws} (water-filled soil porosity)	Surface or Subsurface (calculated)	Equation S20 in Appendix C, Table A for SSL Model, or Equation R22 in Appendix C, Table C for RBCA Model, or Equation J&E 17 in Appendix C, Table L for J&E Model
K (hydraulic conductivity)	Surface or Subsurface	ASTM - D 5084-90 Flexible Wall Permeameter[b]
		Pump Test
		Slug Test
i (hydraulic gradient)	Surface or Subsurface	Field Measurement

[a] This is the location where the sample is collected

[b] As incorporated by reference in Section 742.120.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX C: Tier 2 Tables and Illustrations

Section 742.Table G: Error Function (erf)

$$erf(\beta) = \frac{2}{\sqrt{\pi}} \int_0^{\beta} e^{-\varepsilon^2} \, d\varepsilon$$

β	$erf(\beta)$
0	0
0.05	0.056372
0.1	0.112463
0.15	0.167996
0.2	0.222703
0.25	0.276326
0.3	0.328627
0.35	0.379382
0.4	0.428392
0.45	0.475482
0.5	0.520500
0.55	0.563323
0.6	0.603856
0.65	0.642029
0.7	0.677801
0.75	0.711156
0.8	0.742101
0.85	0.770668
0.9	0.796908
0.95	0.820891
1.0	0.842701
1.1	0.880205
1.2	0.910314
1.3	0.934008
1.4	0.952285
1.5	0.966105
1.6	0.976348
1.7	0.983790
1.8	0.989091
1.9	0.992790
2.0	0.995322
2.1	0.997021
2.2	0.998137
2.3	0.998857
2.4	0.999311
2.5	0.999593
2.6	0.999764
2.7	0.999866
2.8	0.999925
2.9	0.999959
3.0	0.999978

Section 742.APPENDIX C Tier 2 Illustrations and Tables

Section 742.Table H Q/C Values by Source Area

Source (Acres)	Area Q/C Value (g/m^2-s per kg/m^3)
0.5	97.78
1	85.81
2	76.08
5	65.75
10	59.16
30	50.60

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX C TABLE I: K_{oc} Values for Ionizing Organics as a Function of pH (cm^3/g or L/kg or cm^3_{water}/g_{soil})

pH	Benzoic Acid	2-Chloro-phenol	2,4-Dichloro-phenol	Pentachloro-phenol	2,4,5-Trichloro-phenol	2,4,6-Trichloro-phenol	Dinoseb	2,4,5-TP (Silvex)
4.5	1.07E+01	3.98E+02	1.59E+02	1.34E+04	2.37E+03	1.06E+03	3.00E+04	1.28E+04
4.6	9.16E+00	3.98E+02	1.59E+02	1.24E+04	2.37E+03	1.05E+03	2.71E+04	1.13E+04
4.7	7.79E+00	3.98E+02	1.59E+02	1.13E+04	2.37E+03	1.05E+03	2.41E+04	1.01E+04
4.8	6.58E+00	3.98E+02	1.59E+02	1.02E+04	2.37E+03	1.05E+03	2.12E+04	9.16E+03
4.9	5.54E+00	3.98E+02	1.59E+02	9.05E+03	2.37E+03	1.04E+03	1.85E+04	8.40E+03
5.0	4.62E+00	3.98E+02	1.59E+02	7.96E+03	2.36E+03	1.03E+03	1.59E+04	7.76E+03
5.1	3.86E+00	3.98E+02	1.59E+02	6.93E+03	2.36E+03	1.02E+03	1.36E+04	7.30E+03
5.2	3.23E+00	3.98E+02	1.59E+02	5.97E+03	2.35E+03	1.01E+03	1.15E+04	6.91E+03
5.3	2.70E+00	3.98E+02	1.59E+02	5.10E+03	2.34E+03	9.99E+02	9.66E+03	6.60E+03
5.4	2.27E+00	3.98E+02	1.58E+02	4.32E+03	2.33E+03	9.82E+02	8.10E+03	6.36E+03
5.5	1.92E+00	3.97E+02	1.58E+02	3.65E+03	2.32E+03	9.62E+02	6.77E+03	6.16E+03
5.6	1.63E+00	3.97E+02	1.58E+02	3.07E+03	2.31E+03	9.38E+02	5.65E+03	6.00E+03
5.7	1.40E+00	3.97E+02	1.58E+02	2.58E+03	2.29E+03	9.10E+02	4.73E+03	5.88E+03
5.8	1.22E+00	3.97E+02	1.58E+02	2.18E+03	2.27E+03	8.77E+02	3.97E+03	5.78E+03
5.9	1.07E+00	3.97E+02	1.57E+02	1.84E+03	2.24E+03	8.39E+02	3.35E+03	5.70E+03
6.0	9.50E-01	3.96E+02	1.57E+02	1.56E+03	2.21E+03	7.96E+02	2.84E+03	5.64E+03
6.1	8.54E-01	3.96E+02	1.57E+02	1.33E+03	2.17E+03	7.48E+02	2.43E+03	5.59E+03
6.2	7.78E-01	3.96E+02	1.56E+02	1.15E+03	2.12E+03	6.97E+02	2.10E+03	5.55E+03
6.3	7.19E-01	3.95E+02	1.55E+02	9.98E+02	2.06E+03	6.44E+02	1.83E+03	5.52E+03

pH	Benzoic Acid	2-Chloro-phenol	2,4-Dichloro-phenol	Pentachloro-phenol	2,4,5-Trichloro-phenol	2,4,6-Trichloro-phenol	Dinoseb	2,4,5-TP (Silvex)
6.4	6.69E-01	3.94E+02	1.54E+02	8.77E+02	1.99E+03	5.89E+02	1.62E+03	5.50E+03
6.5	6.31E-01	3.93E+02	1.53E+02	7.81E+02	1.91E+03	5.33E+02	1.45E+03	5.48E+03
6.6	6.00E-01	3.92E+02	1.52E+02	7.03E+02	1.82E+03	4.80E+02	1.32E+03	5.46E+03
6.7	5.74E-01	3.90E+02	1.50E+02	6.40E+02	1.71E+03	4.29E+02	1.21E+03	5.45E+03
6.8	5.55E-01	3.88E+02	1.47E+02	5.92E+02	1.60E+03	3.81E+02	1.12E+03	5.44E+03
6.9	5.39E-01	3.86E+02	1.45E+02	5.52E+02	1.47E+03	3.38E+02	1.05E+03	5.43E+03
7.0	5.28E-01	3.83E+02	1.41E+02	5.21E+02	1.34E+03	3.00E+02	9.96E+02	5.43E+03
7.1	5.18E-01	3.79E+02	1.38E+02	4.96E+02	1.21E+03	2.67E+02	9.52E+02	5.42E+03
7.2	5.10E-01	3.75E+02	1.33E+02	4.76E+02	1.07E+03	2.39E+02	9.18E+02	5.42E+03
7.3	5.04E-01	3.69E+02	1.28E+02	4.61E+02	9.43E+02	2.15E+02	8.90E+02	5.42E+03
7.4	4.99E-01	3.62E+02	1.21E+02	4.47E+02	8.19E+02	1.95E+02	8.68E+02	5.41E+03
7.5	4.95E-01	3.54E+02	1.14E+02	4.37E+02	7.03E+02	1.78E+02	8.50E+02	5.41E+03
7.6	4.92E-01	3.44E+02	1.07E+02	4.29E+02	5.99E+02	1.64E+02	8.36E+02	5.41E+03
7.7	4.86E-01	3.33E+02	9.84E+01	4.23E+02	5.07E+02	1.53E+02	8.25E+02	5.41E+03
7.8	4.86E-01	3.19E+02	8.97E+01	4.18E+02	4.26E+02	1.44E+02	8.17E+02	5.41E+03
7.9	4.85E-01	3.04E+02	8.07E+01	4.14E+02	3.57E+02	1.37E+02	8.10E+02	5.41E+03
8.0	4.85E-01	2.86E+02	7.17E+01	4.10E+02	2.98E+02	1.31E+02	8.04E+02	5.41E+03
8.1	4.84E-01	2.67E+02	6.30E+01	4.09E+02	2.49E+02	1.26E+02	8.00E+02	5.40E+03
8.2	4.84E-01	2.46E+02	5.47E+01	4.07E+02	2.08E+02	1.22E+02	7.97E+02	5.40E+03
8.3	4.83E-01	2.24E+02	4.40E+01	4.05E+02	1.75E+02	1.19E+02	7.93E+02	5.40E+03

pH	Benzoic Acid	2-Chloro-phenol	2,4-Dichloro-phenol	Pentachloro-phenol	2,4,5-Trichloro-phenol	2,4,6-Trichloro-phenol	Dinoseb	2,4,5-TP (Silvex)
8.4	4.83E-01	2.02E+02	4.00E+01	4.04E+02	1.48E+02	1.17E+02	7.91E+02	5.40E+03
8.5	4.82E-01	1.80E+02	3.38E+01	4.03E+02	1.25E+02	1.15E+02	7.89E+02	5.40E+03
8.6	4.82E-01	1.58E+02	2.84E+01	4.02E+02	1.08E+02	1.13E+02	7.88E+02	5.40E+03
8.7	4.82E-01	1.37E+02	2.38E+01	4.02E+02	9.31E+02	1.12E+02	7.87E+02	5.40E+03
8.8	4.81E-01	1.18E+02	1.99E+01	4.01E+02	8.16E+02	1.11E+02	7.86E+02	5.40E+03
8.9	4.81E-01	1.00E+02	1.66E+01	4.01E+02	7.23E+01	1.10E+02	7.85E+02	5.40E+03
9.0	4.80E-01	8.47E+01	1.39E+01	4.00E+02	6.48E+01	1.09E+02	7.85E+02	5.40E+03

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX C: Tier 2 Illustrations and Tables

Section 742.TABLE J Values to be Substituted for k_d or k_s when Evaluating Inorganics as a Function of pH (cm^3/g or L/kg or cm^3_{water}/g_{soil})

pH	As	Ba	Be	Cd	Cr (+3)	Cr (+6)	Hg	Ni	Ag	Se	Tl	Zn	Pb
4.9	2.5E+01	1.1E+01	2.3E+01	1.5E+01	1.2E+03	3.1E+01	4.0E-02	1.6E+01	1.0E-01	1.8E+01	4.4E+01	1.6E+01	1.5E+01
5.0	2.5E+01	1.2E+01	2.6E+01	1.7E+01	1.9E+03	3.1E+01	6.0E-02	1.8E+01	1.3E-01	1.7E+01	4.5E+01	1.8E+01	1.5E+01
5.1	2.5E+01	1.4E+01	2.8E+01	1.9E+01	3.0E+03	3.0E+01	9.0E-02	2.0E+01	1.6E-01	1.6E+01	4.6E+01	1.9E+01	1.5E+01
5.2	2.6E+01	1.5E+01	3.1E+01	2.1E+01	4.9E+03	2.9E+01	1.4E-01	2.2E+01	2.1E-01	1.5E+01	4.7E+01	2.1E+01	1.5E+01
5.3	2.6E+01	1.7E+01	3.5E+01	2.3E+01	8.1E+03	2.8E+01	2.0E-01	2.4E+01	2.6E-01	1.4E+01	4.8E+01	2.3E+01	1.5E+01
5.4	2.6E+01	1.9E+01	3.8E+01	2.5E+01	1.3E+04	2.7E+01	3.0E-01	2.6E+01	3.3E-01	1.3E+01	5.0E+01	2.5E+01	1.5E+01
5.5	2.6E+01	2.1E+01	4.2E+01	2.7E+01	2.1E+04	2.7E+01	4.6E-01	2.8E+01	4.2E-01	1.2E+01	5.1E+01	2.6E+01	1.5E+01
5.6	2.6E+01	2.2E+01	4.7E+01	2.9E+01	3.5E+04	2.6E+01	6.9E-01	3.0E+01	5.3E-01	1.1E+01	5.2E+01	2.8E+01	1.5E+01
5.7	2.7E+01	2.4E+01	5.3E+01	3.1E+01	5.5E+04	2.5E+01	1.0E-00	3.2E+01	6.7E-01	1.1E+01	5.4E+01	3.0E+01	1.5E+01
5.8	2.7E+01	2.6E+01	6.0E+01	3.3E+01	8.7E+04	2.5E+01	1.6E-00	3.4E+01	8.4E-01	9.8E+00	5.5E+01	3.2E+01	1.5E+01

pH	As	Ba	Be	Cd	Cr (+3)	Cr (+6)	Hg	Ni	Ag	Se	Tl	Zn	Pb
5.9	2.7E+01	2.8E+01	6.9E+01	3.5E+01	1.3E+05	2.4E+01	2.3E-00	3.6E+01	1.1E+00	9.2E+00	5.6E+01	3.4E+01	1.5E+01
6.0	2.7E+01	3.0E+01	8.2E+01	3.7E+01	2.0E+05	2.3E+01	3.5E-00	3.8E+01	1.3E+00	8.6E+00	5.8E+01	3.6E+01	1.5E+01
6.1	2.7E+01	3.1E+01	9.9E+01	4.0E+01	3.0E+05	2.3E+01	5.1E-00	4.0E+01	1.7E+00	8.0E+00	5.9E+01	3.9E+01	1.5E+01
6.2	2.8E+01	3.3E+01	1.2E+02	4.2E+01	4.2E+05	2.2E+01	7.5E-00	4.2E+01	2.1E+00	7.5E+00	6.1E+01	4.2E+01	1.5E+01
6.3	2.8E+01	3.5E+01	1.6E+02	4.4E+01	5.8E+05	2.2E+01	1.1E+01	4.5E+01	2.7E+00	7.0E+00	6.2E+01	4.4E+01	1.5E+01
6.4	2.8E+01	3.6E+01	2.1E+02	4.8E+01	7.7E+05	2.1E+01	1.6E+01	4.7E+01	3.4E+00	6.5E+00	6.4E+01	4.7E+01	7.1E+02
6.5	2.8E+01	3.7E+01	2.8E+02	5.2E+01	9.9E+05	2.0E+01	2.2E+01	5.0E+01	4.2E+00	6.1E+00	6.6E+01	5.1E+01	7.1E+02
6.6	2.8E+01	3.9E+01	3.9E+02	5.7E+01	1.2E+06	2.0E+01	3.0E+01	5.4E+01	5.3E+00	5.7E+00	6.7E+01	5.4E+01	7.1E+02
6.7	2.9E+01	4.0E+01	5.5E+02	6.4E+01	1.5E+06	1.9E+01	4.0E+01	5.8E+01	6.6E+00	5.3E+00	6.9E+01	5.8E+01	7.1E+02
6.8	2.9E+01	4.1E+01	7.9E+02	7.5E+01	1.8E+06	1.9E+01	5.2E+01	6.5E+01	8.3E+00	5.0E+00	7.1E+01	6.2E+01	7.1E+02
6.9	2.9E+01	4.2E+01	1.1E+03	9.1E+01	2.1E+06	1.8E+01	6.6E+01	7.4E+01	1.0E+01	4.7E+00	7.3E+01	6.8E+01	7.1E+02
7.0	2.9E+01	4.2E+01	1.7E+03	1.1E+02	2.5E+06	1.8E+01	8.2E+01	8.8E+01	1.3E+01	4.3E+00	7.4E+01	7.5E+01	7.1E+02

pH	As	Ba	Be	Cd	Cr (+3)	Cr (+6)	Hg	Ni	Ag	Se	Tl	Zn	Pb
7.1	2.9E+01	4.3E+01	2.5E+03	1.5E+02	2.8E+06	1.7E+01	9.9E+01	1.1E+02	1.6E+01	4.1E+00	7.6E+01	8.3E+01	7.1E+02
7.2	3.0E+01	4.4E+01	3.8E+03	2.0E+02	3.1E+06	1.7E+01	1.2E+02	1.4E+02	2.0E+01	3.8E+00	7.8E+01	9.5E+01	7.1E+02
7.3	3.0E+01	4.4E+01	5.7E+03	2.8E+02	3.4E+06	1.6E+01	1.3E+02	1.8E+02	2.5E+01	3.5E+00	8.0E+01	1.1E+02	7.1E+02
7.4	3.0E+01	4.5E+01	8.6E+03	4.0E+02	3.7E+06	1.6E+01	1.5E+02	2.5E+02	3.1E+01	3.3E+00	8.2E+01	1.3E+02	7.1E+02
7.5	3.0E+01	4.6E+01	1.3E+04	5.9E+02	3.9E+06	1.6E+01	1.6E+02	3.5E+02	3.9E+01	3.1E+00	8.5E+01	1.6E+02	7.1E+02
7.6	3.1E+01	4.6E+01	2.0E+04	8.7E+02	4.1E+06	1.5E+01	1.7E+02	4.9E+02	4.8E+01	2.9E+00	8.7E+01	1.9E+02	7.1E+02
7.7	3.1E+01	4.7E+01	3.0E+04	1.3E+03	4.2E+06	1.5E+01	1.8E+02	7.0E+02	5.9E+01	2.7E+00	8.9E+01	2.4E+02	7.1E+02
7.8	3.1E+01	4.9E+01	4.6E+04	1.9E+03	4.3E+06	1.4E+01	1.9E+02	9.9E+02	7.3E+01	2.5E+00	9.1E+01	3.1E+02	7.1E+02
7.9	3.1E+01	5.0E+01	6.9E+04	2.9E+03	4.3E+06	1.4E+01	1.9E+02	1.4E+03	8.9E+01	2.4E+00	9.4E+01	4.0E+02	7.1E+02
8.0	3.1E+01	5.2E+01	1.0E+05	4.3E+03	4.3E+06	1.4E+01	2.0E+02	1.9E+03	1.1E+02	2.2E+00	9.6E+01	5.3E+02	7.1E+02
8.1	3.2E+01	---[a]	---[a]	---[a]	---[a]	1.3E+01	---[a]	---[a]	---[a]	2.1E+00	1.0E+02	---[a]	7.1E+02
8.2	3.2E+01	---[a]	---[a]	---[a]	---[a]	1.3E+01	---[a]	---[a]	---[a]	1.9E+00	1.0E+02	---[a]	7.1E+02

pH	As	Ba	Be	Cd	Cr (+3)	Cr (+6)	Hg	Ni	Ag	Se	Tl	Zn	Pb
8.3	3.2E+01	---[a]	---[a]	---[a]	---[a]	1.3E+01	---[a]	---[a]	---[a]	1.8E+00	1.0E+02	---[a]	7.1E+02
8.4	3.2E+01	---[a]	---[a]	---[a]	---[a]	1.2E+01	---[a]	---[a]	---[a]	1.7E+00	1.1E+02	---[a]	7.1E+02
8.5	3.2E+01	---[a]	---[a]	---[a]	---[a]	1.2E+01	---[a]	---[a]	---[a]	1.6E+00	1.1E+02	---[a]	7.1E+02
8.6	3.3E+01	---[a]	---[a]	---[a]	---[a]	1.2E+01	---[a]	---[a]	---[a]	1.5E+00	1.1E+02	---[a]	7.1E+02
8.7	3.3E+01	---[a]	---[a]	---[a]	---[a]	1.2E+01	---[a]	---[a]	---[a]	1.4E+00	1.2E+02	---[a]	7.1E+02
8.8	3.3E+01	---[a]	---[a]	---[a]	---[a]	1.1E+01	---[a]	---[a]	---[a]	1.3E+00	1.2E+02	---[a]	1.9E+03
8.9	3.3E+01	---[a]	---[a]	---[a]	---[a]	1.1E+01	---[a]	---[a]	---[a]	1.2E+00	1.2E+02	---[a]	1.9E+03
9.0	3.3E+01	---[a]	---[a]	---[a]	---[a]	1.0E+01	---[a]	---[a]	---[a]	1.1E+00	1.2E+02	---[a]	1.9E+03

[a] No data available for this pH.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX C Tier 2 Illustrations and Tables

Section 742.TABLE K Parameter Estimates for Calculating Water-Filled Soil Porosity (θ_w)

Soil Texture[a]	Saturated Hydraulic Conductivity, K_s (m/yr)	$1/(2b+3)$[b]
Sand	1,830	0.090
Loamy Sand	540	0.085
Sandy Loam	230	0.080
Silt Loam	120	0.074
Loam	60	0.073
Sandy Clay Loam	40	0.058
Silt Clay Loam	13	0.054
Clay Loam	20	0.050
Sandy Clay	10	0.042
Silt Clay	8	0.042
Clay	5	0.039

[a] The appropriate texture classification is determined by a particle size analysis by ASTM D2488-93 as incorporated by reference in Section 742.210 and the U.S. Department of Agriculture Soil Textural Triangle shown in Appendix C, Illustration C.

[b] Where b is the soil-specific exponential parameter (unitless)

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX C: Tier 2 Tables

Section 742.Table L: J&E Equations[a]

Indoor air remediation objectives (mg/m^3)	For carcinogenic contaminants	$RO_{indoor\ air} = \dfrac{TR \times AT_c \times 365 \frac{days}{yr}}{ED \times EF \times URF \times 1000 \frac{\mu g}{mg}}$	**J&E1**
	For noncarcinogenic contaminants	$RO_{indoor\ air} = \dfrac{THQ \times AT_{nc} \times 365 \frac{days}{yr} \times RfC}{ED \times EF}$	**J&E2**
To convert mg/m^3 from parts per million volume		$mg/m^3 = \dfrac{ppmv \times MW}{24.45}$ Note: 24.45 equals the molar volume of air in liters at normal temperature (25°C) and pressure (760 mm Hg).	**J&E3**

Soil gas remediation objective (mg/m^3)		$$RO_{soil\ gas} = \frac{RO_{indoor\ air}}{\alpha}$$	**J&E4**
Soil Vapor Saturation Limit (mg/m^3-air)		$$C_v^{sat} = \frac{P \times MW}{R \times T} \times 10^6$$	**J&E5**
Groundwater remediation objectives		$$RO_{gw} = \frac{RO_{soil\ gas}}{H'_{TS} \times 1000 \frac{L}{m^3}}$$	**J&E6**
Attenuation factor	Attenuation factor when the mode of contaminant transport is both diffusion and advection Q_{soil} = 83.33 cm^3/sec	$$\alpha = \frac{\left[\left(\frac{D_T^{eff} \times A_B}{Q_{bldg} \times L_T}\right) \times \exp\left(\frac{Q_{soil} \times L_{crack}}{D_{crack}^{eff} \times A_{crack}}\right)\right]}{\left[\exp\left(\frac{Q_{soil} \times L_{crack}}{D_{crack}^{eff} \times A_{crack}}\right) + \left(\frac{D_T^{eff} \times A_B}{Q_{bldg} \times L_T}\right) + \left(\frac{D_T^{eff} \times A_B}{Q_{soil} \times L_T}\right)\left[\exp\left(\frac{Q_{soil} \times L_{crack}}{D_{crack}^{eff} \times A_{crack}}\right) - 1\right]\right]}$$	**J&E7**

	Attenuation factor when the mode of contaminant transport is diffusion only Q_{soil}= 0 cm^3/sec	$$\alpha = \frac{\left(\frac{D_T^{eff} \times A_B}{Q_{bldg} \times L_T}\right)}{\left[1 + \left(\frac{D_T^{eff} \times A_B}{Q_{bldg} \times L_T}\right) + \left(\frac{D_T^{eff} \times A_B \times L_{crack}}{L_T \times D_{crack}^{eff} \times A_{crack}}\right)\right]}$$	**J&E8**
Total overall effective diffusion coefficient for vapor transport in porous media for multiple soil layers (cm^2/s)		$$D_T^{eff} = \frac{L_T}{\sum_{i=1}^{n} L_i / D_i^{eff}}$$	**J&E9a**
	In Equation J&E9a, the following condition must be satisfied:	$$\sum_{i=1}^{n} L_i = L_T$$	**J&E9b**
Source to building separation (cm)		$$L_T = D_{source} - L_F$$	**J&E10**
Effective diffusion coefficient for each soil layer (cm^2/s)		$$D_i^{eff} = D_i \left(\frac{\theta_{a,i}^{3.33}}{\theta_{T,i}^2}\right) + \left(\frac{D_w}{H'_{TS}}\right)\left(\frac{\theta_{w,i}^{3.33}}{\theta_{T,i}^2}\right)$$	**J&E11**

Surface area of enclosed space at or below grade (cm^2)	For a building with a full concrete slab-on-grade	$A_B = (L_B \times W_B)$	**J&E12a**
Surface area of enclosed space at or below grade (cm^2)	For a building with a full concrete basement floor and walls	$A_B = (L_B \times W_B) + (2 \times L_F \times L_B) + (2 \times L_F \times W_B)$	**J&E12b**
Building ventilation rate (cm^3/s)		$Q_{bldg} = \left(\frac{L_B \times W_B \times H_B \times ER}{3600 \frac{sec}{hr}} \right)$	**J&E13**
Area of total cracks (cm^2)		$A_{crack} = 2 \times (L_B + W_B) \times w$	**J&E14**
Effective diffusion coefficient through the cracks (cm^2/s)		$D_{crack}^{eff} = D_i \left(\frac{\theta_{a,crack}^{3.33}}{\theta_{T,crack}^2} \right) + \left(\frac{D_w}{H'_{TS}} \right) \left(\frac{\theta_{w,crack}^{3.33}}{\theta_{T,crack}^2} \right)$	**J&E15**

Total porosity		$\theta_{Ti} = 1 - \frac{\rho_{bi}}{\rho_s}$	**J&E16**
Water-filled soil porosity		$\theta_w = (W)\left(\frac{\rho_b}{\rho_w}\right)$	**J&E17**
Air-filled soil porosity		$\theta_a = \theta_T - \theta_w$	**J&E18**

[a] This table contains equations based on the assumption that the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. This table applies only when the existing or potential building has a full concrete slab-on-grade or a full concrete basement floor and walls. Institutional controls under Subpart J are required to develop remediation objectives pursuant to this table. This table does not apply when the existing or potential building has neither a full concrete slab-on-grade nor a full concrete basement floor and walls, such as a building with an earthen crawl space, an earthen floor, a stone foundation, a partial concrete floor, or a sump. In such cases, site evaluators have the option of excluding the indoor inhalation exposure route under Section 742.312, meeting the building control technology requirements under Subpart L, or proposing an alternative approach under Tier 3.

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX C: Tier 2 Tables

Section 742.Table M: J&E Parameters

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
A_B	Surface area of enclosed space at or below grade	cm^2	Equation J&E 12a or 12b, Appendix C, Table L	Residential = 1×10^6 Industrial/Commercial = 4.0×10^6
A_{crack}	Area of total cracks	cm^2	Equation J&E 14, Appendix C, Table L	Calculated Value
AT_c	Averaging time for carcinogens	year	SSL, May 1996	70
AT_{nc}	Averaging time for noncarcinogens	year	AT_{nc}= ED	Residential = 30 Industrial/Commercial = 25
C_v^{sat}	Soil vapor saturation limit	mg/m^3-air	Equation J&E 5, Appendix C, Table L	Chemical-Specific or Calculated Value
D_{crack}^{eff}	Effective diffusion coefficient through the cracks	cm^2 /s	Equation J&E 15, Appendix C, Table L	Calculated Value
D_i	Diffusivity in air	cm^2 /s	Appendix C, Table E	Chemical-Specific

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
D_i^{eff}	Effective diffusion coefficient for each soil layer	cm^2 /s	Equation J&E 11, Appendix C, Table L	Calculated Value
D_{source}	Distance from ground surface to top of contamination	cm	Field Measurement	Soil Gas Contamination = 152.4 Groundwater Contamination = 304.8 Site-Specific
D_T^{eff}	Total overall effective diffusion coefficient	cm^2 /s	Equation J&E 9a, Appendix C, Table L	Calculated Value
D_w	Diffusivity in water	cm^2 /s	Appendix C, Table E	Chemical-Specific
ED	Exposure duration	year	Residential: SSL, May 1996 Industrial/Commercial: SSL 2002	Residential = 30 Industrial/Commercial = 25
EF	Exposure frequency	day/year	Residential: SSL, May 1996 Industrial/Commercial: SSL 2002	Residential = 350 Industrial/Commercial = 250

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
ER	Air exchange rate	exchanges per hour	Illinois EPA	Residential = 0.53 Industrial/Commercial = 0.93
f_{oc}	Fraction organic carbon content	g/g	SSL, May 1996, or Field Measurement Appendix C, Table F	0.002 or Site-Specific
H_B	Height of building	cm	Illinois EPA	Slab on Grade Residential = 244 Industrial/Commercial = 305 or Site-Specific in Tier 3 Basement Residential = 427 Industrial/Commercial = 488 or Site-Specific in Tier 3
H'_{TS}	Dimensionless Henry's law constant at the system (soil) temperature 13°C	unitless	Appendix C, Table E	Chemical-Specific

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
L_B	Length of building	cm	Illinois EPA	Residential = 1000 Industrial/Commercial = 2000 or Site-Specific in Tier 3
L_{crack}	Slab thickness	cm	US EPA, Users Guide 2004	10
L_F	Distance from ground surface to bottom of slab	cm	US EPA, Users Guide 2004	10 (slab on grade) 200 (basement)
L_i	Thickness of soil layer i	cm	Field Measurement For capillary fringe, USEPA, 2004	Site-Specific For capillary fringe, 37.5 cm
L_T	Distance from bottom of slab to top of contamination	cm	Field Measurement or Equation J&E 10, Appendix C, Table L	142.4 or Site-Specific
MW	Molecular weight	g/mole	Illinois EPA	Chemical-Specific

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
n	Total number of layers of different types of soil vapors migrate through from source to building (if source is groundwater, include a capillary fringe layer of 37.5 cm as one of the layers)	unitless	Field measurement	Site-Specific
P	Vapor Pressure	atm	Appendix C, Table E	Chemical-Specific
Q_{bldg}	Building ventilation rate	cm^3/s	Equation J&E 13, Appendix C, Table L	Slab on Grade Residential = 3.59×10^4 Industrial/Commercial = 3.15×10^5 or Site-Specific in Tier 3 Basement Residential = 6.28×10^4 Industrial/Commercial = 5.04×10^5 or Site-Specific in Tier 3

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
Q_{soil}	Volumetric flow rate of soil gas into the enclosed space	cm^3/s	US EPA, Users Guide for Evaluating Subsurface Vapor Intrusion into Buildings 2004	If L_T is less than 5 feet (152 cm), Q_{soil} equals 83.33 If L_T is 5 feet (152 cm) or greater, Q_{soil} equals zero An input value of zero requires an institutional control. See Section 742.505(b) and (c).
R	Ideal gas constant	atm-L/mol-K	US EPA, Users Guide 2004	0.08206
RfC	Reference concentration	ug/m^3	Illinois EPA: http://www.epa.state.il.us/land/taco/toxicity-values.xls	Toxicological-Specific
RO_{gw}	Groundwater remediation objective	mg/L	Appendix B, Table E, or Equation J&E 6, Appendix C, Table L	Chemical-Specific or Calculated Value
$RO_{indoor\ air}$	Indoor air remediation objective	mg/m^3	Equations J&E 1 and 2, Appendix C, Table L	Calculated Value

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
$RO_{soil\ gas}$	Soil gas remediation objective	mg/m^3	Equation J&E 4, Appendix C, Table L	Calculated Value
S	Solubility in water	mg/L	Appendix C, Table E	Chemical-Specific
T	Temperature	K	US EPA, Users Guide 2004	286 (converted from 13°C)
THQ	Target hazard quotient for a chemical	unitless	SSL, May 1996	1
TR	Target risk or the increased chance of developing cancer over a lifetime due to exposure to a chemical	unitless	SSL, May 1996	Residential = 10^{-6} at the point of human exposure Industrial/Commercial = 10^{-6} at the point of human exposure
URF	Unit risk factor	$(ug/m^3)^{-1}$	Illinois EPA: http://www.epa.state.il.us/land/taco/toxicity-values.xls	Toxicological- Specific

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
w	Floor-wall seam gap	cm	US EPA, Users Guide 2004	0.1
W	Moisture content	g of water/g of soil	Field Measurement, Appendix C, Table F	Site-Specific
W_B	Width of building	cm	Illinois EPA	Residential = 1000 Industrial/Commercial = 2000 or Site-Specific in Tier 3
α	Attenuation factor	unitless	Equations J&E 7 or 8, Appendix C, Table L	Site-Specific
θ_a	Air-filled soil porosity	cm^3/cm^3	SSL, May 1996 or Equation J&E 18, Appendix C, Table L	0.28 or Calculated Value
$\theta_{a,crack}$	Air-filled porosity for soil in cracks	cm^3/cm^3	SSL, May 1996 or Equation J&E 18, Appendix C, Table L	0.13
$\theta_{a,i}$	Air-filled porosity of soil layer i	cm^3/cm^3	SSL, May 1996 or Equation J&E 18, Appendix C, Table L	0.13 or Calculated Value For capillary fringe, $\theta_{a,i} = 0.1\ \theta_{T,i}$

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
$\theta_{T,crack}$	Total porosity for soil in cracks	cm^3/cm^3	SSL, May 1996 or Equation J&E 16, Appendix C, Table L	0.43
$\theta_{T,i}$	Total porosity of soil layer i	cm^3/cm^3	SSL, May 1996 or Equation J&E 16, Appendix C, Table L	0.43 or Calculated Value
θ_w	Water-filled soil porosity	cm^3/cm^3	SSL, May 1996 or Equation J&E 17, Appendix C, Table L	0.15 or Calculated Value
$\theta_{w,crack}$	Water-filled porosity for soil in cracks	cm^3/cm^3	SSL, May 1996 or Equation J&E 17, Appendix C, Table L	0.15
$\theta_{w,i}$	Water-filled porosity of soil layer i	cm^3/cm^3	SSL, May 1996 or Equation J&E 17, Appendix C, Table L For capillary fringe, US EPA, Users Guide 2004	0.15 or Calculated Value For capillary fringe = 0.375 or 0.9 $\theta_{T,i}$

Symbol	Parameter	Units	Source	Tier 1 or Calculated Value
ρ_b	Dry soil bulk density	g/cm^3	SSL, May 1996 or Field Measurement, Appendix C, Table F	1.5 or Calculated Value
$\rho_{s,i}$	Soil particle density	g/cm^3	SSL, May 1996 or Field Measurement, Appendix C, Table F	2.65 or Calculated Value
ρ_w	Density of water	g/cm^3	Illinois EPA	1

(Source: Added at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX D Highway Authority Agreement

HIGHWAY AUTHORITY AGREEMENT

This Agreement is entered into this ____ day of _____, 200_ pursuant to 35 Ill. Adm. Code 742.1020 by and between the (1)_____ ("Property Owner") *[or, in the case of a petroleum leaking underground storage tank, the owner/operator of the tank ("Owner/Operator")]* and (2) *Name of Entity in Control of the Right-of-Way* ("Highway Authority"), collectively known as the "Parties."

[Use this paragraph for sites with petroleum leaking underground storage tank(s)] **WHEREAS,** _____ is the owner or operator of one or more leaking underground storage tanks presently or formerly located at *common address or description of Site location* ("the Site");

[Use this paragraph for sites that do not have petroleum leaking underground storage tanks] **WHEREAS,** _____ is the owner of the property located at *common address or description of Site location* ("the Site");

WHEREAS, as a result of one or more releases of contaminants [*insert either "from the above referenced underground storage tanks" or "at the above referenced Site"*] ("the Release(s)"), soil and/or groundwater contamination at the Site exceeds the Tier 1 residential remediation objectives of 35 Ill. Adm. Code 742;

WHEREAS, the soil and/or groundwater contamination exceeding Tier 1 residential remediation objectives extends or may extend into the Highway Authority's right-of-way;

WHEREAS, the Owner/Operator or Property Owner is conducting corrective action in response to the Release(s);

WHEREAS, the Parties desire to prevent groundwater beneath the Highway Authority's right-of-way that exceeds Tier 1 remediation objectives from use as a supply of potable or domestic water and to limit access to soil within the right-of-way that exceeds Tier 1 residential remediation objectives so that human health and the environment are protected during and after any access;

NOW, THEREFORE, the Parties agree as follows:

1. The recitals set forth above are incorporated by reference as if fully set forth herein.

2. *[Use this paragraph if IEMA has issued an incident number]* The Illinois Emergency Management Agency has assigned incident number(s) to the Release(s).

3. Attached as Exhibit A is a scaled map(s) prepared by the *[Owner/Operator or Property Owner]* that shows the Site and surrounding area and delineates the

current and estimated future extent of soil and groundwater contamination above the applicable Tier 1 residential remediation objectives as a result of the Release(s). *[Use the following sentence if either soil or groundwater is not contaminated above applicable Tier 1 residential remediation objectives:* [Soil] [Groundwater] is not contaminated above the applicable Tier 1 residential remediation objectives.*]*

4. Attached as Exhibit B is a table(s) prepared by the *[Owner/Operator or Property Owner]* that lists each contaminant of concern that exceeds its Tier 1 residential remediation objective, its Tier 1 residential remediation objective and its concentrations within the zone where Tier 1 residential remediation objectives are exceeded. The locations of the concentrations listed in Exhibit B are identified on the map(s) in Exhibit A.

5. Attached as Exhibit C is a scaled map prepared by the *[Owner/Operator or Property Owner]* showing the area of the Highway Authority's right-of-way that is governed by this agreement ("Right-of-Way"). Because Exhibit C is not a surveyed plat, the Right-of-Way boundary may be an approximation of the actual Right-of-Way lines.

6. *[Use this paragraph if samples have not been collected within the Right-of-Way, sampling within the Right-of-Way is not practical, and contamination does not extend beyond the Right-of-Way].* Because the collection of samples within the Right-of-Way is not practical, the Parties stipulate that, based on modeling, soil and groundwater contamination exceeding Tier 1 residential remediation objectives does not and will not extend beyond the boundaries of the Right-of-Way.

7. The Highway Authority stipulates it has jurisdiction over the Right-of-Way that gives it sole control over the use of the groundwater and access to the soil located within or beneath the Right-of-Way.

8. The Highway Authority agrees to prohibit within the Right-of-Way all potable and domestic uses of groundwater exceeding Tier 1 residential remediation objectives.

9. The Highway Authority further agrees to limit access by itself and others to soil within the Right-of-Way exceeding Tier 1 residential remediation objectives. Access shall be allowed only if human health (including worker safety) and the environment are protected during and after any access. The Highway Authority may construct, reconstruct, improve, repair, maintain and operate a highway upon the Right-of-Way, or allow others to do the same by permit. In addition, the Highway Authority and others using or working in the Right-of-Way under permit have the right to remove soil or groundwater from the Right-of-Way and dispose of the same in accordance with applicable environmental laws and regulations. The Highway Authority agrees to issue all permits for work in the

Right-of-Way, and make all existing permits for work in the Right-of-Way, subject to the following or a substantially similar condition:

As a condition of this permit the permittee shall request the office issuing this permit to identify sites in the Right-of-Way where a Highway Authority Agreement governs access to soil that exceeds the Tier 1 residential remediation objectives of 35 Ill. Adm. Code 742. The permittee shall take all measures necessary to protect human health (including worker safety) and the environment during and after any access to such soil.

10. This agreement shall be referenced in the Agency's no further remediation determination issued for the Release(s).

11. The Agency shall be notified of any transfer of jurisdiction over the Right-of-Way at least 30 days prior to the date the transfer takes effect. This agreement shall be null and void upon the transfer unless the transferee agrees to be bound by this agreement as if the transferee were an original party to this agreement. The transferee's agreement to be bound by the terms of this agreement shall be memorialized at the time of transfer in a writing ("Rider") that references this Highway Authority Agreement and is signed by the Highway Authority, or subsequent transferor, and the transferee.

12. This agreement shall become effective on the date the Agency issues a no further remediation determination for the Release(s). It shall remain effective until the Right-of-Way is demonstrated to be suitable for unrestricted use and the Agency issues a new no further remediation determination to reflect there is no longer a need for this agreement, or until the agreement is otherwise terminated or voided.

13. In addition to any other remedies that may be available, the Agency may bring suit to enforce the terms of this agreement or may, in its sole discretion, declare this agreement null and void if any of the Parties or any transferee violates any term of this agreement. The Parties or transferee shall be notified in writing of any such declaration.

14. This agreement shall be null and void if a court of competent jurisdiction strikes down any part or provision of the agreement.

15. This agreement supersedes any prior written or oral agreements or understandings between the Parties on the subject matter addressed herein. It may be altered, modified or amended only upon the written consent and agreement of the Parties.

16. Any notices or other correspondence regarding this agreement shall be sent to the Parties at following addresses:

Manager, Division of Remediation Management
Bureau of Land
Illinois Environmental Protection Agency

Property Owner or Owner/Operator
[*Address*]

P.O. Box 19276
Springfield, IL 62974-9276

[Contact at Highway Authority]

[Address]

IN WITNESS WHEREOF, the Parties have caused this agreement to be signed by their duly authorized representatives.

[NAME OF LOCAL GOVERNMENT]

Date: _____ By: _____

Its: _____

Property Owner or Owner/Operator

Date: _____ By: _____

Title

(Source: Added at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX E Highway Authority Agreement Memorandum of Agreement

HIGHWAY AUTHORITY AGREEMENT MEMORANDUM OF AGREEMENT

This Memorandum of Agreement is entered by and between the Illinois Environmental Protection Agency ("Agency") and *Name of Local Government* ("Highway Authority"), collectively known as the "Parties."

[Use this paragraph for sites with petroleum leaking underground storage tank(s)]
WHEREAS, the Highway Authority is the owner or operator of one or more leaking underground storage tanks presently or formerly located at *common address or description of Site location* ("the Site");

[Use this paragraph for sites where the highway authority is also the property owner]
WHEREAS, the Highway Authority is the owner of the property located at *common address or description of Site location* ("the Site");

WHEREAS, as a result of one or more releases of contaminants [*insert either "from the above referenced underground storage tanks" or "at the above referenced Site"*] ("the Release(s)"), soil and/or groundwater contamination at the Site exceeds the Tier 1 residential remediation objectives of 35 Ill. Adm. Code 742;

WHEREAS, the soil and/or groundwater contamination exceeding Tier 1 residential remediation objectives extends or may extend into the Highway Authority's right-of-way adjacent to the Site;

WHEREAS, the Highway Authority is conducting corrective action in response to the Release(s);

WHEREAS, the Parties desire to prevent groundwater beneath the Highway Authority's right-of-way that exceeds Tier 1 residential remediation objectives from use as a supply of potable or domestic water and to limit access to soil within the right-of-way that exceeds Tier 1 residential remediation objectives so that human health and the environment are protected during and after any access;

NOW, THEREFORE, the Parties agree as follows:

1. The recitals set forth above are incorporated by reference as if fully set forth herein.

2. [Use this paragraph if IEMA has issued an incident number] The Illinois Emergency Management Agency has assigned incident number(s) to the Release(s).

3. Attached as Exhibit A is a scaled map(s) prepared by the Highway Authority that shows the Site and surrounding area and delineates the current and estimated future extent of soil and groundwater contamination above the applicable Tier 1 residential remediation objectives as a result of the Release(s). [Use the following sentence if either soil or groundwater is not contaminated above applicable Tier 1 residential remediation objectives: [Soil] [Groundwater] is not contaminated above the applicable Tier 1 residential remediation objectives.]

4. Attached as Exhibit B is a table(s) prepared by the Highway Authority that lists each contaminant of concern that exceeds its Tier 1 residential remediation objective, its Tier 1 residential remediation objective and its concentrations within the zone where Tier 1 residential remediation objectives are exceeded. The locations of the concentrations listed in Exhibit B are identified on the map(s) in Exhibit A.

5. Attached as Exhibit C is a scaled map prepared by the Highway Authority showing the area of the Highway Authority's right-of-way that is governed by this agreement ("Right-of-Way"). Because Exhibit C is not a surveyed plat, the Right-of-Way boundary may be an approximation of the actual Right-of-Way lines.

6. *[Use this paragraph if samples have not been collected within the Right-of-Way, sampling within the Right-of-Way is not practical, and contamination does not extend beyond the Right-of-Way].* Because the collection of samples within the Right-of-Way is not practical, the Parties stipulate that, based on modeling, soil and groundwater contamination exceeding Tier 1 residential remediation objectives does not and will not extend beyond the boundaries of the Right-of-Way.

7. The Highway Authority stipulates it has jurisdiction over the Right-of-Way that gives it sole control over the use of the groundwater and access to the soil located within or beneath the Right-of-Way.

8. The Highway Authority agrees to prohibit within the Right-of-Way all potable and domestic uses of groundwater exceeding Tier 1 residential remediation objectives.

9. The Highway Authority further agrees to limit access by itself and others to soil within the Right-of-Way exceeding Tier 1 residential remediation objectives. Access shall be allowed only if human health (including worker safety) and the environment are protected during and after any access. The Highway Authority may construct, reconstruct, improve, repair, maintain and operate a highway upon the Right-of-Way, or allow others to do the same by permit. In addition, the Highway Authority and others using or working in the Right-of-Way under permit have the right to remove soil or groundwater from the Right-of-Way and dispose of the same in accordance with applicable environmental laws and regulations. The Highway Authority agrees to issue all permits for work in the

Right-of-Way, and make all existing permits for work in the Right-of-Way, subject to the following or a substantially similar condition:

As a condition of this permit the permittee shall request the office issuing this permit to identify sites in the Right-of-Way where a Highway Authority Memorandum of Agreement governs access to soil that exceeds the Tier 1 residential remediation objectives of 35 Ill. Adm. Code 742. The permittee shall take all measures necessary to protect human health (including worker safety) and the environment during and after any access to such soil.

10. This agreement shall be referenced in the Agency's no further remediation determination issued for the Release(s).

11. The Agency shall be notified of any transfer of jurisdiction over the Right-of-Way at least 30 days prior to the date the transfer takes effect. This agreement shall be null and void upon the transfer unless the transferee agrees to be bound by this agreement as if the transferee were an original party to this agreement. The transferee's agreement to be bound by the terms of this agreement shall be memorialized at the time of transfer in a writing ("Rider") that references this Highway Authority Memorandum of Agreement and is signed by the Highway Authority, or subsequent transferor, and the transferee.

12. This agreement shall become effective on the date the Agency issues a no further remediation determination for the Release(s). It shall remain effective until the Right-of-Way is demonstrated to be suitable for unrestricted use and the Agency issues a new no further remediation determination to reflect there is no longer a need for this agreement, or until the agreement is otherwise terminated or voided.

13. In addition to any other remedies that may be available, the Agency may bring suit to enforce the terms of this agreement or may, in its sole discretion, declare this agreement null and void if the Highway Authority or a transferee violates any term of this agreement. The Highway Authority or transferee shall be notified in writing of any such declaration.

14. This agreement shall be null and void if a court of competent jurisdiction strikes down any part or provision of the agreement.

15. This agreement supersedes any prior written or oral agreements or understandings between the Parties on the subject matter addressed herein. It may be altered, modified or amended only upon the written consent and agreement of the Parties.

16. Any notices or other correspondence regarding this agreement shall be sent to the Parties at following addresses:

Manager, Division of Remediation Management
Bureau of Land
Illinois Environmental Protection Agency

P.O. Box 19276
Springfield, IL 62974-9276

[Contact at Highway Authority]

[Address]

IN WITNESS WHEREOF, the Parties have caused this agreement to be signed by their duly authorized representatives.

[NAME OF LOCAL GOVERNMENT]

Date: _____ By: _____

Its: _____

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

Date: _____ By: _____

Director

(Source: Added at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX F: Environmental Land Use Control

PREPARED BY:

Name: _____

_____

Address: _____

RETURN TO:

Name: _____

_____

Address: _____

THE ABOVE SPACE FOR RECORDER'S OFFICE

Model Environmental Land Use Control

THIS ENVIRONMENTAL LAND USE CONTROL ("ELUC"), is made this _____ day of _____, 20__, by _____, ("Property Owner") of the real property located at the common address_____("Property").

WHEREAS, 415 ILCS 5/58.17 and 35 Ill. Adm. Code 742 provide for the use of an ELUC as an institutional control in order to impose land use limitations or requirements related to environmental contamination so that persons conducting remediation can obtain a No Further Remediation determination from the Illinois Environmental Protection Agency ("IEPA"). The reason for an ELUC is to ensure protection of human health and the environment. The limitations and requirements contained herein are necessary in order to protect against exposure to contaminated soil, groundwater, or soil gas that may be present on the property as a result of [**VARIABLE**] activities. Under 35 Ill. Adm. Code 742, the use of risk-based, site-specific remediation objectives may require the use of an ELUC on real property, and the ELUC may apply to certain physical features (e.g., engineered barriers, indoor inhalation building control technologies, monitoring wells, caps, etc.).

WHEREAS, _____ [**the party performing remediation**] intends to request risk-based, site specific soil, groundwater, or soil gas remediation objectives from IEPA under 35 Ill. Adm. Code 742 to obtain risk-based closure of the site, identified by Bureau of Land [**10-digit LPC or Identification number**] _____ , utilizing an ELUC.

NOW, THEREFORE, the recitals set forth above are incorporated by reference as if fully

set forth herein, and the Property Owner agrees as follows:
Date: _____By:_____

Director

Section One. Property Owner does hereby establish an ELUC on the real estate, situated in the County of _____, State of Illinois and further described in Exhibit A attached hereto and incorporated herein by reference (the "Property").

Attached as Exhibit B are site maps that show the legal boundary of the Property, any physical features to which the ELUC applies, the horizontal and vertical extent of the contaminants of concern above the applicable remediation objectives for soil, groundwater, or soil gas, and the nature, location of the source, and direction of movement of the contaminants of concern, as required under 35 Ill. Adm. Code 742.

Section Two. Property Owner represents and warrants **he/she** is the current owner of the Property and has the authority to record this ELUC on the chain of title for the Property with the Office of the Recorder or Registrar of Titles in _____ County, Illinois.

Section Three. The Property Owner hereby agrees, for **himself/herself**, and **his/her** heirs, grantees, successors, assigns, transferees and any other owner, occupant, lessee, possessor or user of the Property or the holder of any portion thereof or interest therein, that [**INSERT RESTRICTION (e.g. the groundwater under the Property shall not be used as a potable supply of water, and any contaminated groundwater or soil that is removed, excavated, or disturbed from the Property described in Exhibit A herein must be handled in accordance with all applicable laws and regulations**)].

Section Four. This ELUC is binding on the Property Owner, **his/her** heirs, grantees, successors, assigns, transferees and any other owner, occupant, lessee, possessor or user of the Property or the holder of any portion thereof or interest therein. This ELUC shall apply in perpetuity against the Property and shall not be released until the IEPA determines there is no longer a need for this ELUC as an institutional control; until the IEPA, upon written request, issues to the site that received the no further remediation determination a new no further remediation determination approving modification or removal of the limitation(s) or requirement(s); the new no further remediation determination is filed on the chain of title of the site subject to the no further remediation determination; and until a release or modification of the land use limitation or requirement is filed on the chain of title for the Property.

Section Five. Information regarding the remediation performed on the Property may be obtained from the IEPA through a request under the Freedom of Information Act (5 ILCS 140) and rules promulgated thereunder by providing the IEPA with the [10-digit LPC or identification number] listed above.

Section Six. The effective date of this ELUC shall be the date that it is officially recorded in the chain of title for the Property to which the ELUC applies.

WITNESS the following signatures:

Property Owner(s)

By:_____

Its: _____

Date: _____

STATE OF ILLINOIS)
) SS:
COUNTY OF)

I, _____the undersigned, a Notary Public for said County and State, DO HEREBY CERTIFY, that _____ and _____, personally known to me to be the Property Owner(s) of _____, and personally known to me to be the same persons whose names are subscribed to the foregoing instrument, appeared before me this day in person and severally acknowledged that in said capacities they signed and delivered the said instrument as their free and voluntary act for the uses and purposes therein set forth.

Given under my hand and official seal, this _____ day of _____, 20__.

Notary Public

STATE OF _____)
) S.S.
COUNTY OF _____)

I, _____, a notary public, do hereby certify that before me this day in person appeared _____, personally known to me to be the Property Owner(s), of _____, each severally acknowledged that they signed and delivered the foregoing instrument as the Property Owner(s) herein set forth, and as their own free and voluntary act, for the uses and purposes herein set forth.

Given under my hand and seal this _____ day of _____, 20__.

Notary Public

PIN NO. XX-XX-XXX-XXX-XXXX
(Parcel Index Number)

Exhibit A

The subject property is located in the City of _____, _____ County, State of Illinois, commonly known as _____, _____, Illinois and more particularly described as:

LIST THE COMMON ADDRESS;
LEGAL DESCRIPTION; AND
REAL ESTATE TAX INDEX OR PARCEL #
(PURSUANT TO SECTION 742. 1010(d)(2))

PIN NO. XX-XX-XXX-XXX-XXXX

Exhibit B

IN ACCORDANCE WITH SECTION 742.1010(d)(8)(A) through (D), PROVIDE ALL THE FOLLOWING ELEMENTS. ATTACH SEPARATE SHEETS, LABELED AS EXHIBIT B, WHERE NECESSARY.

(A) A scaled map showing the legal boundary of the property to which the ELUC applies.

(B) Scaled maps showing the horizontal and vertical extent of contaminants of concern above the applicable remediation objectives for soil, groundwater, and soil gas to which the ELUC applies.

(C) Scaled maps showing the physical features to which an ELUC applies (e.g., engineered barriers, indoor inhalation building control technologies, monitoring wells, caps, etc.).

(D) Scaled maps showing the nature, location of the source, and direction of movement of the contaminants of concern.

(Source: Amended at 37 Ill. Reg. 7506, effective July 15, 2013)

Section 742.APPENDIX G Model Ordinance

ORDINANCE NUMBER _____

AN ORDINANCE PROHIBITING THE USE OF GROUNDWATER AS A POTABLE WATER SUPPLY BY THE INSTALLATION OR USE OF POTABLE WATER SUPPLY WELLS OR BY ANY OTHER METHOD

WHEREAS, certain properties in the City [Village] of _____, Illinois have been used over a period of time for commercial/industrial purposes; and

WHEREAS, because of said use, concentrations of certain chemical constituents in the groundwater beneath the City [Village] may exceed Class I groundwater quality standards for potable resource groundwater as set forth in 35 Illinois Administrative Code 620 or Tier 1 remediation objectives as set forth in 35 Illinois Administrative Code 742; and

WHEREAS, the City [Village] of _____ desires to limit potential threats to human health from groundwater contamination while facilitating the redevelopment and productive use of properties that are the source of said chemical constituents;

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY [VILLAGE] OF _____, ILLINOIS:

Section One. Use of groundwater as a potable water supply prohibited.

[Except for such uses or methods in existence before the effective date of this ordinance,] The use or attempt to use as a potable water supply groundwater from within the corporate limits of the City [Village] of _____, as a potable water supply, by the installation or drilling of wells or by any other method is hereby prohibited. This prohibition [expressly includes] [does not include] the City [Village] of _____.

Section Two. Penalties.

Any person violating the provisions of this ordinance shall be subject to a fine of up to _____ for each violation.

Section Three. Definitions.

"Person" is any individual, partnership, co-partnership, firm, company, limited liability company, corporation, association, joint stock company, trust, estate, political subdivision, or any other legal entity, or their legal representatives, agents or assigns.

"Potable water" is any water used for human or domestic consumption, including, but not limited to, water used for drinking, bathing, swimming, washing dishes, or preparing foods.

Section Four. Memorandum of Understanding.

'[This Section is only necessary if ordinance does not expressly prohibit installation of potable water supply wells by the city or village--could be separate resolution]

The Mayor of the City [Village] of _____ is hereby authorized and directed to enter into a Memorandum of Understanding with the Illinois Environmental Protection Agency ("Illinois EPA") in which the City [Village] of _____ assumes responsibility for tracking all sites that have received no further remediation determinations from the Illinois EPA, notifying the Illinois EPA of changes to this ordinance, and taking certain precautions when siting public potable water supply wells.

Section Five. Repealer.

All ordinances or parts of ordinances in conflict with this ordinance are hereby repealed insofar as they are in conflict with this ordinance.

Section Six. Severability.

If any provision of this ordinance or its application to any person or under any circumstances is adjudged invalid, such adjudication shall not affect the validity of the ordinance as a whole or of any portion not adjudged invalid.

Section Seven. Effective date.

This ordinance shall be in full force and effect from and after its passage, approval and publication as required by law.

ADOPTED: _____ APPROVED: _____
(Date) (Date)

_____ _____
(City Clerk) (Mayor)

Officially published this _____ day of _____, 20___.

(Source: Added at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX H Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING BETWEEN _____
AND THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY REGARDING THE USE OF A LOCAL GROUNDWATER OR WATER WELL ORDINANCE AS AN ENVIRONMENTAL INSTITUTIONAL CONTROL

I. PURPOSE AND INTENT

A. This Memorandum of Understanding ("MOU") between _____ and the Illinois Environmental Protection Agency ("Illinois EPA") is entered into for the purpose of satisfying the requirements of 35 Ill. Adm. Code 742.1015 for the use of groundwater or water well ordinances as environmental institutional controls. The Illinois EPA has reviewed the groundwater or water well ordinance of _____ (Attachment A) and determined that the ordinance prohibits the use of groundwater for potable purposes and/or the installation and use of new potable water supply wells by private entities but does not expressly prohibit those activities by the unit of local government itself. In such cases, 35 Ill. Adm. Code 742.1015(a) provides that the unit of local government may enter into an MOU with the Illinois EPA to allow the use of the ordinance as an institutional control.

B. The intent of this Memorandum of Understanding is to specify the responsibilities that must be assumed by the unit of local government to satisfy the requirements for MOUs as set forth at 35 Ill. Adm. Code 742.1015(i).

II. DECLARATIONS AND ASSUMPTION OF RESPONSIBILITY

In order to ensure the long-term integrity of the groundwater or water well ordinance as an environmental institutional control and that risk to human health and the environment from contamination left in place in reliance on the groundwater or water well ordinance is effectively managed, _____ hereby assumes the following responsibilities pursuant to 35 Ill. Adm. Code 742.1015(d)(2) and (i):

A. _____ will notify the Illinois EPA Bureau of Land of any proposed ordinance changes or requests for variance at least 30 days prior to the date the local government is scheduled to take action on the proposed change or request (35 Ill. Adm. Code 742.1015(i)(4));

B. _____ will maintain a registry of all sites within its corporate limits that have received "No Further Remediation" determinations in reliance on the ordinance from the Illinois EPA (35 Ill. Adm. Code 742.1015(i)(5));

C. _____ will review the registry of sites established under paragraph II. B. prior to siting public potable water supply wells within the area covered by the ordinance (35 Ill. Adm. Code 742.1015(i)(6)(A));

D. _____ will determine whether the potential source of potable water has been or may be affected by contamination left in place at the sites tracked and reviewed under paragraphs II. B. and C. (35 Ill. Adm. Code 742.1015(i)(6)(B)); and

E. _____ will take action as necessary to ensure that the potential source of potable water is protected from contamination or treated before it is used as a potable water supply (35 Ill. Adm. Code 742.1015(i)(6)(C)).

NOTE: Notification under paragraph II. A. above or other communications concerning this MOU should be directed to:

Manager, Division of Remediation Management
Bureau of Land
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, IL 62794-9276

III. SUPPORTING DOCUMENTATION

The following documentation is required by 35 Ill. Adm. Code 742.1015(i) and is attached to this MOU:

A. Attachment A: A copy of the groundwater or water well ordinance certified by the city clerk or other official as the current, controlling law (35 Ill. Adm. Code 742.1015(i)(3));

B. Attachment B: Identification of the legal boundaries within which the ordinance is applicable (certification by city clerk or other official that the ordinance is applicable everywhere within the corporate limits; if ordinance is not applicable throughout the entire city or village, legal description and map of area showing sufficient detail to determine where ordinance is applicable) (35 Ill. Adm. Code 742.1015(i)(2));

C. Attachment C: A statement of the authority of the unit of local government to enter into the MOU (council resolution, code of ordinances, inherent powers of mayor or other official signing MOU -- attach copies) (35 Ill. Adm. Code 742.1015(i)(1)).

IN WITNESS WHEREOF, the lawful representatives of the parties have caused this MOU to be signed as follows:

FOR: _____
(Name of city or village)

BY: _____ DATE: _____
(Name and title of signatory)

FOR: Illinois Environmental Protection Agency

BY: _____ DATE: _____
Manager, Division of Remediation Management
Bureau of Land

(Source: Added at 31 Ill. Reg. 4063, effective February 23, 2007)

Chemicals not in TACO Tier I Tables

The Excel spreadsheet presented below includes objectives for chemicals not contained in the TACO Tier I tables. These objectives are for convenience only and are not TACO Tier I objectives. Section 742.510 c) of the TACO regulations allow a person to request site-specific remediation objectives from the Agency for chemicals not included in the TACO Tables. Approval to use these objectives must still be obtained from Illinois EPA on a site specific and program basis.

The development of these objectives is based upon the USEPA's toxicity value hierarchy as specified in OSWER Directive 9285.7-53. USEPA's integrated Risk Information System (IRIS) is the first tier of this hierarchy.

Calculation of the soil remediation objectives was accomplished through use of the risk-based soil screening level (SSL) equations from Section 742.Appendix C, Table A of TACO. Default exposure durations and contact rates from Section 742.Appendix C, Table B of TACO were used in these calculations. Groundwater objectives were established following methodologies presented in the Groundwater Quality Standards, 35 IAC 620. Subpart F.

Non-TACO Objectives

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CHEMICAL NAME	CAS No.	RESIDENTIAL INGESTION	RESIDENTIAL INHALATION	I/C INGESTION	I/C INHALATION	CONST. WORKER INGESTION	CONST. WORKER INHALATION	MIGRATION TO CLASS 1 GW	MIGRATION TO CLASS 2 GW
ACENAPHTHYLENE	208-96-8	2300(a)	(c)	61000(a)	(c)	61000(a)	(c)	85(a)	420
ACETALDEHYDE (e)	75-07-0	(c)	9.9(b,i)	(c)	19(b)	(c)	8.6(a)	(c,h)	(c,h)
ACETOCHLOR (e,g)	34256-82-1	1600(a)	(c)	41000(a)	(c)	4100(a)	(c)	5.9(a)	30
ACROLEIN (e)	107-02-8	39(a)	0.17(a,i)	1000(a)	0.26(a)	820(a)	0.008(a)	0.014(a)	0.014
ACRYLIC ACID (e)	79-10-7	39000(a)	140(a,i)	1000000(a)	230(a)	41000(a)	0.3(a)	14(a)	14
ACRYLONITRILE (e)	107-13-1	1.2(b)	0.29(b,i)	11(b)	0.56(b)	230(b)	0.17(a)	0.0006(b)	0.0006
ALLYL ALCOHOL (e)	107-18-6	390(a)	3.6(a,i)	10000(a)	5.8(a)	820(a)	0.37(a)	0.14(a)	0.14
ALUMINUM	7429-90-5	78000(a)	1000000(a,i)	1000000(a)	1000000(a)	200000(a)	870000(a)	3.5 mg/l (TCLP or SPLP)	5.0 mg/l (TCLP or SPLP)
ANILINE (e)	62-53-3	110(b)	83(a,i)	1000(b)	130(a)	1400(a)	8.6(a)	0.064(b)	0.064
BENTAZON (g)	25057-89-0	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	2.5(a)	2.5
BENZALDEHYDE (e)	100-52-7	7800(a)	(c)	200000(a)	(c)	200000(a)	(c)	3.3(a)	3.3
BENZIDINE	92-87-5	0.003(b)	0.009(b,i)	0.02(b)	0.02(b)	0.54(b)	0.02(b)	0.000002(b)	0.000002
BENZO(g,h,i,)PERYLENE	191-24-2	2300(a)	(c)	61000(a)	(c)	61000(a)	(c)	27000(a)	130000
BENZYL ALCOHOL (e)	100-51-6	7800(a)	(c)	200000(a)	(c)	61000(a)	(c)	3(a)	3
BIDRIN (e,g)	141-66-2	7.8(a)	(c)	200(a)	(c)	20(a)	(c)	0.0028(a)	0.0028
1,1-BIPHENYL	92-52-4	3900(a)	(c)	100000(a)	(c)	20000(a)	(c)	150(a)	740
BIS(2-CHLORO-1-METHYLETHYL)ETHER (e)	108-60-1	3100(a)	(c)	82000(a)	(c)	200(a)	(c)	2.4(a)	2.4
BROMOBENZENE (e)	108-86-1	630(a)	630(a,i)	16000(a)	810(d)	4100(a)	22(a)	0.86(a)	4.3
BROMOXYNIL (g)	1689-84-5	1600(a)	(c)	41000(a)	(c)	4100(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
1,3-BUTADIENE (e)	106-99-0	(c)	0.05(b,i)	(c)	0.09(b)	(c)	0.01(a)	(c,h)	(c,h)
2-BUTANONE (MEK) (e)	78-93-3	47000(a)	25000(d,i)	1000000(a)	25000(d,i)	120000(a)	730(a)	17(a)	17
BUTYLATE (e,g)	2008-41-5	3900(a)	(c)	100000(a)	(c)	10000(a)	(c)	170(a)	850
n-BUTYLBENZENE (e)	104-51-8	3900(a)	(c)	100000(a)	(c)	20000(a)	(c)	52(a)	87(d)
CAPROLACTAM	105-60-2	39000(a)	(c)	1000000(a)	(c)	100000(a)	(c)	14(a)	14
CAPTAN (g)	133-06-2	10000(a)	(c)	270000(a)	(c)	27000(a)	(c)	11(a)	11
CARBARYL (g)	63-25-2	7800(a)	(c)	200000(a)	(c)	20000(a)	(c)	8.7(a)	8.7
CARBOXIN (g)	5234-68-4	7800(a)	(c)	200000(a)	(c)	20000(a)	(c)	6.3(a)	6.3
CHLORAMBEN (g)	133-90-4	1200(a)	(c)	31000(a)	(c)	3100(a)	(c)	0.47(a)	0.47
CHLORFENVINPHOS (e)	470-90-6	55(a)	(c)	1400(a)	(c)	410(a)	(c)	1.1(a)	5.6
1-CHLOROBUTANE (e)	109-69-3	3100(a)	(c)	82000(a)	(c)	14000(a)	(c)	3.1(a)	16
CHLOROETHANE (e)	75-00-3	(c)	1500(d,i)	(c)	1500(d)	20000(a)	39(a)	(c,h)	(c,h)
CHLOROMETHANE (e)	74-87-3	(c)	110(a,i)	(c)	180(a)	(c)	5(a)	(c,h)	(c,h)
2-CHLORONAPHTHALENE	91-58-7	6300(a)	(c)	160000(a)	(c)	41000(a)	(c)	49(a)	240
o-CHLOROTOLUENE (e)	95-49-8	1600(a)	(c)	41000(a)	(c)	4100(a)	150(a)	4(a)	20
CHLORPYRIFOS (g)	2921-88-2	78(a)	(c)	2000(a)	(c)	610(a)	(c)	29(a)	150
CHLORPYRIFOS METHYL (g)	5598-13-0	780(a)	(c)	20000(a)	(c)	2000(a)	(c)	49(a)	240
CYANAZINE (g)	21725-46-2	160(a)	(c)	4100(a)	(c)	410(a)	(c)	0.14(a)	0.14
CYCLOHEXANE (e)	110-82-7	(c)	280(d,i)	(c)	280(d)	(c)	280(d)	(c,h)	(c,h)
CYCLOHEXANONE (e)	108-94-1	390000(a)	660(d,i)	1000000(a)	660(d)	410000(a)	660(d)	150(a)	150
2,4-DB (g)	94-82-6	630(a)	(c)	16,000(a)	(c)	16,000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
DIAZINON (g)	333-41-5	55(a)	(c)	1400(a)	(c)	410(a)	400(a)	1.4(a)	7.2
DIBENZOFURAN	132-64-9	78(a)	(c)	2000(a)	(c)	820(a)	(c)	3(a)	15(a)
DICAMBA	1918-00-9	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	0.86(a)	0.86
DICHLORODIFLUOROMETHANE (e)	75-71-8	16000(a)	200(a,i)	410000(a)	310(a)	180000(a)	20(a)	43(a)	220
1,3-DICHLOROPROPANE (e)	142-28-9	1600(a)	(c)	41000(a)	(c)	41000(a)	(c)	0.83(a)	0.83
DICHLORVOS (e)	62-73-7	2.2(b)	0.18(b,i)	20(b)	0.34(b)	430(b)	0.2(b)	0.0014(b)	0.0014
DICYCLOPENTADIENE (e)	77-73-6	630(a)	18(a,i)	16000(a)	29(a)	16000(a)	0.53(a)	1.3(a)	6.6
DIETHANOLAMINE (e)	111-42-2	(c)	490(a,i)	(c)	790(a)	(c)	15(a)	(c)	(c)
DIETHYLENE GLYCOL MONOBUTYL ETHER (e)	112-34-5	2300(a)	23(a,i)	61000(a)	37(a)	61000(a)	2.4(a)	0.91(a)	0.91
DIETHYLENE GLYCOL MONOETHYL ETHER (e)	111-90-0	4700(a)	56(a,i)	120000(a)	89(a)	120000(a)	5.8(a)	1.7(a)	1.7
DIISOPROPYL ETHER (e)	108-20-3	(c)	470(d,i)	(c)	470(d)	(c)	21(a)	(c,h)	(c,h)
DIMETHYL PHTHALATE (e)	131-11-3	(c)	(c)	(c)	(c)	20000(a)	(c)	(c)	(c)
1,3-DINITROBENZENE	75-71-8	7.8(a)	(c)	200(a)	(c)	200(a)	(c)	0.0037(a)	0.0037
4,6-DINITRO-o-CRESOL	534-52-1	6.3(a)	(c)	160(a)	(c)	160(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
p-DIOXANE (e)	123-91-1	58(b)	8.2(b,i)	520(b)	16(b)	11000(b)	22(b)	0.031(b)	0.031
DIPHENYLAMINE	122-39-4	2000(a)	(c)	51000(a)	(c)	4100(a)	(c)	20(a)	100
DISULFOTON (e,g)	298-04-4	3.1(a)	(c)	82(a)	(c)	18(a)	3.9(a)	0.09(a)	0.45
EPTC (e,g)	759-94-4	2000(a)	(c)	51000(a)	(c)	5100(a)	(c)	3.6(a)	18
ETHION (e,g)	563-12-2	39(a)	(c)	1000(a)	(c)	410(a)	(c)	13(a)	67
ETHOXYETHANOL ACETATE (e)	111-15-9	7800(a)	4500(a,i)	200000(a)	7300(a)	200000(a)	47(a)	2.9(a)	2.9
ETHYL ACETATE (e)	141-78-6	70000(a)	(c)	1000000(a)	(c)	1000000(a)	(c)	26(a)	26

ETHYL ACRYLATE (e)	140-88-5	13(b)	(c)	120(b)	(c)	2600(b)	(c)	0.0081(b)	0.0081
ETHYLENE GLYCOL (e)	107-21-1	160000(a)	54000(a,i)	1000000(a)	86000(a)	160000(a)	5600(a)	56(a)	56
ETHYLENE GLYCOL MONBUTYL ETHER (e)	111-76-2	7800(a)	130000(d,i)	200000(a)	130000(d)	20000(a)	2800(a)	2.9(a)	2.9
ETHYLENE THIOUREA	96-45-7	6.3(a)	27(b,i)	130(b)	51(b)	16(a)	72(b)	0.0076(b)	0.0076
ETHYL ETHER (e)	60-29-7	16000(a)	(c)	410000(a)	(c)	100000(a)	110(a)	6.1(a)	6.1
FONOFOS (e,g)	944-22-9	160(a)	(c)	4100(a)	(c)	410(a)	(c)	4.2(a)	21
FORMALDEHYDE (e)	50-00-0	16000(a)	16(b,i)	410000(a)	30(b)	61000(a)	33(a)	5.7(a)	5.7
FURFURAL (e)	98-01-1	230(a)	2700(a,i)	6100(a)	4200(a)	6100(a)	270(a)	0.086(a)	0.086
GLYPHOSATE (g)	1071-83-6	7800(a)	(c)	200000(a)	(c)	20000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
HEXACHLOROBUTADIENE (e)	87-68-3	78(a)	(c)	2000(a)	(c)	200(a)	(c)	2.2(a)	11
HEXANE (e)	110-54-3	4700(a)	290(d,i)	120000(a)	290(d)	61000(a)	16(a)	82(a)	120(d)
2-HEXANONE (e)	591-78-6	390(a)	450(a,i)	10000(a)	720(a)	1000(a)	47(a)	0.16(a)	0.16
HMX	2691-41-0	3900(a)	(c)	100000(a)	(c)	100000(a)	(c)	5.7(a)	5.7
HYDRAZINE (e)	302-01-2	0.21(b)	0.033(b,i)	1.9(b)	0.064(b)	41(b)	0.065(a)	0.0001(b)	0.0001
IMAZAQUIN (g)	81335-37-7	20000(a)	(c)	510000(a)	(c)	51000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
IODINE	7553-56-2	780(a)	(c)	20000(a)	(c)	2000(a)	(c)	0.35 mg/l (TCLP or SPLP)	not available
ISOBUTANOL (e)	78-83-1	23000(a)	(c)	610000(a)	(c)	610000(a)	(c)	8.8(a)	8.8
ISOPROPYBENZENE (cumene)(e)	98-82-8	7800(a)	500(a,i)	200000(a)	800(a)	82000(a)	52(a)	91(a)	400(d)
MALATHION (e,g)	121-75-5	1600(a)	(c)	41000(a)	(c)	4100(a)	170(a)	1.7(a)	1.7
MCPA	94-74-6	39(a)	(c)	1000(a)	(c)	100(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
MCPP	93-65-2	78(a)	(c)	2000(a)	(c)	2000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
METHANOL (e)	67-56-1	39000(a)	100000(d,i)	1000000(a)	100000(d)	1000000(a)	3400(a)	14(a)	14
METHYL ACETATE (e)	79-20-9	78000(a)	(c)	1000000(a)	(c)	1000000(a)	9.2(a)	28(a)	28
METHYL ACRYLATE (e)	96-33-3	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	0.88(a)	0.88
4,4'-METHYLENEBIS(2-CHLOROANILINE)	101-14-4	6.4(b)	(c)	57(b)	(c)	410(a)	(c)	0.25(b)	1.3
METHYLENE BROMIDE (e)	74-95-3	(c)	28(a,i)	(c)	44(a)	1800(a)	2.8(a)	(c)	(c)
4,4'-METHYLENEDIANILINE	101-77-9	0.4(b)	1.5(b,i)	3.6(b)	2.9(b)	78(b)	4.0(b)	0.00026(b)	0.00026
METHYLISOBUTYLKETONE (e)	108-10-1	6300(a)	3100(d,i)	160000(a)	3100(d)	160000(a)	340(a)	2.5(a)	2.5
1-METHYLNAPHTHALENE (e)	90-12-0	5500(a)	(c)	140000(a)	(c)	14000(a)	(c)	130(a)	330(d)
2-METHYLNAPHTHALENE	93-65-2	310(a)	(c)	8200(a)	(c)	820(a)	(c)	1.9(a)	9.5
3-METHYLPHENOL (e)	108-39-4	3900(a)	8100(d,i)	100000(a)	8100(d)	20000(a)	3200(a)	2(a)	2
4-METHYLPHENOL	106-44-5	7800(a)	100000(a,i)	200000(a)	170000(a)	4100(a)	3300(a)	3.9(a)	3.9
METOLACHLOR (e,g)	51218-45-2	12000(a)	(c)	310000(a)	(c)	31000(a)	(c)	55(a)	270
METRIBUZIN(g)	21087-64-9	2000(a)	(c)	51000(a)	(c)	5100(b)	(c)	1(b)	1
MOLYBDENUM	7439-98-7	390(a)	(c)	10000(a)	(c)	1000(a)	(c)	0.035 mg/l (TCLP or SPLP)	0.035 mg/l (TCLP or SPLP)
2-NITROANILINE	88-74-4	1200(a)	18(a,i)	31000(a)	28(a)	31000(a)	1.5(a)	0.7(a)	0.7
3-NITROANILINE	99-09-2	(c)	(c)	(c)	(c)	200(a)	(c)	(c)	(c)
4-NITROANILINE	100-01-6	310(a)	1500(a,i)	8200(a)	2400(a)	2000(a)	52(a)	0.14(a)	0.14
NITROGLYCERINE (e)	55-63-0	7.8(a)	(c)	200(a)	(c)	20(a)	(c)	0.028(b)	0.028
n-NITROSODIMETHYLAMINE (e)	62-75-9	0.013(b)	0.012(b,i)	0.11(b)	0.023(b)	1.6(a)	2	0.000007(b)	0.000007
2-NITROTOLUENE (e)	88-72-2	2.9(b)	(c)	26(b)	(c)	560(b)	(c)	0.0028(b)	0.0028
3-NITROTOLUENE (e)	99-08-1	7.8(a)	(c)	200(a)	(c)	200(a)	(c)	0.0057(a)	0.0057
4-NITROTOLUENE	99-99-0	40(b)	(c)	360(b)	(c)	820(a)	(c)	0.067(b)	0.067
PARAQUAT DICHLORIDE (g)	1910-42-5	350(a)	(c)	9200(a)	(c)	920(a)	(c)	0.13(a)	0.13
PARATHION-ETHYL (e,g)	56-38-2	470(a)	(c)	12000(a)	(c)	1200(a)	(c)	40(a)	78(d)
PARATHION-METHYL (g)	298-00-0	20(a)	(c)	510(a)	(c)	140(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
PENDIMETHALIN (g)	40487-42-1	3100(a)	(c)	82000(a)	(c)	8200(a)	(c)	1400(a)	6900
PENTACHLORONITROBENZENE	82-68-8	230(a)	(c)	6100(a)	(c)	610(a)	(c)	31(a)	150
PENTAERYTHRITOL TETRANITRATE (PETN)	78-11-5	160(a)	(c)	4000(a)	(c)	410(a)	(c)	0.18(a)	0.18(a)
PERCHLORATE	14797-73-0	55(a)	(c)	1400(a)	(c)	140(a)		0.0049 mg/l(TCLP or SPLP)	0.0049 mg/l(TCLP or SPLP)
PHENANTHRENE	85-01-8	2300(a)	(c)	61000(a)	(c)	61000(a)	(c)	210(a)	1100
PHORATE (e,g)	298-02-2	16(a)	(c)	410(a)	(c)	41(a)	(c)	0.11(a)	0.55
PROMETON (g)	1610-18-0	1200(a)	(c)	31000(a)	(c)	31000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
n-PROPYLBENZENE (e)	103-65-1	7800(a)	300(d,i)	200000(a)	300(d)	20000(a)	91(a)	31(a)	120(d)
PROPYLENE GLYCOL (e)	57-55-6	1000000(a)	(c)	1000000(a)	(c)	1000000(a)	49(a)	560(a)	560
PROPYLENE GLYCOL DINITRATE	6423-43-4	(c)	54(a,i)	(c)	87(a)	(c)	0.56(a)	(c)	(c)
PROPYLENE GLYCOL MONOMETHYL ETHER (e)	107-98-2	55000(a)	100000(d,i)	1000000(a)	100000(d)	1000000(a)	34000(a)	20(a)	20
PYRIDINE (e)	110-86-1	78(a)	(c)	2000(a)	(c)	2000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet
RDX	121-82-4	230(a)	(c)	6100(a)	(c)	610(a)	(c)	0.36(a)	0.36
STRONTIUM	7440-24-6	47000(a)	(c)	1000000(a)	(c)	410000(a)	(c)	4.2 mg/l (TCLP or SPLP)	not available
TEBUTHIURON (g)	34014-18-1	5500(a)	(c)	140000(a)	(c)	14000(a)	(c)	3.1(a)	3.1
TERBUFOS (e,g)	13071-79-9	2(a)	(c)	51(a)	(c)	5.1(a)	(c)	0.031(a)	0.15

1,1,1,2-TETRACHLOROETHANE (e)	630-20-6	2300(a)	(c)	61000(a)	(c)	18000(a)	(c)	3.4(a)	17
1,1,2,2-TETRACHLOROETHANE (e)	79-34-5	3.2(b)	0.62(b,i)	27(b)	1.2(b)	620(b)	1.7(b)	0.0035(b)	0.0035
TETRACHLOROVINPHOS	961-11-5	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	26(a)	130
THIRAM (g)	137-26-8	390(a)	(c)	10000(a)	(c)	1200(a)	(c)	0.21(a)	0.21
TIN	7440-31-5	47000(a)	(c)	1000000(a)	(c)	61000(a)	(c)	4.2 mg/l (TCLP or SPLP)	not available
2,4,6-TRIBROMOPHENOL	118-79-6	(c)	(c)	(c)	(c)	18000(a)	(c)	(c)	(c)
1,2,3-TRICHLOROBENZENE	87-61-6	63(a)	(c)	1600(a)	(c)	1600(a)	(c)	0.46(a)	2.3
TRICHLOROFLUOROMETHANE (e)	75-69-4	23000(a)	870(a,i)	610000(a)	1400(a)	140000(a)	13(a)	34(a)	170
2,4,5-TRICHLOROPHENOXYACETIC ACID (g)	93-76-5	780(a)	(c)	20000(a)	(c)	20000(a)	(c)	5.2 (a)	26
1,2,3-TRICHLOROPROPANE (e)	96-18-4	0.021(b)	3.2(a,i)	0.19(b)	5.0(a)	4.1(b)	0.32(a)	0.000017(b)	0.000017
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (e)	76-13-1	1000000(a)	1000(d,i)	1000000(a)	1000(d)	610000(a)	350(a)	450(d)	450(d)
TRIFLURALIN (g)	1582-09-8	590(a)	(c)	15000(a)	(c)	1500(a)	(c)	420(a)	2100
1,2,3-TRIMETHYLBENZENE (e)	526-73-8	(c)	66(a,i)	(c)	110(a)	(c)	6.9(a)	(c)	(c)
1,2,4-TRIMETHYLBENZENE (e)	95-63-6	(c)	87(a,i)	(c)	140(a)	(c)	8.9(a)	(c,h)	(c,h)
1,3,5-TRIMETHYLBENZENE (e)	108-67-8	780(a)	(c)	20000(a)	(c)	20000(a)	0.79(a)	2.0(a)	10
1,3,5-TRINITROBENZENE	99-35-4	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	3.9	3.9
2,4,6-TRINITROTOLUENE	118-96-7	39(a)	(c)	1000(a)	(c)	310(a)	(c)	0.077	0.077
2,4,6-TRINITROPHENYLMETHYLNITRAMINE (TETRYL)	479-45-8	310(a)	(c)	8200(a)	(c)	2000(a)	(c)	0.62(a)	0.62

NOTE: ALL CONCENTRATIONS IN MG/KG

(a) Calculated using a target hazard quotient of 1
(b) Calculated using a cancer risk level of 1 in 1,000,000
(c) No toxicity criteria for this route of exposure
(d) Soil Saturation Concentration
(e) See workbook page for soil saturation concentration
(f) For soils contaminated with secondary explosives where no chunks of aggregated or precipitated material are present
(g) For agrichemical facilities, surface soil objectives based on field application rates may be more appropriate for currently registered pesticides.
(h) Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact the Toxicity Assessment Unit for assistance in evaluating this pathway.
(i) The remediation objectives for this receptor must also include the Construction Worker inhalation objective.

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CHEMICAL NAME	CAS No.	CLASS 1 GW	CLASS 2 GW
ACENAPHTHYLENE	208-96-8	0.21	1.05
ACETALDEHYDE	75-07-0	not available	not available
ACETOCHLOR	34256-82-1	0.14	0.7
ACROLEIN	107-02-8	0.0035	0.0035
ACRYLIC ACID	79-10-7	3.5	3.5
ACRYLONITRILE	107-13-1	0.001	0.001
ALLYL ALCOHOL	107-18-6	0.035	0.035
ALUMINUM	7429-90-5	3.5	5
ANILINE	62-53-3	0.023	0.023
BENTAZON	25057-89-0	0.21	0.21
BENZALDEHYDE	100-52-7	0.7	0.7
BENZIDINE	92-87-5	0.00000037	0.00000037
BENZO(g,h,i,)PERYLENE	191-24-2	0.21	1.05
BENZYL ALCOHOL	100-51-6	0.7	0.7
BIDRIN	141-66-2	0.0007	0.0007
1,1-BIPHENYL	92-52-4	0.35	1.75
BIS(2-CHLORO-1-METHYLETHYL)ETHER	108-60-1	0.28	0.28
BROMOBENZENE	108-86-1	0.056	0.28
BROMOXYNIL	1689-84-5	0.14	0.14
1,3-BUTADIENE	106-99-0	not available	not available
2-BUTANONE	78-93-3	4.2	4.2
BUTYLATE	2008-41-5	0.35	1.75
n-BUTYLBENZENE	104-51-8	0.35	1.75
CAPROLACTAM	105-60-2	3.5	3.5
CAPTAN	133-06-2	0.91	0.91
CARBARYL	63-25-2	0.7	0.7
CARBOXIN	5234-68-4	0.7	0.7
CHLORAMBEN	133-90-4	0.105	0.105
CHLORFENVINPHOS	470-90-6	0.0049	0.0245
1-CHLOROBUTANE	109-69-3	0.28	1.4
CHLOROETHANE	75-00-3	not available	not available
CHLOROMETHANE	74-87-3	not available	not available
2-CHLORONAPHTHALENE	91-58-7	0.56	2.8
o-CHLOROTOLUENE	95-49-8	0.14	0.7
CHLORPYRIFOS	2921-88-2	0.007	0.035
CHLORPYRIFOS METHYL	5598-13-0	0.07	0.35
CYANAZINE	21725-46-2	0.014	0.014
CYCLOHEXANE	110-82-7	not available	not available
CYCLOHEXANONE	108-94-1	35	35
2,4-DB (pH 4.5 -5.5)	94-82-6	0.056	0.28
2,4-DB (pH 6.0 - 9.0)	94-82-6	0.056	0.056
DIAZINON	333-41-5	0.0063	0.0315
DIBENZOFURAN	132-64-9	0.007	0.035
DICAMBA	1918-00-9	0.21	0.21
DICHLORODIFLUOROMETHANE	75-71-8	1.4	7
1,3-DICHLOROPROPANE	142-28-9	0.14	0.14
DICHLORVOS	62-73-7	0.008	0.008
DICYCLOPENTADIENE	77-73-6	0.056	0.28
DIETHANOLAMINE	111-42-2	not available	not available
DIETHYLENE GLYCOL MONOBUTYL ETHER	112-34-5	0.21	0.21
DIETHYLENE GLYCOL MONOETHYL ETHER	111-90-0	0.42	0.42

DIISOPROPYL ETHER	108-20-3	not available	not available
DIMETHYL PHTHALATE	131-11-3	not available	not available
1,3-DINITROBENZENE	75-71-8	0.0007	0.0007
DINITRO-o-CRESOL, 4,6-	534-52-1	0.00056	0.00056
p-DIOXANE	123-91-1	0.0077	0.0077
DIPHENYLAMINE	122-39-4	0.175	0.875
DISULFOTON	298-04-4	0.00028	0.0014
EPTC	759-94-4	0.175	0.875
ETHION	563-12-2	0.0035	0.0175
ETHOXYETHANOL ACETATE	111-15-9	0.7	0.7
ETHYL ACETATE	141-78-6	6.3	6.3
ETHYL ACRYLATE	140-88-5	0.00177	0.00177
ETHYLENE GLYCOL	107-21-1	14	14
ETHYLENE GLYCOL MONBUTYL ETHER	111-76-2	0.7	0.7
ETHYLENE THIOUREA	96-45-7	0.0019	0.0019
ETHYL ETHER	60-29-7	1.4	1.4
FONOFOS	944-22-9	0.014	0.07
FORMALDEHYDE	50-00-0	1.4	1.4
FURFURAL	98-01-1	0.021	0.021
GLYPHOSATE (pH 4.5-7.24)	1071-83-6	0.7	3.5
GLYPHOSATE (pH 7.25-9.0)	1071-83-6	0.7	0.7
HEXACHLOROBUTADIENE	87-68-3	0.007	0.035
HEXANE	110-54-3	0.42	2.1
2-HEXANONE	591-78-6	0.035	0.035
HMX	2691-41-0	1.4	1.4
HYDRAZINE	302-01-2	0.000028	0.000028
IMAZAQUIN	81335-37-7	1.75	1.75
IODINE	7553-56-2	0.35	not available
ISOBUTANOL	78-83-1	2.1	2.1
ISOPROPYLBENZENE (cumene)	98-82-8	0.7	3.5
MALATHION	121-75-5	0.14	0.14
MCPA	94-74-6	0.0035	0.0035
MCPP	93-65-2	0.007	0.007
METHANOL	67-56-1	3.5	3.5
METHYL ACETATE	79-20-9	7	7
METHYL ACRYLATE	96-33-3	0.21	0.21
4,4'-METHYLENEBIS(2-CHLOROANILINE)	101-14-4	0.00085	0.0043
METHYLENE BROMIDE	74-95-3	not available	not available
4,4'-METHYLENEDIANILINE	101-77-9	0.000053	0.000053
METHYLISOBUTYLKETONE	108-10-1	0.56	0.56
1-METHYLNAPHTHALENE	90-12-0	0.49	2.45
2-METHYLNAPHTHALENE	93-65-2	0.028	0.14
3-METHYLPHENOL	108-39-4	0.35	0.35
4-METHYLPHENOL	106-44-5	0.7	0.7
METOLACHLOR	51218-45-2	1.05	5.25
METRIBUZIN	21087-64-9	0.175	0.175
MOLYBDENUM	7439-98-7	0.035	0.035
2-NITROANILINE	88-74-4	0.105	0.105
3-NITROANILINE	99-09-2	not available	not available
4-NITROANILINE	100-01-6	0.028	0.028
NITROGLYCERINE	55-63-0	0.005	0.005
n-NITROSODIMETHYLAMINE	62-75-9	0.0006	0.0006

2-NITROTOLUENE	88-72-2	0.00039	0.00039
3-NITROTOLUENE	99-08-1	0.0007	0.0007
4-NITROTOLUENE	99-99-0	0.0085	0.0085
PARAQUAT DICHLORIDE	1910-42-5	0.0315	0.0315
PARATHION-ETHYL	56-38-2	0.168	0.84
PARATHION-METHYL (pH 4.5-7.24)	298-00-0	0.0018	0.0088
PARATHION-METHYL (pH 7.25-9.0)	298-00-0	0.0018	0.0018
PENDIMETHALIN	40487-42-1	0.28	1.4
PENTACHLORONITROBENZENE	82-68-8	0.021	0.105
PENTAERYTHRITOL TETRANITRATE (PETN)	78-11-5	0.014	0.014
PERCHLORATE	14797-73-0	0.0049	0.0049
PHENANTHRENE	85-01-8	0.21	1.05
PHORATE	298-02-2	0.0014	0.007
PROMETON (g)	1610-18-0	0.105	0.105
n-PROPYLBENZENE	103-65-1	0.7	3.5
PROPYLENE GLYCOL	57-55-6	140	140
PROPYLENE GLYCOL DINITRATE	6423-43-4	not available	not available
PROPYLENE GLYCOL MONOMETHYL ETHER	107-98-2	4.9	4.9
PYRIDINE	110-86-1	0.007	0.007
RDX	121-82-4	0.084	0.084
STRONTIUM	7440-24-6	4.2	not available
TEBUTHIURON	34014-18-1	0.49	0.49
TERBUFOS	13071-79-9	0.00018	0.0009
1,1,1,2-TETRACHLOROETHANE	630-20-6	0.21	1.05
1,1,2,2-TETRACHLOROETHANE	79-34-5	0.0043	0.0043
TETRACHLOROVINPHOS	961-11-5	0.21	1.05
THIRAM	137-26-8	0.035	0.035
TIN	7440-31-5	4.2	not available
2,4,6-TRIBROMOPHENOL	118-79-6	not available	not available
1,2,3-TRICHLOROBENZENE	87-61-6	0.0056	0.028
TRICHLOROFLUOROMETHANE	75-69-4	2.1	10.5
2,4,5-TRICHLOROPHENOXYACETIC ACID	93-76-5	0.28	1.4
1,2,3-TRICHLOROPROPANE	96-18-4	0.001	0.001
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	210	1050
TRIFLURALIN	1582-09-8	0.052	0.26
1,2,3-TRIMETHYLBENZENE	526-73-8	not available	not available
1,2,4-TRIMETHYLBENZENE	95-63-6	not available	not available
1,3,5-TRIMETHYLBENZENE	108-67-8	0.07	0.35
1,3,5-TRINITROBENZENE	99-35-4	0.84	0.84
2,4,6-TRINITROTOLUENE	118-96-7	0.014	0.014
TRINITROPHENYLMETHYLNITRAMINE, 2,4,6- (TETRYL)	479-45-8	0.11	0.11

NOTE: ALL CONCENTRATIONS IN MG/L

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pH SPECIFIC SOIL REMEDIATION OBJECTIVES FOR THE SOIL COMPONENT OF THE CLASS I GROUNDWATER INGESTION ROUTE

CHEMICAL NAME	pH 4.5-4.74	pH 4.75-5.24	pH 5.25-5.74	pH 5.75-6.24	pH 6.25-6.64	pH 6.65-6.89	pH 6.9-7.24	pH 7.25-7.74	pH 7.75-8.24	pH 8.25-8.74	pH 8.75-9.0
BROMOXYNIL	1.26	0.85	0.69	0.64	0.62	0.62	0.62	0.61	0.61	0.61	0.61
2,4-DB	5.1	3.4	1.8	0.86	0.5	0.41	0.38	0.34	0.33	0.33	0.33
4,6-DINTIRO-O-CRESOL	0.0033	0.0027	0.0024	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023
GLYPHOSATE	170	160	130	78	38	23	17	9.4	6.7	5.9	5.6
IMAZAQUIN	7.8	7.3	7.2	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
MCPA	0.019	0.016	0.016	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
MCPP	0.046	0.037	0.034	0.034	0.033	0.033	0.033	0.033	0.033	0.033	0.033
PARATHION-METHYL	0.056	0.056	0.056	0.053	0.048	0.041	0.036	0.023	0.014	0.01	0.0086
PROMETON	1.9	1.1	0.69	0.55	0.5	0.49	0.48	0.47	0.47	0.47	0.47
PYRIDINE	0.029	0.029	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028

pH SPECIFIC SOIL REMEDIATION OBJECTIVES FOR THE SOIL COMPONENT OF THE CLASS II GROUNDWATER INGESTION ROUTE

CHEMICAL NAME	pH 4.5-4.74	pH 4.75-5.24	pH 5.25-5.74	pH 5.75-6.24	pH 6.25-6.64	pH 6.65-6.89	pH 6.9-7.24	pH 7.25-7.74	pH 7.75-8.24	pH 8.25-8.74	pH 8.75-9.0
BROMOXYNIL	1.26	0.85	0.69	0.64	0.62	0.62	0.62	0.61	0.61	0.61	0.61
2,4-DB	26	17	8.8	0.86	0.5	0.41	0.38	0.34	0.33	0.33	0.33
4,6-DINTIRO-O-CRESOL	0.0033	0.0027	0.0024	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023
GLYPHOSATE	860	790	630	390	190	120	86	9.4	6.7	5.9	5.6
IMAZAQUIN	7.8	7.3	7.2	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
MCPA	0.019	0.016	0.016	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
MCPP	0.046	0.037	0.034	0.034	0.033	0.033	0.033	0.033	0.033	0.033	0.033
PARATHION-METHYL	0.28	0.28	0.28	0.27	0.24	0.21	0.18	0.023	0.014	0.01	0.0086
PROMETON	1.9	1.1	0.69	0.55	0.5	0.49	0.48	0.47	0.47	0.47	0.47
PYRIDINE	0.029	0.029	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028

NOTE: ALL CONCENTRATIONS IN MG/KG

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Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information												Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
1.8E-02	C	5.1E-06	C	1.5E-01	I					1	0.1		ALAR	1596-84-5	2.7E+01	c	9.6E+01	c	4.8E-01	c	2.4E+00	c	3.7E+00	c		8.2E-04	
8.7E-03	I			4.0E-03	I					1	0.1		Acephate	30560-19-1	5.6E+01	c**	2.0E+02	c*					7.7E+00	c**		1.7E-03	
		2.2E-06	I			9.0E-03	I	V		1		1.1E+05	Acetaldehyde	75-07-0	1.0E+01	c**	5.2E+01	c**	1.1E+00	c**	5.6E+00	c**	2.2E+00	c**		4.5E-04	
				2.0E-02	I					1	0.1		Acetochlor	34256-82-1	1.2E+03	n	1.2E+04	n					2.7E+02	n		2.2E-01	
				9.0E-01	I	3.1E+01	A	V		1		1.1E+05	Acetone	67-64-1	6.1E+04	n	6.3E+05	nms	3.2E+04	n	1.4E+05	n	1.2E+04	n		2.4E+00	
						2.0E-03	X	V		1		1.1E+05	Acetone Cyanohydrin	75-86-5	5.3E+01	n	2.2E+02	n	2.1E+00	n	8.8E+00	n	4.2E+00	n		8.4E-04	
						6.0E-02	I	V		1		1.3E+05	Acetonitrile	75-05-8	8.7E+02	n	3.7E+03	n	6.3E+01	n	2.6E+02	n	1.3E+02	n		2.6E-02	
				1.0E-01	I			V		1		2.5E+03	Acetophenone	98-86-2	7.8E+03	ns	1.0E+05	nms					1.5E+03	n		4.5E-01	
3.8E+00	C	1.3E-03	C							1	0.1		Acetylaminofluorene, 2-	53-96-3	1.3E-01	c	4.5E-01	c	1.9E-03	c	9.4E-03	c	1.3E-02	c		6.2E-05	
				5.0E-04	I	2.0E-05	I	V		1		2.3E+04	Acrolein	107-02-8	1.5E-01	n	6.5E-01	n	2.1E-02	n	8.8E-02	n	4.1E-02	n		8.4E-06	
5.0E-01	I	1.0E-04	I	2.0E-03	I	6.0E-03	I		M	1	0.1		Acrylamide	79-06-1	2.3E-01	c	3.4E+00	c	9.6E-03	c	1.2E-01	c	4.3E-02	c		9.1E-06	
				5.0E-01	I	1.0E-03	I			1	0.1		Acrylic Acid	79-10-7	3.0E+04	n	2.9E+05	nm	1.0E+00	n	4.4E+00	n	7.7E+03	n		1.6E+00	
5.4E-01	I	6.8E-05	I	4.0E-02	A	2.0E-03	I	V		1		1.1E+04	Acrylonitrile	107-13-1	2.4E-01	c*	1.2E+00	c*	3.6E-02	c*	1.8E-01	c*	4.5E-02	c*		9.8E-06	
						6.0E-03	P			1	0.1		Adiponitrile	111-69-3	8.5E+06	nm	3.6E+07	nm	6.3E+00	n	2.6E+01	n					
5.6E-02	C			1.0E-02	I					1	0.1		Alachlor	15972-60-8	8.7E+00	c*	3.1E+01	c					9.1E-01	c	2.0E+00	7.5E-04	1.6E-03
				1.0E-03	I					1	0.1		Aldicarb	116-06-3	6.1E+01	n	6.2E+02	n					1.5E+01	n	3.0E+00	3.8E-03	7.5E-04
				1.0E-03	I					1	0.1		Aldicarb Sulfone	1646-88-4	6.1E+01	n	6.2E+02	n					1.6E+01	n	2.0E+00	3.4E-03	4.4E-04
										1	0.1		Aldicarb sulfoxide	1646-87-3											4.0E+00		8.8E-04
1.7E+01	I	4.9E-03	I	3.0E-05	I					1	0.1		Aldrin	309-00-2	2.9E-02	c*	1.0E-01	c	5.0E-04	c	2.5E-03	c	4.0E-03	c		6.5E-04	
				2.5E-01	I					1	0.1		Ally	74223-64-6	1.5E+04	n	1.5E+05	nm					3.8E+03	n		1.5E+00	
				5.0E-03	I	1.0E-04	X			1	0.1		Allyl Alcohol	107-18-6	3.0E+02	n	3.1E+03	n	1.0E-01	n	4.4E-01	n	7.8E+01	n		1.6E-02	
2.1E-02	C	6.0E-06	C			1.0E-03	I	V		1		1.4E+03	Allyl Chloride	107-05-1	6.8E-01	c**	3.4E+00	c**	4.1E-01	c**	2.0E+00	c**	6.3E-01	c**		2.0E-04	
				1.0E+00	P	5.0E-03	P			1			Aluminum	7429-90-5	7.7E+04	n	9.9E+05	nm	5.2E+00	n	2.2E+01	n	1.6E+04	n		2.3E+04	
				4.0E-04	I					1			Aluminum Phosphide	20859-73-8	3.1E+01	n	4.1E+02	n					6.2E+00	n			
				3.0E-04	I					1	0.1		Amdro	67485-29-4	1.8E+01	n	1.8E+02	n					4.6E+00	n		1.7E+03	
				9.0E-03	I					1	0.1		Ametryn	834-12-8	5.5E+02	n	5.5E+03	n					1.2E+02	n		1.2E-01	
2.1E+01	C	6.0E-03	C							1	0.1		Aminobiphenyl, 4-	92-67-1	2.3E-02	c	8.2E-02	c	4.1E-04	c	2.0E-03	c	2.6E-03	c		1.3E-05	
				8.0E-02	P					1	0.1		Aminophenol, m-	591-27-5	4.9E+03	n	4.9E+04	n					1.2E+03	n		4.7E-01	
				2.0E-02	P					1	0.1		Aminophenol, p-	123-30-8	1.2E+03	n	1.2E+04	n					3.1E+02	n		1.2E-01	
				2.5E-03	I					1	0.1		Amitraz	33089-61-1	1.5E+02	n	1.5E+03	n					5.9E+00	n		3.0E+00	
						1.0E-01	I			1			Ammonia	7664-41-7					1.0E+02	n	4.4E+02	n					
				2.0E-01	I					1			Ammonium Sulfamate	7773-06-0	1.6E+04	n	2.0E+05	nm					3.1E+03	n			
5.7E-03	I	1.6E-06	C	7.0E-03	P	1.0E-03	I			1	0.1		Aniline	62-53-3	8.5E+01	c**	3.0E+02	c*	1.0E+00	n	4.4E+00	n	1.2E+01	c**		3.9E-03	
4.0E-02	P			2.0E-03	X					1	0.1		Anthraquinone, 9,10-	84-65-1	1.2E+01	c*	4.3E+01	c*					1.2E+00	c*		1.2E-02	
				4.0E-04	I					0.15			Antimony (metallic)	7440-36-0	3.1E+01	n	4.1E+02	n					6.0E+00	n	6.0E+00	2.7E-01	2.7E-01
				5.0E-04	H					0.15			Antimony Pentoxide	1314-60-9	3.9E+01	n	5.1E+02	n					7.5E+00	n			
				9.0E-04	H					0.15			Antimony Potassium Tartrate	11071-15-1	7.0E+01	n	9.2E+02	n					1.3E+01	n			
				4.0E-04	H					0.15			Antimony Tetroxide	1332-81-6	3.1E+01	n	4.1E+02	n					6.0E+00	n			
						2.0E-04	I			0.15			Antimony Trioxide	1309-64-4	2.8E+05	nm	1.2E+06	nm	2.1E-01	n	8.8E-01	n					
				1.3E-02	I					1	0.1		Apollo	74115-24-5	7.9E+02	n	8.0E+03	n					1.8E+02	n		1.1E+01	
2.5E-02	I	7.1E-06	I	5.0E-02	H					1	0.1		Aramite	140-57-8	1.9E+01	c	6.9E+01	c	3.4E-01	c	1.7E+00	c	1.1E+00	c		1.3E-02	
1.5E+00	I	4.3E-03	I	3.0E-04	I	1.5E-05	C			1	0.03		Arsenic, Inorganic	7440-38-2	6.1E-01	c*R	2.4E+00	cR	5.7E-04	c*	2.9E-03	c*	4.5E-02	c	1.0E+01	1.3E-03	2.9E-01
				3.5E-06	C	5.0E-05	I			1			Arsine	7784-42-1	2.7E-01	n	3.6E+00	n	5.2E-02	n	2.2E-01	n	5.4E-02	n			
				9.0E-03	I					1	0.1		Assure	76578-14-8	5.5E+02	n	5.5E+03	n					9.3E+01	n		1.4E+00	
				5.0E-02	I					1	0.1		Asulam	3337-71-1	3.1E+03	n	3.1E+04	n					7.8E+02	n		2.0E-01	
2.3E-01	C			3.5E-02	I					1	0.1		Atrazine	1912-24-9	2.1E+00	c	7.5E+00	c					2.6E-01	c	3.0E+00	1.7E-04	1.9E-03
8.8E-01	C	2.5E-04	C							1	0.1		Auramine	492-80-8	5.5E-01	c	2.0E+00	c	9.7E-03	c	4.9E-02	c	5.7E-02	c		5.2E-04	
				4.0E-04	I					1	0.1		Avermectin B1	65195-55-3	2.4E+01	n	2.5E+02	n					6.3E+00	n		1.1E+01	
1.1E-01	I	3.1E-05	I					V		1			Azobenzene	103-33-3	5.1E+00	c	2.3E+01	c	7.8E-02	c	4.0E-01	c	1.0E-01	c		8.0E-04	
				2.0E-01	I	5.0E-04	H			0.07			Barium	7440-39-3	1.5E+04	n	1.9E+05	nm	5.2E-01	n	2.2E+00	n	2.9E+03	n	2.0E+03	1.2E+02	8.2E+01
				4.0E-03	I					1	0.1		Baygon	114-26-1	2.4E+02	n	2.5E+03	n					6.1E+01	n		2.0E-02	
				3.0E-02	I					1	0.1		Bayleton	43121-43-3	1.8E+03	n	1.8E+04	n					4.3E+02	n		3.4E-01	
				2.5E-02	I					1	0.1		Baythroid	68359-37-5	1.5E+03	n	1.5E+04	n					8.7E+01	n		2.3E+01	
				3.0E-01	I					1	0.1		Benefin	1861-40-1	1.8E+04	n	1.8E+05	nm					1.2E+03	n		4.1E+01	
				5.0E-02	I					1	0.1		Benomyl	17804-35-2	3.1E+03	n	3.1E+04	n					7.5E+02	n		6.6E-01	
				3.0E-02	I					1	0.1		Bentazon	25057-89-0	1.8E+03	n	1.8E+04	n					4.4E+02	n		9.6E-02	
				1.0E-01	I			V		1		1.2E+03	Benzaldehyde	100-52-7	7.8E+03	ns	1.0E+05	nms					1.5E+03	n		3.3E-01	
5.5E-02	I	7.8E-06	I	4.0E-03	I	3.0E-02	I	V		1		1.8E+03	Benzene	71-43-2	1.1E+00	c*	5.4E+00	c*	3.1E-01	c	1.6E+00	c*	3.9E-01	c*	5.0E+00	2.0E-04	2.6E-03
1.0E-01	X			3.0E-04	X					1	0.1		Benzenediamine-2-methyl sulfate, 1,4-	6369-59-1	4.9E+00	c**	1.7E+01	c*					6.7E-01	c**		1.9E-04	
				1.0E-03	P			V		1		1.3E+03	Benzenethiol	108-98-5	7.8E+01	n	1.0E+03	n					1.3E+01	n		8.6E-03	
2.3E+02	I	6.7E-02	I	3.0E-03	I				M	1	0.1		Benzidine	92-87-5	5.0E-04	c	7.5E-03	c	1.4E-05	c	1.8E-04	c	9.2E-05	c		2.4E-07	
				4.0E+00	I					1	0.1		Benzoic Acid	65-85-0	2.4E+05	nm	2.5E+06	nm					5.8E+04	n		1.4E+01	
1.3E+01	I							V		1		3.2E+02	Benzotrichloride	98-07-7	4.9E-02	c	2.2E-01	c					2.6E-03	c		5.6E-06	
				1.0E-01	P					1	0.1		Benzyl Alcohol	100-51-6	6.1E+03	n	6.2E+04	n					1.5E+03	n		3.7E-01	
1.7E-01	I	4.9E-05	C	2.0E-03	P	1.0E-03	P	V		1		1.5E+03	Benzyl Chloride	100-44-7	1.0E+00	c*	4.9E+00	c*	5.0E-02	c*	2.5E-01	c*	7.7E-02	c*		8.4E-05	

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
		2.4E-03	I	2.0E-03	I	2.0E-05	I			0.007			Beryllium and compounds	7440-41-7	1.6E+02	n	2.0E+03	n	1.0E-03	c*	5.1E-03	c*	1.6E+01	n	4.0E+00	1.3E+01	3.2E+00
				1.0E-04	I					1	0.1		Bidrin	141-66-2	6.1E+00	n	6.2E+01	n					1.6E+00	n		3.6E-04	
				9.0E-03	P					1	0.1		Bifenox	42576-02-3	5.5E+02	n	5.5E+03	n					7.5E+01	n		5.7E-01	
				1.5E-02	I					1	0.1		Biphenthrin	82657-04-3	9.2E+02	n	9.2E+03	n					2.3E+02	n		1.1E+03	
8.0E-03	X			5.0E-02	I	4.0E-04	X	V		1			Biphenyl, 1,1'-	92-52-4	5.1E+01	n	2.1E+02	n	4.2E-01	n	1.8E+00	n	8.3E-01	n		8.7E-03	
7.0E-02	H	1.0E-05	H	4.0E-02	I			V		1		1.0E+03	Bis(2-chloro-1-methylethyl) ether	108-60-1	4.6E+00	c	2.2E+01	c	2.4E-01	c	1.2E+00	c	3.1E-01	c		1.1E-04	
				3.0E-03	P					1	0.1		Bis(2-chloroethoxy)methane	111-91-1	1.8E+02	n	1.8E+03	n					4.6E+01	n		1.1E-02	
1.1E+00	I	3.3E-04	I					V		1		5.1E+03	Bis(2-chloroethyl)ether	111-44-4	2.1E-01	c	1.0E+00	c	7.4E-03	c	3.7E-02	c	1.2E-02	c		3.1E-06	
1.4E-02	I	2.4E-06	C	2.0E-02	I					1	0.1		Bis(2-ethylhexyl)phthalate	117-81-7	3.5E+01	c*	1.2E+02	c	1.0E+00	c	5.1E+00	c	4.8E+00	c*	6.0E+00	1.1E+00	1.4E+00
2.2E+02	I	6.2E-02	I					V		1		4.2E+03	Bis(chloromethyl)ether	542-88-1	7.7E-05	c	3.9E-04	c	3.9E-05	c	2.0E-04	c	6.2E-05	c		1.5E-08	
				5.0E-02	I					1	0.1		Bisphenol A	80-05-7	3.1E+03	n	3.1E+04	n					5.8E+02	n		4.4E+01	
				2.0E-01	I	2.0E-02	H			1			Boron And Borates Only	7440-42-8	1.6E+04	n	2.0E+05	nm	2.1E+01	n	8.8E+01	n	3.1E+03	n		9.9E+00	
				2.0E+00	P	2.0E-02	P			1			Boron Trichloride	10294-34-5	1.6E+05	nm	2.0E+06	nm	2.1E+01	n	8.8E+01	n	3.1E+04	n			
				4.0E-02	C	1.3E-02	C			1			Boron Trifluoride	7637-07-2	3.1E+03	n	4.1E+04	n	1.4E+01	n	5.7E+01	n	6.2E+02	n			
7.0E-01	I			4.0E-03	I					1			Bromate	15541-45-4	9.1E-01	c	4.1E+00	c					9.6E-02	c	1.0E+01	7.4E-04	7.7E-02
2.0E+00	X	6.0E-04	X					V		1		2.4E+03	Bromo-2-chloroethane, 1-	107-04-0	2.4E-02	c	1.2E-01	c	4.1E-03	c	2.0E-02	c	6.4E-03	c		1.8E-06	
				8.0E-03	I	6.0E-02	I	V		1		6.8E+02	Bromobenzene	108-86-1	3.0E+02	n	1.8E+03	ns	6.3E+01	n	2.6E+02	n	5.4E+01	n		3.6E-02	
						4.0E-02	X	V		1		4.0E+03	Bromochloromethane	74-97-5	1.6E+02	n	6.8E+02	n	4.2E+01	n	1.8E+02	n	8.3E+01	n		2.1E-02	
6.2E-02	I	3.7E-05	C	2.0E-02	I			V		1		9.3E+02	Bromodichloromethane	75-27-4	2.7E-01	c	1.4E+00	c	6.6E-02	c	3.3E-01	c	1.2E-01	c	8.0E+01(F)	3.2E-05	2.2E-02
7.9E-03	I	1.1E-06	I	2.0E-02	I					1	0.1		Bromoform	75-25-2	6.2E+01	c*	2.2E+02	c*	2.2E+00	c	1.1E+01	c	7.9E+00	c*	8.0E+01(F)	2.1E-03	2.1E-02
				1.4E-03	I	5.0E-03	I	V		1		3.6E+03	Bromomethane	74-83-9	7.3E+00	n	3.2E+01	n	5.2E+00	n	2.2E+01	n	7.0E+00	n		1.8E-03	
				5.0E-03	H					1	0.1		Bromophos	2104-96-3	3.1E+02	n	3.1E+03	n					2.6E+01	n		1.1E-01	
				2.0E-02	I					1	0.1		Bromoxynil	1689-84-5	1.2E+03	n	1.2E+04	n					2.5E+02	n		2.2E-01	
				2.0E-02	I					1	0.1		Bromoxynil Octanoate	1689-99-2	1.2E+03	n	1.2E+04	n					1.0E+02	n		8.7E-01	
3.4E+00	C	3.0E-05	I			2.0E-03	I	V		1		6.7E+02	Butadiene, 1,3-	106-99-0	5.4E-02	c*	2.6E-01	c*	8.1E-02	c*	4.1E-01	c*	1.6E-02	c		8.6E-06	
				1.0E-01	I					1	0.1		Butanol, N-	71-36-3	6.1E+03	n	6.2E+04	n					1.5E+03	n		3.2E-01	
1.9E-03	P			2.0E-01	I					1	0.1		Butyl Benzyl Phthlate	85-68-7	2.6E+02	c*	9.1E+02	c					1.4E+01	c*		2.0E-01	
				2.0E+00	P	3.0E+01	P			1	0.1		Butyl alcohol, sec-	78-92-2	1.2E+05	nm	1.2E+06	nm	3.1E+04	n	1.3E+05	n	3.1E+04	n		6.3E+00	
				5.0E-02	I					1	0.1		Butylate	2008-41-5	3.1E+03	n	3.1E+04	n					3.4E+02	n		3.3E-01	
2.0E-04	C	5.7E-08	C							1	0.1		Butylated hydroxyanisole	25013-16-5	2.4E+03	c	8.6E+03	c	4.3E+01	c	2.2E+02	c	2.1E+02	c		3.9E-01	
				5.0E-02	P			V		1		1.1E+02	Butylbenzene, n-	104-51-8	3.9E+03	ns	5.1E+04	ns					7.8E+02	n		2.5E+00	
				1.0E-01	X			V		1		1.5E+02	Butylbenzene, sec-	135-98-8	7.8E+03	ns	1.0E+05	nms					1.6E+03	n		4.6E+00	
				1.0E-01	X			V		1		1.8E+02	Butylbenzene, tert-	98-06-6	7.8E+03	ns	1.0E+05	nms					5.1E+02	n		1.1E+00	
				1.0E+00	I					1	0.1		Butylphthalyl Butylglycolate	85-70-1	6.1E+04	n	6.2E+05	nm					1.0E+04	n		2.3E+02	
				2.0E-02	A					1	0.1		Cacodylic Acid	75-60-5	1.2E+03	n	1.2E+04	n					3.1E+02	n			
		1.8E-03	I	1.0E-03	I	1.0E-05	A			0.025	0.001		Cadmium (Diet)	7440-43-9	7.0E+01	n	8.0E+02	n									
		1.8E-03	I	5.0E-04	I	1.0E-05	A			0.05	0.001		Cadmium (Water)	7440-43-9					1.4E-03	c**	6.8E-03	c**	6.9E+00	n	5.0E+00	5.2E-01	3.8E-01
				5.0E-01	I					1	0.1		Caprolactam	105-60-2	3.1E+04	n	3.1E+05	nm					7.7E+03	n		1.9E+00	
1.5E-01	C	4.3E-05	C	2.0E-03	I					1	0.1		Captafol	2425-06-1	3.2E+00	c*	1.1E+01	c	5.7E-02	c	2.9E-01	c	3.5E-01	c*		6.1E-04	
2.3E-03	C	6.6E-07	C	1.3E-01	I					1	0.1		Captan	133-06-2	2.1E+02	c*	7.5E+02	c	3.7E+00	c	1.9E+01	c	2.7E+01	c*		1.9E-02	
				1.0E-01	I					1	0.1		Carbaryl	63-25-2	6.1E+03	n	6.2E+04	n					1.4E+03	n		1.3E+00	
				5.0E-03	I					1	0.1		Carbofuran	1563-66-2	3.1E+02	n	3.1E+03	n					7.3E+01	n	4.0E+01	2.8E-02	1.6E-02
				1.0E-01	I	7.0E-01	I	V		1		7.4E+02	Carbon Disulfide	75-15-0	8.2E+02	ns	3.7E+03	ns	7.3E+02	n	3.1E+03	n	7.2E+02	n		2.1E-01	
7.0E-02	I	6.0E-06	I	4.0E-03	I	1.0E-01	I	V		1		4.6E+02	Carbon Tetrachloride	56-23-5	6.1E-01	c	3.0E+00	c	4.1E-01	c	2.0E+00	c	3.9E-01	c	5.0E+00	1.5E-04	1.9E-03
				1.0E-02	I					1	0.1		Carbosulfan	55285-14-8	6.1E+02	n	6.2E+03	n					3.7E+01	n		9.0E-01	
				1.0E-01	I					1	0.1		Carboxin	5234-68-4	6.1E+03	n	6.2E+04	n					1.5E+03	n		8.0E-01	
						9.0E-04	I			1			Ceric oxide	1306-38-3	1.3E+06	nm	5.4E+06	nm	9.4E-01	n	3.9E+00	n					
				1.0E-01	I					1	0.1		Chloral Hydrate	302-17-0	6.1E+03	n	6.2E+04	n					1.5E+03	n		3.1E-01	
				1.5E-02	I					1	0.1		Chloramben	133-90-4	9.2E+02	n	9.2E+03	n					2.2E+02	n		5.5E-02	
4.0E-01	H									1	0.1		Chloranil	118-75-2	1.2E+00	c	4.3E+00	c					1.6E-01	c		1.3E-04	
3.5E-01	I	1.0E-04	I	5.0E-04	I	7.0E-04	I			1	0.04		Chlordane	12789-03-6	1.6E+00	c*	6.5E+00	c*	2.4E-02	c*	1.2E-01	c*	1.9E-01	c*	2.0E+00	1.3E-02	1.4E-01
1.0E+01	I	4.6E-03	C	3.0E-04	I					1	0.1		Chlordecone (Kepone)	143-50-0	4.9E-02	c	1.7E-01	c	5.3E-04	c	2.7E-03	c	3.0E-03	c		1.1E-04	
				7.0E-04	A					1	0.1		Chlorfenvinphos	470-90-6	4.3E+01	n	4.3E+02	n					8.6E+00	n		2.3E-02	
				2.0E-02	I					1	0.1		Chlorimuron, Ethyl-	90982-32-4	1.2E+03	n	1.2E+04	n					3.0E+02	n		1.0E-01	
				1.0E-01	I	1.5E-04	A			1			Chlorine	7782-50-5	7.5E+03	n	9.1E+04	n	1.5E-01	n	6.4E-01	n	1.6E+03	n		7.0E-01	
				3.0E-02	I	2.0E-04	I			1			Chlorine Dioxide	10049-04-4	2.3E+03	n	3.0E+04	n	2.1E-01	n	8.8E-01	n	4.7E+02	n			
				3.0E-02	I					1			Chlorite (Sodium Salt)	7758-19-2	2.3E+03	n	3.1E+04	n					4.7E+02	n	1.0E+03		
						5.0E+01	I	V		1		1.2E+03	Chloro-1,1-difluoroethane, 1-	75-68-3	5.8E+04	ns	2.4E+05	nms	5.2E+04	n	2.2E+05	n	1.0E+05	n		5.2E+01	
		3.0E-04	I	2.0E-02	H	2.0E-02	I	V		1		7.5E+02	Chloro-1,3-butadiene, 2-	126-99-8	9.4E-03	c	4.7E-02	c	8.1E-03	c	4.1E-02	c	1.6E-02	c		8.5E-06	
4.6E-01	H									1	0.1		Chloro-2-methylaniline HCl, 4-	3165-93-3	1.1E+00	c	3.7E+00	c					1.5E-01	c		1.3E-04	
1.0E-01	P	7.7E-05	C	3.0E-03	X					1	0.1		Chloro-2-methylaniline, 4-	95-69-2	4.9E+00	c*	1.7E+01	c	3.2E-02	c	1.6E-01	c	6.0E-01	c*		3.4E-04	
2.7E-01	X							V		1	0.1	2.8E+04	Chloroacetaldehyde, 2-	107-20-0	1.8E+00	c	6.4E+00	c					2.5E-01	c		5.0E-05	
				2.0E-03	H					1	0.1		Chloroacetic Acid	79-11-8	1.2E+02	n	1.2E+03	n					3.1E+01	n	6.0E+01	6.3E-03	1.2E-02
						3.0E-05	I			1	0.1		Chloroacetophenone, 2-	532-27-4	4.3E+04	n	1.8E+05	nm	3.1E-02	n	1.3E-01	n					
2.0E-01	P			4.0E-03	I					1	0.1		Chloroaniline, p-	106-47-8	2.4E+00	c	8.6E+00	c					3.2E-01	c		1.3E-04	

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Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				2.0E-02	I	5.0E-02	P	V		1		7.6E+02	Chlorobenzene	108-90-7	2.9E+02	n	1.4E+03	ns	5.2E+01	n	2.2E+02	n	7.2E+01	n	1.0E+02	4.9E-02	6.8E-02
1.1E-01	C	3.1E-05	C	2.0E-02	I					1	0.1		Chlorobenzilate	510-15-6	4.4E+00	c	1.6E+01	c	7.8E-02	c	4.0E-01	c	2.7E-01	c		8.8E-04	
				3.0E-02	X					1	0.1		Chlorobenzoic Acid, p-	74-11-3	1.8E+03	n	1.8E+04	n					3.9E+02	n		9.9E-02	
				3.0E-03	P	3.0E-01	P	V		1		1.2E+02	Chlorobenzotrifluoride, 4-	98-56-6	2.1E+02	ns	2.3E+03	ns	3.1E+02	n	1.3E+03	n	2.6E+01	n		9.3E-02	
				4.0E-02	P			V		1		7.3E+02	Chlorobutane, 1-	109-69-3	3.1E+03	ns	4.1E+04	ns					4.8E+02	n		2.0E-01	
						5.0E+01	I	V		1		1.7E+03	Chlorodifluoromethane	75-45-6	5.3E+04	ns	2.2E+05	nms	5.2E+04	n	2.2E+05	n	1.0E+05	n		4.3E+01	
				2.0E-02	P					1	0.1		Chloroethanol, 2-	107-07-3	1.2E+03	n	1.2E+04	n					3.1E+02	n		6.3E-02	
3.1E-02	C	2.3E-05	I	1.0E-02	I	9.8E-02	A	V		1		2.5E+03	Chloroform	67-66-3	2.9E-01	c	1.5E+00	c	1.1E-01	c	5.3E-01	c	1.9E-01	c	8.0E+01(F)	5.3E-05	2.2E-02
						9.0E-02	I	V		1		1.3E+03	Chloromethane	74-87-3	1.2E+02	n	5.0E+02	n	9.4E+01	n	3.9E+02	n	1.9E+02	n		4.9E-02	
2.4E+00	C	6.9E-04	C					V		1		2.6E+04	Chloromethyl Methyl Ether	107-30-2	1.9E-02	c	9.4E-02	c	3.5E-03	c	1.8E-02	c	5.6E-03	c		1.2E-06	
				8.0E-02	I			V		1			Chloronaphthalene, Beta-	91-58-7	6.3E+03	n	8.2E+04	n					5.5E+02	n		2.9E+00	
3.0E-01	P			3.0E-03	P	1.0E-05	X			1	0.1		Chloronitrobenzene, o-	88-73-3	1.6E+00	c	5.7E+00	c	1.0E-02	n	4.4E-02	n	2.0E-01	c		1.9E-04	
6.3E-03	P			1.0E-03	P	6.0E-04	P			1	0.1		Chloronitrobenzene, p-	100-00-5	6.1E+01	n	2.7E+02	c**	6.3E-01	n	2.6E+00	n	9.4E+00	c**		8.7E-03	
				5.0E-03	I			V		1		2.2E+04	Chlorophenol, 2-	95-57-8	3.9E+02	n	5.1E+03	n					7.1E+01	n		5.7E-02	
						4.0E-04	C	V		1		6.2E+02	Chloropicrin	76-06-2	2.1E+00	n	8.8E+00	n	4.2E-01	n	1.8E+00	n	8.3E-01	n		2.5E-04	
3.1E-03	C	8.9E-07	C	1.5E-02	I					1	0.1		Chlorothalonil	1897-45-6	1.6E+02	c**	5.6E+02	c*	2.7E+00	c	1.4E+01	c	1.9E+01	c*		4.3E-02	
				2.0E-02	I			V		1		9.1E+02	Chlorotoluene, o-	95-49-8	1.6E+03	ns	2.0E+04	ns					1.8E+02	n		1.7E-01	
				2.0E-02	X			V		1		2.5E+02	Chlorotoluene, p-	106-43-4	1.6E+03	ns	2.0E+04	ns					1.9E+02	n		1.8E-01	
2.4E+02	C	6.9E-02	C							1	0.1		Chlorozotocin	54749-90-5	2.0E-03	c	7.2E-03	c	3.5E-05	c	1.8E-04	c	2.8E-04	c		6.2E-08	
				2.0E-01	I					1	0.1		Chlorpropham	101-21-3	1.2E+04	n	1.2E+05	nm					2.2E+03	n		1.9E+00	
				1.0E-03	A					1	0.1		Chlorpyrifos	2921-88-2	6.1E+01	n	6.2E+02	n					6.2E+00	n		9.2E-02	
				1.0E-02	H					1	0.1		Chlorpyrifos Methyl	5598-13-0	6.1E+02	n	6.2E+03	n					8.9E+01	n		4.1E-01	
				5.0E-02	I					1	0.1		Chlorsulfuron	64902-72-3	3.1E+03	n	3.1E+04	n					7.7E+02	n		6.5E-01	
				8.0E-04	H					1	0.1		Chlorthiophos	60238-56-4	4.9E+01	n	4.9E+02	n					2.0E+00	n		5.2E-02	
				1.5E+00	I					0.013			Chromium(III), Insoluble Salts	16065-83-1	1.2E+05	nm	1.5E+06	nm					1.6E+04	n		2.8E+07	
5.0E-01	J	8.4E-02	S	3.0E-03	I	1.0E-04	I		M	0.025			Chromium(VI)	18540-29-9	2.9E-01	c	5.6E+00	c	1.1E-05	c	1.5E-04	c	3.1E-02	c		5.9E-04	
										0.013			Chromium, Total	7440-47-3											1.0E+02		1.8E+05
		9.0E-03	P	3.0E-04	P	6.0E-06	P			1			Cobalt	7440-48-4	2.3E+01	n	3.0E+02	n	2.7E-04	c*	1.4E-03	c*	4.7E+00	n		2.1E-01	
		6.2E-04	I						M	1	0.1		Coke Oven Emissions	8007-45-2					1.5E-03	c	2.0E-02	c					
				4.0E-02	H					1			Copper	7440-50-8	3.1E+03	n	4.1E+04	n					6.2E+02	n	1.3E+03	2.2E+01	4.6E+01
				5.0E-02	I	6.0E-01	C			1	0.1		Cresol, m-	108-39-4	3.1E+03	n	3.1E+04	n	6.3E+02	n	2.6E+03	n	7.2E+02	n		5.7E-01	
				5.0E-02	I	6.0E-01	C			1	0.1		Cresol, o-	95-48-7	3.1E+03	n	3.1E+04	n	6.3E+02	n	2.6E+03	n	7.2E+02	n		5.8E-01	
				1.0E-01	A	6.0E-01	C			1	0.1		Cresol, p-	106-44-5	6.1E+03	n	6.2E+04	n	6.3E+02	n	2.6E+03	n	1.4E+03	n		1.1E+00	
				1.0E-01	A					1	0.1		Cresol, p-chloro-m-	59-50-7	6.1E+03	n	6.2E+04	n					1.1E+03	n		1.3E+00	
				1.0E-01	A	6.0E-01	C			1	0.1		Cresols	1319-77-3	6.1E+03	n	6.2E+04	n	6.3E+02	n	2.6E+03	n	1.4E+03	n		1.2E+00	
1.9E+00	H			1.0E-03	P			V		1		1.7E+04	Crotonaldehyde, trans-	123-73-9	3.4E-01	c	1.5E+00	c					3.5E-02	c		7.1E-06	
				1.0E-01	I	4.0E-01	I	V		1		2.7E+02	Cumene	98-82-8	2.1E+03	ns	1.1E+04	ns	4.2E+02	n	1.8E+03	n	3.9E+02	n		6.4E-01	
2.2E-01	C	6.3E-05	C							1	0.1		Cupferron	135-20-6	2.2E+00	c	7.8E+00	c	3.9E-02	c	1.9E-01	c	3.1E-01	c		5.3E-04	
8.4E-01	H			2.0E-03	H					1	0.1		Cyanazine	21725-46-2	5.8E-01	c	2.1E+00	c					7.6E-02	c		3.5E-05	
													Cyanides														
				1.0E-03	I					1			~Calcium Cyanide	592-01-8	7.8E+01	n	1.0E+03	n					1.6E+01	n			
				5.0E-03	I					1			~Copper Cyanide	544-92-3	3.9E+02	n	5.1E+03	n					7.8E+01	n			
				6.0E-04	I	8.0E-04	S	V		1		1.0E+07	~Cyanide (CN-)	57-12-5	2.2E+01	n	1.4E+02	n	8.3E-01	n	3.5E+00	n	1.4E+00	n	2.0E+02	1.4E-02	2.0E+00
				1.0E-03	I			V		1			~Cyanogen	460-19-5	7.8E+01	n	1.0E+03	n					1.6E+01	n			
				9.0E-02	I			V		1			~Cyanogen Bromide	506-68-3	7.0E+03	n	9.2E+04	n					1.4E+03	n			
				5.0E-02	I			V		1			~Cyanogen Chloride	506-77-4	3.9E+03	n	5.1E+04	n					7.8E+02	n			
				6.0E-04	I	8.0E-04	I	V		1		1.0E+07	~Hydrogen Cyanide	74-90-8	2.3E+01	n	1.5E+02	n	8.3E-01	n	3.5E+00	n	1.4E+00	n		1.4E-02	
				2.0E-03	I					1			~Potassium Cyanide	151-50-8	1.6E+02	n	2.0E+03	n					3.1E+01	n			
				5.0E-03	I					0.04			~Potassium Silver Cyanide	506-61-6	3.9E+02	n	5.1E+03	n					5.9E+01	n			
				1.0E-01	I					0.04			~Silver Cyanide	506-64-9	7.8E+03	n	1.0E+05	nm					1.3E+03	n			
				1.0E-03	I					1			~Sodium Cyanide	143-33-9	7.8E+01	n	1.0E+03	n					1.6E+01	n	2.0E+02		
				2.0E-04	P					1			~Thiocyanates	NA	1.6E+01	n	2.0E+02	n					3.1E+00	n			
				2.0E-04	X					1			~Thiocyanic Acid	463-56-9									3.1E+00	n			
				5.0E-02	I					1			~Zinc Cyanide	557-21-1	3.9E+03	n	5.1E+04	n					7.8E+02	n			
						6.0E+00	I	V		1		1.2E+02	Cyclohexane	110-82-7	7.0E+03	ns	2.9E+04	ns	6.3E+03	n	2.6E+04	n	1.3E+04	n		1.3E+01	
2.3E-02	H									1	0.1		Cyclohexane, 1,2,3,4,5-pentabromo-6-chloro-	87-84-3	2.1E+01	c	7.5E+01	c					2.1E+00	c		1.2E-02	
				5.0E+00	I	7.0E-01	P			1	0.1		Cyclohexanone	108-94-1	3.1E+05	nm	3.1E+06	nm	7.3E+02	n	3.1E+03	n	7.7E+04	n		1.8E+01	
				5.0E-03	P	1.0E+00	X	V		1		2.8E+02	Cyclohexene	110-83-8	3.1E+02	ns	2.8E+03	ns	1.0E+03	n	4.4E+03	n	5.3E+01	n		3.5E-02	
				2.0E-01	I					1	0.1		Cyclohexylamine	108-91-8	1.2E+04	n	1.2E+05	nm					3.0E+03	n		7.9E-01	
				5.0E-03	I					1	0.1		Cyhalothrin/karate	68085-85-8	3.1E+02	n	3.1E+03	n					7.8E+01	n		5.3E+01	
				1.0E-02	I					1	0.1		Cypermethrin	52315-07-8	6.1E+02	n	6.2E+03	n					1.6E+02	n		2.5E+01	
				7.5E-03	I					1	0.1		Cyromazine	66215-27-8	4.6E+02	n	4.6E+03	n					1.2E+02	n		3.0E-02	
2.4E-01	I	6.9E-05	C							1	0.1		DDD	72-54-8	2.0E+00	c	7.2E+00	c	3.5E-02	c	1.8E-01	c	2.7E-02	c		6.4E-03	
3.4E-01	I	9.7E-05	C							1	0.1		DDE, p,p'-	72-55-9	1.4E+00	c	5.1E+00	c	2.5E-02	c	1.3E-01	c	2.0E-01	c		4.6E-02	
3.4E-01	I	9.7E-05	I	5.0E-04	I					1	0.03		DDT	50-29-3	1.7E+00	c*	7.0E+00	c*	2.5E-02	c	1.3E-01	c	2.0E-01	c*		6.7E-02	

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Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	volc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				1.0E-02	I					1	0.1		Dacthal	1861-32-1	6.1E+02	n	6.2E+03	n					9.3E+01	n		1.1E-01	
				3.0E-02	I					1	0.1		Dalapon	75-99-0	1.8E+03	n	1.8E+04	n					4.6E+02	n	2.0E+02	9.6E-02	4.1E-02
7.0E-04	I			7.0E-03	I					1	0.1		Decabromodiphenyl ether, 2,2',3,3',4,4',5,5',6,6'- (BDE-209)	1163-19-5	4.3E+02	n	2.5E+03	c**					9.6E+01	c**		5.3E+01	
				4.0E-05	I					1	0.1		Demeton	8065-48-3	2.4E+00	n	2.5E+01	n					5.2E-01	n			
1.2E-03	I			6.0E-01	I					1	0.1		Di(2-ethylhexyl)adipate	103-23-1	4.1E+02	c*	1.4E+03	c					5.6E+01	c	4.0E+02	4.0E+00	2.9E+01
6.1E-02	H									1	0.1		Diallate	2303-16-4	8.0E+00	c	2.8E+01	c					4.6E-01	c		6.8E-04	
				7.0E-04	A					1	0.1		Diazinon	333-41-5	4.3E+01	n	4.3E+02	n					7.9E+00	n		4.9E-02	
8.0E-01	P	6.0E-03	P	2.0E-04	P	2.0E-04	I	V	M	1		9.8E+02	Dibromo-3-chloropropane, 1,2-	96-12-8	5.4E-03	c	6.9E-02	c	1.6E-04	c	2.0E-03	c	3.2E-04	c	2.0E-01	1.4E-07	8.6E-05
				1.0E-02	I					1	0.1		Dibromobenzene, 1,4-	106-37-6	6.1E+02	n	6.2E+03	n					9.8E+01	n		9.3E-02	
8.4E-02	I	2.7E-05	C	2.0E-02	I			V		1	0.1	8.0E+02	Dibromochloromethane	124-48-1	6.8E-01	c	3.3E+00	c	9.0E-02	c	4.5E-01	c	1.5E-01	c	8.0E+01(F)	3.9E-05	2.1E-02
2.0E+00	I	6.0E-04	I	9.0E-03	I	9.0E-03	I	V		1		1.3E+03	Dibromoethane, 1,2-	106-93-4	3.4E-02	c	1.7E-01	c	4.1E-03	c	2.0E-02	c	6.5E-03	c	5.0E-02	1.8E-06	1.4E-05
				1.0E-02	H	4.0E-03	X	V		1		2.8E+03	Dibromomethane (Methylene Bromide)	74-95-3	2.5E+01	n	1.1E+02	n	4.2E+00	n	1.8E+01	n	7.9E+00	n		1.9E-03	
				1.0E-01	I					1	0.1		Dibutyl Phthalate	84-74-2	6.1E+03	n	6.2E+04	n					6.7E+02	n		1.7E+00	
				3.0E-04	P					1	0.1		Dibutyltin Compounds	NA	1.8E+01	n	1.8E+02	n					4.7E+00	n			
				3.0E-02	I					1	0.1		Dicamba	1918-00-9	1.8E+03	n	1.8E+04	n					4.4E+02	n		1.1E-01	
		4.2E-03	P					V		1		5.2E+02	Dichloro-2-butene, 1,4-	764-41-0	6.9E-03	c	3.5E-02	c	5.8E-04	c	2.9E-03	c	1.2E-03	c		5.4E-07	
		4.2E-03	P					V		1	0.1	5.2E+02	Dichloro-2-butene, cis-1,4-	1476-11-5	6.9E-03	c	3.5E-02	c	5.8E-04	c	2.9E-03	c	1.2E-03	c		5.4E-07	
		4.2E-03	P					V		1	0.1	7.6E+02	Dichloro-2-butene, trans-1,4-	110-57-6	6.9E-03	c	3.5E-02	c	5.8E-04	c	2.9E-03	c	1.2E-03	c		5.4E-07	
5.0E-02	I			4.0E-03	I					1	0.1		Dichloroacetic Acid	79-43-6	9.7E+00	c*	3.4E+01	c*					1.3E+00	c*	6.0E+01	2.7E-04	1.2E-02
				9.0E-02	I	2.0E-01	H	V		1		3.8E+02	Dichlorobenzene, 1,2-	95-50-1	1.9E+03	ns	9.8E+03	ns	2.1E+02	n	8.8E+02	n	2.8E+02	n	6.0E+02	2.7E-01	5.8E-01
5.4E-03	C	1.1E-05	C	7.0E-02	A	8.0E-01	I	V		1			Dichlorobenzene, 1,4-	106-46-7	2.4E+00	c	1.2E+01	c	2.2E-01	c	1.1E+00	c	4.2E-01	c	7.5E+01	4.0E-04	7.2E-02
4.5E-01	I	3.4E-04	C							1	0.1		Dichlorobenzidine, 3,3'-	91-94-1	1.1E+00	c	3.8E+00	c	7.2E-03	c	3.6E-02	c	1.1E-01	c		7.1E-04	
				9.0E-03	X					1	0.1		Dichlorobenzophenone, 4,4'-	90-98-2	5.5E+02	n	5.5E+03	n					5.7E+01	n		3.5E-01	
				2.0E-01	I	1.0E-01	X	V		1		8.5E+02	Dichlorodifluoromethane	75-71-8	9.4E+01	n	4.0E+02	n	1.0E+02	n	4.4E+02	n	1.9E+02	n		3.0E-01	
5.7E-03	C	1.6E-06	C	2.0E-01	P			V		1		1.7E+03	Dichloroethane, 1,1-	75-34-3	3.3E+00	c	1.7E+01	c	1.5E+00	c	7.7E+00	c	2.4E+00	c		6.8E-04	
9.1E-02	I	2.6E-05	I	6.0E-03	X	7.0E-03	P	V		1		3.0E+03	Dichloroethane, 1,2-	107-06-2	4.3E-01	c*	2.2E+00	c*	9.4E-02	c*	4.7E-01	c*	1.5E-01	c*	5.0E+00	4.2E-05	1.4E-03
				5.0E-02	I	2.0E-01	I	V		1		1.2E+03	Dichloroethylene, 1,1-	75-35-4	2.4E+02	n	1.1E+03	n	2.1E+02	n	8.8E+02	n	2.6E+02	n	7.0E+00	9.3E-02	2.5E-03
				9.0E-03	H			V		1		1.3E+03	Dichloroethylene, 1,2- (Mixed Isomers)	540-59-0	7.0E+02	n	9.2E+03	ns					1.3E+02	n		3.7E-02	
				2.0E-03	I			V		1		2.4E+03	Dichloroethylene, 1,2-cis-	156-59-2	1.6E+02	n	2.0E+03	n					2.8E+01	n	7.0E+01	8.2E-03	2.1E-02
				2.0E-02	I	6.0E-02	P	V		1		1.7E+03	Dichloroethylene, 1,2-trans-	156-60-5	1.5E+02	n	6.9E+02	n	6.3E+01	n	2.6E+02	n	8.6E+01	n	1.0E+02	2.5E-02	2.9E-02
				3.0E-03	I					1	0.1		Dichlorophenol, 2,4-	120-83-2	1.8E+02	n	1.8E+03	n					3.5E+01	n		4.1E-02	
				1.0E-02	I					1	0.05		Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	6.9E+02	n	7.7E+03	n					1.3E+02	n	7.0E+01	3.5E-02	1.8E-02
				8.0E-03	I					1	0.1		Dichlorophenoxy)butyric Acid, 4-(2,4-	94-82-6	4.9E+02	n	4.9E+03	n					9.1E+01	n		3.6E-02	
3.6E-02	C	1.0E-05	C	9.0E-02	A	4.0E-03	I	V		1		1.4E+03	Dichloropropane, 1,2-	78-87-5	9.4E-01	c*	4.7E+00	c*	2.4E-01	c*	1.2E+00	c*	3.8E-01	c*	5.0E+00	1.3E-04	1.7E-03
				2.0E-02	P			V		1		1.5E+03	Dichloropropane, 1,3-	142-28-9	1.6E+03	ns	2.0E+04	ns					2.9E+02	n		9.9E-02	
				3.0E-03	I					1	0.1		Dichloropropanol, 2,3-	616-23-9	1.8E+02	n	1.8E+03	n					4.6E+01	n		9.8E-03	
1.0E-01	I	4.0E-06	I	3.0E-02	I	2.0E-02	I	V		1		1.6E+03	Dichloropropene, 1,3-	542-75-6	1.7E+00	c*	8.3E+00	c*	6.1E-01	c*	3.1E+00	c*	4.1E-01	c*		1.5E-04	
2.9E-01	I	8.3E-05	C	5.0E-04	I	5.0E-04	I			1	0.1		Dichlorvos	62-73-7	1.7E+00	c*	5.9E+00	c*	2.9E-02	c*	1.5E-01	c*	2.3E-01	c*		7.0E-05	
				8.0E-03	P	7.0E-03	P	V		1			Dicyclopentadiene	77-73-6	3.1E+01	n	1.3E+02	n	7.3E+00	n	3.1E+01	n	1.2E+01	n		4.3E-02	
1.6E+01	I	4.6E-03	I	5.0E-05	I					1	0.1		Dieldrin	60-57-1	3.0E-02	c	1.1E-01	c	5.3E-04	c	2.7E-03	c	1.5E-03	c		6.1E-05	
		3.0E-04	C			5.0E-03	I			1	0.1		Diesel Engine Exhaust	NA					8.1E-03	c	4.1E-02	c					
				2.0E-03	P	2.0E-04	P			1	0.1		Diethanolamine	111-42-2	1.2E+02	n	1.2E+03	n	2.1E-01	n	8.8E-01	n	3.1E+01	n		6.3E-03	
				8.0E-01	I					1	0.1		Diethyl Phthalate	84-66-2	4.9E+04	n	4.9E+05	nm					1.1E+04	n		4.7E+00	
				3.0E-02	P	1.0E-04	P			1	0.1		Diethylene Glycol Monobutyl Ether	112-34-5	1.8E+03	n	1.8E+04	n	1.0E-01	n	4.4E-01	n	4.7E+02	n		1.0E-01	
				6.0E-02	P	3.0E-04	P			1	0.1		Diethylene Glycol Monoethyl Ether	111-90-0	3.6E+03	n	3.6E+04	n	3.1E-01	n	1.3E+00	n	9.4E+02	n		1.9E-01	
				1.0E-03	P					1	0.1		Diethylformamide	617-84-5	6.1E+01	n	6.2E+02	n					1.6E+01	n		3.2E-03	
3.5E+02	C	1.0E-01	C							1	0.1		Diethylstilbestrol	56-53-1	1.4E-03	c	4.9E-03	c	2.4E-05	c	1.2E-04	c	4.3E-05	c		2.4E-05	
				8.0E-02	I					1	0.1		Difenzoquat	43222-48-6	4.9E+03	n	4.9E+04	n					1.2E+03	n			
				2.0E-02	I					1	0.1		Diflubenzuron	35367-38-5	1.2E+03	n	1.2E+04	n					2.2E+02	n		2.5E-01	
						4.0E+01	I	V		1		1.4E+03	Difluoroethane, 1,1-	75-37-6	5.2E+04	ns	2.2E+05	nms	4.2E+04	n	1.8E+05	n	8.3E+04	n		2.8E+01	
4.4E-02	C	1.3E-05	C					V		1	0.1		Dihydrosafrole	94-58-6	2.4E-01	c	1.2E+00	c	1.9E-01	c	9.4E-01	c	2.6E-01	c		3.2E-04	
						7.0E-01	P	V		1		2.3E+03	Diisopropyl Ether	108-20-3	2.4E+03	ns	1.0E+04	ns	7.3E+02	n	3.1E+03	n	1.5E+03	n		3.7E-01	
				8.0E-02	I			V		1		5.3E+02	Diisopropyl Methylphosphonate	1445-75-6	6.3E+03	ns	8.2E+04	ns					1.2E+03	n		3.5E-01	
				2.0E-02	I					1	0.1		Dimethipin	55290-64-7	1.2E+03	n	1.2E+04	n					3.1E+02	n		6.9E-02	
				2.0E-04	I					1	0.1		Dimethoate	60-51-5	1.2E+01	n	1.2E+02	n					3.1E+00	n		7.0E-04	
1.4E-02	H									1	0.1		Dimethoxybenzidine, 3,3'-	119-90-4	3.5E+01	c	1.2E+02	c					4.7E+00	c		5.7E-03	
1.7E-03	P			6.0E-02	P					1	0.1		Dimethyl methylphosphonate	756-79-6	2.9E+02	c*	1.0E+03	c*					3.9E+01	c*		8.3E-03	
4.6E+00	C	1.3E-03	C							1	0.1		Dimethylamino azobenzene [p-]	60-11-7	1.1E-01	c	3.7E-01	c	1.9E-03	c	9.4E-03	c	4.3E-03	c		1.8E-05	
5.8E-01	H									1	0.1		Dimethylaniline HCl, 2,4-	21436-96-4	8.4E-01	c	3.0E+00	c					1.2E-01	c		1.0E-04	
2.0E-01	P			2.0E-03	X					1	0.1		Dimethylaniline, 2,4-	95-68-1	2.4E+00	c*	8.6E+00	c					3.2E-01	c*		1.8E-04	
				2.0E-03	I			V		1		8.3E+02	Dimethylaniline, N,N-	121-69-7	1.6E+02	n	2.0E+03	ns					2.7E+01	n		9.8E-03	
1.1E+01	P									1	0.1		Dimethylbenzidine, 3,3'-	119-93-7	4.4E-02	c	1.6E-01	c					5.6E-03	c		3.7E-05	
				1.0E-01	P	3.0E-02	I			1	0.1		Dimethylformamide	68-12-2	6.1E+03	n	6.2E+04	n	3.1E+01	n	1.3E+02	n	1.6E+03	n		3.2E-01	
				1.0E-04	X	2.0E-06	X			1	0.1		Dimethylhydrazine, 1,1-	57-14-7	6.1E+00	n	6.1E+01	n	2.1E-03	n	8.8E-03	n	1.6E+00	n		3.5E-04	
5.5E+02	C	1.6E-01	C							1	0.1		Dimethylhydrazine, 1,2-	540-73-8	8.8E-04	c	3.1E-03	c	1.5E-05	c	7.7E-05	c	1.2E-04	c		2.8E-08	

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information												Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				2.0E-02	I					1	0.1		Dimethylphenol, 2,4-	105-67-9	1.2E+03	n	1.2E+04	n					2.7E+02	n		3.2E-01	
				6.0E-04	I					1	0.1		Dimethylphenol, 2,6-	576-26-1	3.7E+01	n	3.7E+02	n					8.1E+00	n		9.8E-03	
				1.0E-03	I					1	0.1		Dimethylphenol, 3,4-	95-65-8	6.1E+01	n	6.2E+02	n					1.4E+01	n		1.6E-02	
				1.0E-01	I			V		1			Dimethylterephthalate	120-61-6	7.8E+03	n	1.0E+05	nm					1.4E+03	n		3.8E-01	
4.5E-02	C	1.3E-05	C					V		1	0.1	1.1E+03	Dimethylvinylchloride	513-37-1	2.0E-01	c	1.0E+00	c	1.9E-01	c	9.4E-01	c	2.8E-01	c		1.8E-04	
				8.0E-05	X					1	0.1		Dinitro-o-cresol, 4,6-	534-52-1	4.9E+00	n	4.9E+01	n					1.2E+00	n		2.0E-03	
				2.0E-03	I					1	0.1		Dinitro-o-cyclohexyl Phenol, 4,6-	131-89-5	1.2E+02	n	1.2E+03	n					1.7E+01	n		5.7E-01	
				1.0E-04	P					1	0.1		Dinitrobenzene, 1,2-	528-29-0	6.1E+00	n	6.2E+01	n					1.5E+00	n		1.4E-03	
				1.0E-04	I					1	0.1		Dinitrobenzene, 1,3-	99-65-0	6.1E+00	n	6.2E+01	n					1.5E+00	n		1.4E-03	
				1.0E-04	P					1	0.1		Dinitrobenzene, 1,4-	100-25-4	6.1E+00	n	6.2E+01	n					1.5E+00	n		1.4E-03	
				2.0E-03	I					1	0.1		Dinitrophenol, 2,4-	51-28-5	1.2E+02	n	1.2E+03	n					3.0E+01	n		3.4E-02	
6.8E-01	I									1	0.1		Dinitrotoluene Mixture, 2,4/2,6-	NA	7.2E-01	c	2.5E+00	c					9.2E-02	c		1.3E-04	
3.1E-01	C	8.9E-05	C	2.0E-03	I					1	0.102		Dinitrotoluene, 2,4-	121-14-2	1.6E+00	c*	5.5E+00	c	2.7E-02	c	1.4E-01	c	2.0E-01	c		2.8E-04	
1.5E+00	P			3.0E-04	X					1	0.099		Dinitrotoluene, 2,6-	606-20-2	3.3E-01	c*	1.2E+00	c					4.2E-02	c		5.8E-05	
				2.0E-03	S					1	0.006		Dinitrotoluene, 2-Amino-4,6-	35572-78-2	1.5E+02	n	2.0E+03	n					3.0E+01	n		2.3E-02	
				2.0E-03	S					1	0.009		Dinitrotoluene, 4-Amino-2,6-	19406-51-0	1.5E+02	n	1.9E+03	n					3.0E+01	n		2.3E-02	
4.5E-01	X			9.0E-04	X					1	0.1		Dinitrotoluene, Technical grade	25321-14-6	1.1E+00	c	3.8E+00	c					1.4E-01	c		1.9E-04	
				1.0E-03	I					1	0.1		Dinoseb	88-85-7	6.1E+01	n	6.2E+02	n					1.1E+01	n	7.0E+00	9.8E-02	6.2E-02
1.0E-01	I	7.7E-06	C	3.0E-02	I	1.1E-01	A			1	0.1		Dioxane, 1,4-	123-91-1	4.9E+00	c	1.7E+01	c	3.2E-01	c	1.6E+00	c	6.7E-01	c		1.4E-04	
													Dioxins														
6.2E+03	I	1.3E+00	I							1	0.03		~Hexachlorodibenzo-p-dioxin, Mixture	NA	9.4E-05	c	3.9E-04	c	1.9E-06	c	9.4E-06	c	1.1E-05	c		1.5E-05	
1.3E+05	C	3.8E+01	C	7.0E-10	I	4.0E-08	C			1	0.03		~TCDD, 2,3,7,8-	1746-01-6	4.5E-06	c*	1.8E-05	c*	6.4E-08	c	3.2E-07	c	5.2E-07	c*	3.0E-05	2.6E-07	1.5E-05
				3.0E-02	I					1	0.1		Diphenamid	957-51-7	1.8E+03	n	1.8E+04	n					4.1E+02	n		4.0E+00	
				8.0E-04	X					1	0.1		Diphenyl Sulfone	127-63-9	4.9E+01	n	4.9E+02	n					1.1E+01	n		2.8E-02	
				2.5E-02	I					1	0.1		Diphenylamine	122-39-4	1.5E+03	n	1.5E+04	n					2.4E+02	n		4.4E-01	
8.0E-01	I	2.2E-04	I							1	0.1		Diphenylhydrazine, 1,2-	122-66-7	6.1E-01	c	2.2E+00	c	1.1E-02	c	5.6E-02	c	6.7E-02	c		2.2E-04	
				2.2E-03	I					1	0.1		Diquat	85-00-7	1.3E+02	n	1.4E+03	n					3.4E+01	n	2.0E+01	6.5E-01	3.7E-01
7.4E+00	C	2.1E-03	C							1	0.1		Direct Black 38	1937-37-7	6.6E-02	c	2.3E-01	c	1.2E-03	c	5.8E-03	c	9.1E-03	c		4.4E+00	
7.4E+00	C	2.1E-03	C							1	0.1		Direct Blue 6	2602-46-2	6.6E-02	c	2.3E-01	c	1.2E-03	c	5.8E-03	c	9.1E-03	c		1.4E+01	
6.7E+00	C	1.9E-03	C							1	0.1		Direct Brown 95	16071-86-6	7.3E-02	c	2.6E-01	c	1.3E-03	c	6.5E-03	c	1.0E-02	c			
				4.0E-05	I					1	0.1		Disulfoton	298-04-4	2.4E+00	n	2.5E+01	n					3.8E-01	n		7.1E-04	
				1.0E-02	I			V		1	0.1		Dithiane, 1,4-	505-29-3	6.1E+02	n	6.2E+03	n					1.5E+02	n		7.6E-02	
				2.0E-03	I					1	0.1		Diuron	330-54-1	1.2E+02	n	1.2E+03	n					2.8E+01	n		1.2E-02	
				4.0E-03	I					1	0.1		Dodine	2439-10-3	2.4E+02	n	2.5E+03	n					6.2E+01	n		3.2E-01	
				2.5E-02	I			V		1			EPTC	759-94-4	2.0E+03	n	2.6E+04	n					2.9E+02	n		1.5E-01	
				6.0E-03	I					1	0.1		Endosulfan	115-29-7	3.7E+02	n	3.7E+03	n					7.8E+01	n		1.1E+00	
				2.0E-02	I					1	0.1		Endothall	145-73-3	1.2E+03	n	1.2E+04	n					3.0E+02	n	1.0E+02	7.1E-02	2.4E-02
				3.0E-04	I					1	0.1		Endrin	72-20-8	1.8E+01	n	1.8E+02	n					1.7E+00	n	2.0E+00	6.8E-02	8.1E-02
9.9E-03	I	1.2E-06	I	6.0E-03	P	1.0E-03	I	V		1		1.1E+04	Epichlorohydrin	106-89-8	2.0E+01	n	8.8E+01	n	1.0E+00	n	4.4E+00	n	2.0E+00	n		4.5E-04	
						2.0E-02	I	V		1		1.5E+04	Epoxybutane, 1,2-	106-88-7	1.7E+02	n	7.2E+02	n	2.1E+01	n	8.8E+01	n	4.2E+01	n		9.2E-03	
				5.0E-03	I					1	0.1		Ethephon	16672-87-0	3.1E+02	n	3.1E+03	n					7.8E+01	n		1.6E-02	
				5.0E-04	I					1	0.1		Ethion	563-12-2	3.1E+01	n	3.1E+02	n					3.2E+00	n		6.3E-03	
				1.0E-01	P	6.0E-02	P			1	0.1		Ethoxyethanol Acetate, 2-	111-15-9	6.1E+03	n	6.2E+04	n	6.3E+01	n	2.6E+02	n	1.5E+03	n		3.2E-01	
				4.0E-01	H	2.0E-01	I			1	0.1		Ethoxyethanol, 2-	110-80-5	2.4E+04	n	2.5E+05	nm	2.1E+02	n	8.8E+02	n	6.2E+03	n		1.3E+00	
				9.0E-01	I			V		1		1.1E+04	Ethyl Acetate	141-78-6	7.0E+04	ns	9.2E+05	nms					1.4E+04	n		2.9E+00	
4.8E-02	H							V		1		2.5E+03	Ethyl Acrylate	140-88-5	1.3E+01	c	6.0E+01	c					1.4E+00	c		3.0E-04	
						1.0E+01	I	V		1		2.1E+03	Ethyl Chloride	75-00-3	1.5E+04	ns	6.1E+04	ns	1.0E+04	n	4.4E+04	n	2.1E+04	n		5.9E+00	
				2.0E-01	I			V		1		1.0E+04	Ethyl Ether	60-29-7	1.6E+04	ns	2.0E+05	nms					3.1E+03	n		6.8E-01	
				9.0E-02	H	3.0E-01	P	V		1		1.1E+03	Ethyl Methacrylate	97-63-2	1.5E+03	ns	7.5E+03	ns	3.1E+02	n	1.3E+03	n	4.2E+02	n		9.9E-02	
				1.0E-05	I					1	0.1		Ethyl-p-nitrophenyl Phosphonate	2104-64-5	6.1E-01	n	6.2E+00	n					6.6E-02	n		2.1E-03	
1.1E-02	C	2.5E-06	C	1.0E-01	I	1.0E+00	I	V		1		4.8E+02	Ethylbenzene	100-41-4	5.4E+00	c	2.7E+01	c	9.7E-01	c	4.9E+00	c	1.3E+00	c	7.0E+02	1.5E-03	7.8E-01
				7.0E-02	P					1	0.1		Ethylene Cyanohydrin	109-78-4	4.3E+03	n	4.3E+04	n					1.1E+03	n		2.2E-01	
				9.0E-02	P					1	0.1		Ethylene Diamine	107-15-3	5.5E+03	n	5.5E+04	n					1.4E+03	n		3.2E-01	
				2.0E+00	I	4.0E-01	C			1	0.1		Ethylene Glycol	107-21-1	1.2E+05	nm	1.2E+06	nm	4.2E+02	n	1.8E+03	n	3.1E+04	n		6.3E+00	
				1.0E-01	I	1.6E+00	I			1	0.1		Ethylene Glycol Monobutyl Ether	111-76-2	6.1E+03	n	6.2E+04	n	1.7E+03	n	7.0E+03	n	1.5E+03	n		3.2E-01	
3.1E-01	C	8.8E-05	C			3.0E-02	C	V		1		1.2E+05	Ethylene Oxide	75-21-8	1.7E-01	c	8.3E-01	c	2.8E-02	c	1.4E-01	c	4.4E-02	c		9.1E-06	
4.5E-02	C	1.3E-05	C	8.0E-05	I					1	0.1		Ethylene Thiourea	96-45-7	4.9E+00	n	3.8E+01	c**	1.9E-01	c	9.4E-01	c	1.2E+00	n		2.8E-04	
6.5E+01	C	1.9E-02	C					V		1	0.1	1.5E+05	Ethyleneimine	151-56-4	2.3E-03	c	1.0E-02	c	1.3E-04	c	6.5E-04	c	2.1E-04	c		4.5E-08	
				3.0E+00	I					1	0.1		Ethylphthalyl Ethyl Glycolate	84-72-0	1.8E+05	nm	1.8E+06	nm					4.5E+04	n		1.0E+02	
				8.0E-03	I					1	0.1		Express	101200-48-0	4.9E+02	n	4.9E+03	n					1.2E+02	n		4.7E-02	
				2.5E-04	I					1	0.1		Fenamiphos	22224-92-6	1.5E+01	n	1.5E+02	n					3.4E+00	n		3.3E-03	
				2.5E-02	I					1	0.1		Fenpropathrin	39515-41-8	1.5E+03	n	1.5E+04	n					4.6E+01	n		2.1E+00	
				1.3E-02	I					1	0.1		Fluometuron	2164-17-2	7.9E+02	n	8.0E+03	n					1.9E+02	n		1.4E-01	
				4.0E-02	C	1.3E-02	C			1			Fluoride	16984-48-8	3.1E+03	n	4.1E+04	n	1.4E+01	n	5.7E+01	n	6.2E+02	n		9.3E+01	
				6.0E-02	I	1.3E-02	C			1			Fluorine (Soluble Fluoride)	7782-41-4	4.7E+03	n	6.1E+04	n	1.4E+01	n	5.7E+01	n	9.3E+02	n	4.0E+03	1.4E+02	6.0E+02

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				8.0E-02	I					1	0.1		Fluridone	59756-60-4	4.9E+03	n	4.9E+04	n					1.1E+03	n		1.3E+02	
				2.0E-02	I					1	0.1		Flurprimidol	56425-91-3	1.2E+03	n	1.2E+04	n					2.6E+02	n		1.2E+00	
				6.0E-02	I					1	0.1		Flutolanil	66332-96-5	3.7E+03	n	3.7E+04	n					7.2E+02	n		3.9E+00	
				1.0E-02	I					1	0.1		Fluvalinate	69409-94-5	6.1E+02	n	6.2E+03	n					1.6E+02	n		2.3E+02	
3.5E-03	I			1.0E-01	I					1	0.1		Folpet	133-07-3	1.4E+02	c*	4.9E+02	c					1.7E+01	c*		4.1E-03	
1.9E-01	I									1	0.1		Fomesafen	72178-02-0	2.6E+00	c	9.1E+00	c					3.4E-01	c		1.1E-03	
				2.0E-03	I					1	0.1		Fonofos	944-22-9	1.2E+02	n	1.2E+03	n					1.8E+01	n		3.5E-02	
		1.3E-05	I	2.0E-01	I	9.8E-03	A			1	0.1		Formaldehyde	50-00-0	1.2E+04	n	1.2E+05	nm	1.9E-01	c*	9.4E-01	c*	3.1E+03	n		6.2E-01	
				9.0E-01	P	3.0E-04	X			1	0.1		Formic Acid	64-18-6	4.9E+04	n	4.2E+05	nm	3.1E-01	n	1.3E+00	n	1.4E+04	n		2.8E+00	
				3.0E+00	I					1	0.1		Fosetyl-AL	39148-24-8	1.8E+05	nm	1.8E+06	nm					4.7E+04	n			
													Furans														
				1.0E-03	X			V		1			~Dibenzofuran	132-64-9	7.8E+01	n	1.0E+03	n					5.8E+00	n		1.1E-01	
				1.0E-03	I			V		1		6.2E+03	~Furan	110-00-9	7.8E+01	n	1.0E+03	n					1.5E+01	n		5.7E-03	
				9.0E-01	I	2.0E+00	I	V		1	0.1	1.7E+05	~Tetrahydrofuran	109-99-9	1.8E+04	n	9.5E+04	n	2.1E+03	n	8.8E+03	n	3.2E+03	n		7.1E-01	
3.8E+00	H									1	0.1		Furazolidone	67-45-8	1.3E-01	c	4.5E-01	c					1.8E-02	c		3.4E-05	
				3.0E-03	I	5.0E-02	H			1	0.1		Furfural	98-01-1	1.8E+02	n	1.8E+03	n	5.2E+01	n	2.2E+02	n	4.6E+01	n		9.9E-03	
1.5E+00	C	4.3E-04	C							1	0.1		Furium	531-82-8	3.2E-01	c	1.1E+00	c	5.7E-03	c	2.9E-02	c	4.4E-02	c		5.9E-05	
3.0E-02	I	8.6E-06	C							1	0.1		Furmecyclox	60568-05-0	1.6E+01	c	5.7E+01	c	2.8E-01	c	1.4E+00	c	9.6E-01	c		1.0E-03	
				4.0E-04	I					1	0.1		Glufosinate, Ammonium	77182-82-2	2.4E+01	n	2.5E+02	n					6.3E+00	n		1.4E-03	
						8.0E-05	C			1	0.1		Glutaraldehyde	111-30-8	1.1E+05	nm	4.8E+05	nm	8.3E-02	n	3.5E-01	n					
				4.0E-04	I	1.0E-03	H			1	0.1		Glycidyl	765-34-4	2.4E+01	n	2.5E+02	n	1.0E+00	n	4.4E+00	n	6.2E+00	n		1.3E-03	
				1.0E-01	I					1	0.1		Glyphosate	1071-83-6	6.1E+03	n	6.2E+04	n					1.6E+03	n	7.0E+02	6.9E+00	3.1E+00
				3.0E-03	I					1	0.1		Goal	42874-03-3	1.8E+02	n	1.8E+03	n					2.4E+01	n		1.9E+00	
				3.0E-03	A	1.0E-02	A			1	0.1		Guthion	86-50-0	1.8E+02	n	1.8E+03	n	1.0E+01	n	4.4E+01	n	4.3E+01	n		1.3E-02	
				5.0E-05	I					1	0.1		Haloxyfop, Methyl	69806-40-2	3.1E+00	n	3.1E+01	n					5.8E-01	n		6.4E-03	
				1.3E-02	I					1	0.1		Harmony	79277-27-3	7.9E+02	n	8.0E+03	n					2.0E+02	n		6.1E-02	
4.5E+00	I	1.3E-03	I	5.0E-04	I					1	0.1		Heptachlor	76-44-8	1.1E-01	c	3.8E-01	c	1.9E-03	c	9.4E-03	c	1.8E-03	c	4.0E-01	1.4E-04	3.3E-02
9.1E+00	I	2.6E-03	I	1.3E-05	I					1	0.1		Heptachlor Epoxide	1024-57-3	5.3E-02	c*	1.9E-01	c*	9.4E-04	c	4.7E-03	c	3.3E-03	c*	2.0E-01	6.8E-05	4.1E-03
				2.0E-03	I					1	0.1		Hexabromobenzene	87-82-1	1.2E+02	n	1.2E+03	n					3.1E+01	n		1.8E-01	
				2.0E-04	I					1	0.1		Hexabromodiphenyl ether, 2,2',4,4',5,5'- (BDE-153)	68631-49-2	1.2E+01	n	1.2E+02	n					3.1E+00	n			
1.6E+00	I	4.6E-04	I	8.0E-04	I					1	0.1		Hexachlorobenzene	118-74-1	3.0E-01	c	1.1E+00	c	5.3E-03	c	2.7E-02	c	4.2E-02	c	1.0E+00	5.3E-04	1.3E-02
7.8E-02	I	2.2E-05	I	1.0E-03	P					1	0.1		Hexachlorobutadiene	87-68-3	6.2E+00	c**	2.2E+01	c*	1.1E-01	c	5.6E-01	c	2.6E-01	c*		5.0E-04	
6.3E+00	I	1.8E-03	I	8.0E-03	A					1	0.1		Hexachlorocyclohexane, Alpha-	319-84-6	7.7E-02	c	2.7E-01	c	1.4E-03	c	6.8E-03	c	6.2E-03	c		3.6E-05	
1.8E+00	I	5.3E-04	I							1	0.1		Hexachlorocyclohexane, Beta-	319-85-7	2.7E-01	c	9.6E-01	c	4.6E-03	c	2.3E-02	c	2.2E-02	c		1.3E-04	
1.1E+00	C	3.1E-04	C	3.0E-04	I					1	0.04		Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	5.2E-01	c*	2.1E+00	c	7.8E-03	c	4.0E-02	c	3.6E-02	c*	2.0E-01	2.1E-04	1.2E-03
1.8E+00	I	5.1E-04	I							1	0.1		Hexachlorocyclohexane, Technical	608-73-1	2.7E-01	c	9.6E-01	c	4.8E-03	c	2.4E-02	c	2.2E-02	c		1.3E-04	
				6.0E-03	I	2.0E-04	I			1	0.1		Hexachlorocyclopentadiene	77-47-4	3.7E+02	n	3.7E+03	n	2.1E-01	n	8.8E-01	n	2.2E+01	n	5.0E+01	7.0E-02	1.6E-01
4.0E-02	I	1.1E-05	C	7.0E-04	I	3.0E-02	I			1	0.1		Hexachloroethane	67-72-1	1.2E+01	c**	4.3E+01	c*	2.2E-01	c	1.1E+00	c	7.9E-01	c**		4.8E-04	
				3.0E-04	I					1	0.1		Hexachlorophene	70-30-4	1.8E+01	n	1.8E+02	n					4.7E+00	n		6.3E+00	
1.1E-01	I			3.0E-03	I					1	0.015		Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	5.6E+00	c*	2.4E+01	c					6.1E-01	c*		2.3E-04	
						1.0E-05	I	V		1		5.2E+03	Hexamethylene Diisocyanate, 1,6-	822-06-0	3.4E+00	n	1.4E+01	n	1.0E-02	n	4.4E-02	n	2.1E-02	n		2.1E-04	
				4.0E-04	P					1	0.1		Hexamethylphosphoramide	680-31-9	2.4E+01	n	2.5E+02	n					6.2E+00	n		1.4E-03	
				6.0E-02	H	7.0E-01	I	V		1		1.4E+02	Hexane, N-	110-54-3	5.7E+02	ns	2.6E+03	ns	7.3E+02	n	3.1E+03	n	2.5E+02	n		1.8E+00	
				2.0E+00	P					1	0.1		Hexanedioic Acid	124-04-9	1.2E+05	nm	1.2E+06	nm					3.1E+04	n		7.7E+00	
				5.0E-03	I	3.0E-02	I	V		1		3.3E+03	Hexanone, 2-	591-78-6	2.1E+02	n	1.4E+03	n	3.1E+01	n	1.3E+02	n	3.4E+01	n		7.9E-03	
				3.3E-02	I					1	0.1		Hexazinone	51235-04-2	2.0E+03	n	2.0E+04	n					5.0E+02	n		2.3E-01	
3.0E+00	I	4.9E-03	I			3.0E-05	P			1			Hydrazine	302-01-2	2.1E-01	c	9.5E-01	c	5.0E-04	c*	2.5E-03	c*	2.2E-02	c			
3.0E+00	I	4.9E-03	I							1			Hydrazine Sulfate	10034-93-2	2.1E-01	c	9.5E-01	c	5.0E-04	c	2.5E-03	c	2.2E-02	c			
						2.0E-02	I			1			Hydrogen Chloride	7647-01-0	2.8E+07	nm	1.2E+08	nm	2.1E+01	n	8.8E+01	n					
				4.0E-02	C	1.4E-02	C			1			Hydrogen Fluoride	7664-39-3	3.1E+03	n	4.1E+04	n	1.5E+01	n	6.1E+01	n	6.2E+02	n			
						2.0E-03	I			1			Hydrogen Sulfide	7783-06-4	2.8E+06	nm	1.2E+07	nm	2.1E+00	n	8.8E+00	n					
6.0E-02	P			4.0E-02	P					1	0.1		Hydroquinone	123-31-9	8.1E+00	c	2.9E+01	c					1.1E+00	c		7.5E-04	
				1.3E-02	I					1	0.1		Imazalil	35554-44-0	7.9E+02	n	8.0E+03	n					1.4E+02	n		2.5E+00	
				2.5E-01	I					1	0.1		Imazaquin	81335-37-7	1.5E+04	n	1.5E+05	nm					3.8E+03	n		1.9E+01	
				1.0E-02	A					1			Iodine	7553-56-2	7.8E+02	n	1.0E+04	n					1.6E+02	n		9.4E+00	
				4.0E-02	I					1	0.1		Iprodione	36734-19-7	2.4E+03	n	2.5E+04	n					5.7E+02	n		1.7E-01	
				7.0E-01	P					1			Iron	7439-89-6	5.5E+04	n	7.2E+05	nm					1.1E+04	n		2.7E+02	
				3.0E-01	I					1	0.1		Isobutyl Alcohol	78-83-1	1.8E+04	n	1.8E+05	nm					4.6E+03	n		9.5E-01	
9.5E-04	I			2.0E-01	I	2.0E+00	C			1	0.1		Isophorone	78-59-1	5.1E+02	c*	1.8E+03	c*	2.1E+03	n	8.8E+03	n	6.7E+01	c*		2.2E-02	
				1.5E-02	I					1	0.1		Isopropalin	33820-53-0	9.2E+02	n	9.2E+03	n					2.9E+01	n		6.6E-01	
						7.0E+00	C			1	0.1		Isopropanol	67-63-0	9.9E+09	nm	4.2E+10	nm	7.3E+03	n	3.1E+04	n					
				1.0E-01	I					1	0.1		Isopropyl Methyl Phosphonic Acid	1832-54-8	6.1E+03	n	6.2E+04	n					1.6E+03	n		3.4E-01	
				5.0E-02	I					1	0.1		Isoxaben	82558-50-7	3.1E+03	n	3.1E+04	n					5.6E+02	n		1.5E+00	
						3.0E-01	A	V		1			JP-7	NA	4.3E+08	nm	1.8E+09	nm	3.1E+02	n	1.3E+03	n	6.3E+02	n			
				7.5E-02	I					1	0.1		Kerb	23950-58-5	4.6E+03	n	4.6E+04	n					9.0E+02	n		9.1E-01	

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Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				2.0E-03	I					1	0.1		Lactofen	77501-63-4	1.2E+02	n	1.2E+03	n					1.9E+01	n		8.7E-01	
													Lead Compounds														
2.8E-01	C	8.0E-05	C							1	0.1		~Lead acetate	301-04-2	1.7E+00	c	6.2E+00	c	3.0E-02	c	1.5E-01	c	2.4E-01	c			
										1			~Lead and Compounds	7439-92-1	4.0E+02	L	8.0E+02	L	1.5E-01	L		L		L	1.5E+01		1.4E+01
3.8E-02	C	1.1E-05	C							1	0.1		~Lead subacetate	1335-32-6	1.3E+01	c	4.5E+01	c	2.2E-01	c	1.1E+00	c	1.8E+00	c			
				1.0E-07	I					1	0.1		~Tetraethyl Lead	78-00-2	6.1E-03	n	6.2E-02	n					9.9E-04	n		3.5E-06	
				2.0E-03	I					1	0.1		Linuron	330-55-2	1.2E+02	n	1.2E+03	n					2.6E+01	n		2.3E-02	
				2.0E-03	P					1			Lithium	7439-93-2	1.6E+02	n	2.0E+03	n					3.1E+01	n		9.3E+00	
				2.0E-01	I					1	0.1		Londax	83055-99-6	1.2E+04	n	1.2E+05	nm					3.1E+03	n		7.9E-01	
				5.0E-04	I					1	0.1		MCPA	94-74-6	3.1E+01	n	3.1E+02	n					5.7E+00	n		1.5E-03	
				1.0E-02	I					1	0.1		MCPB	94-81-5	6.1E+02	n	6.2E+03	n					1.1E+02	n		4.4E-02	
				1.0E-03	I					1	0.1		MCPP	93-65-2	6.1E+01	n	6.2E+02	n					1.2E+01	n		3.5E-03	
				2.0E-02	I					1	0.1		Malathion	121-75-5	1.2E+03	n	1.2E+04	n					3.0E+02	n		7.9E-02	
				1.0E-01	I	7.0E-04	C			1	0.1		Maleic Anhydride	108-31-6	6.1E+03	n	6.1E+04	n	7.3E-01	n	3.1E+00	n	1.5E+03	n		3.0E-01	
				5.0E-01	I					1	0.1		Maleic Hydrazide	123-33-1	3.1E+04	n	3.1E+05	nm					7.8E+03	n		1.6E+00	
				1.0E-04	P					1	0.1		Malononitrile	109-77-3	6.1E+00	n	6.2E+01	n					1.6E+00	n		3.2E-04	
				3.0E-02	H					1	0.1		Mancozeb	8018-01-7	1.8E+03	n	1.8E+04	n					4.6E+02	n		6.5E-01	
				5.0E-03	I					1	0.1		Maneb	12427-38-2	3.1E+02	n	3.1E+03	n					7.7E+01	n		1.1E-01	
				1.4E-01	I	5.0E-05	I			1			Manganese (Diet)	7439-96-5													
				2.4E-02	S	5.0E-05	I			0.04			Manganese (Non-diet)	7439-96-5	1.8E+03	n	2.3E+04	n	5.2E-02	n	2.2E-01	n	3.2E+02	n		2.1E+01	
				9.0E-05	H					1	0.1		Mephosfolan	950-10-7	5.5E+00	n	5.5E+01	n					1.4E+00	n		2.1E-03	
				3.0E-02	I					1	0.1		Mepiquat Chloride	24307-26-4	1.8E+03	n	1.8E+04	n					4.7E+02	n		1.6E-01	
													Mercury Compounds														
				3.0E-04	I	3.0E-04	S			0.07			~Mercuric Chloride (and other Mercury salts)	7487-94-7	2.3E+01	n	3.1E+02	n	3.1E-01	n	1.3E+00	n	4.3E+00	n	2.0E+00		
						3.0E-04	I	V		1		3.1E+00	~Mercury (elemental)	7439-97-6	1.0E+01	ns	4.3E+01	ns	3.1E-01	n	1.3E+00	n	6.3E-01	n	2.0E+00	3.3E-02	1.0E-01
				1.0E-04	I					1			~Methyl Mercury	22967-92-6	7.8E+00	n	1.0E+02	n					1.6E+00	n			
				8.0E-05	I					1	0.1		~Phenylmercuric Acetate	62-38-4	4.9E+00	n	4.9E+01	n					1.2E+00	n		3.9E-04	
				3.0E-05	I					1	0.1		Merphos	150-50-5	1.8E+00	n	1.8E+01	n					4.7E-01	n		4.6E-02	
				3.0E-05	I					1	0.1		Merphos Oxide	78-48-8	1.8E+00	n	1.8E+01	n					6.1E-02	n		3.0E-04	
				6.0E-02	I					1	0.1		Metalaxyl	57837-19-1	3.7E+03	n	3.7E+04	n					9.2E+02	n		2.5E-01	
				1.0E-04	I	3.0E-02	P	V		1		4.6E+03	Methacrylonitrile	126-98-7	7.6E+00	n	9.2E+01	n	3.1E+01	n	1.3E+02	n	1.5E+00	n		3.4E-04	
				5.0E-05	I					1	0.1		Methamidophos	10265-92-6	3.1E+00	n	3.1E+01	n					7.8E-01	n		1.6E-04	
				5.0E-01	I	4.0E+00	C			1	0.1		Methanol	67-56-1	3.1E+04	n	3.1E+05	nm	4.2E+03	n	1.8E+04	n	7.8E+03	n		1.6E+00	
				1.0E-03	I					1	0.1		Methidathion	950-37-8	6.1E+01	n	6.2E+02	n					1.5E+01	n		3.7E-03	
				2.5E-02	I					1	0.1		Methomyl	16752-77-5	1.5E+03	n	1.5E+04	n					3.9E+02	n		8.5E-02	
4.9E-02	C	1.4E-05	C							1	0.1		Methoxy-5-nitroaniline, 2-	99-59-2	9.9E+00	c	3.5E+01	c	1.7E-01	c	8.8E-01	c	1.3E+00	c		4.6E-04	
				5.0E-03	I					1	0.1		Methoxychlor	72-43-5	3.1E+02	n	3.1E+03	n					2.7E+01	n	4.0E+01	1.5E+00	2.2E+00
				8.0E-03	P	1.0E-03	P			1	0.1		Methoxyethanol Acetate, 2-	110-49-6	4.9E+02	n	4.9E+03	n	1.0E+00	n	4.4E+00	n	1.2E+02	n		2.6E-02	
				5.0E-03	P	2.0E-02	I			1	0.1		Methoxyethanol, 2-	109-86-4	3.1E+02	n	3.1E+03	n	2.1E+01	n	8.8E+01	n	7.8E+01	n		1.6E-02	
				1.0E+00	X			V		1		2.9E+04	Methyl Acetate	79-20-9	7.8E+04	ns	1.0E+06	nms					1.6E+04	n		3.2E+00	
				3.0E-02	H	2.0E-02	P	V		1		6.8E+03	Methyl Acrylate	96-33-3	1.5E+02	n	6.4E+02	n	2.1E+01	n	8.8E+01	n	3.8E+01	n		8.1E-03	
				6.0E-01	I	5.0E+00	I	V		1		2.8E+04	Methyl Ethyl Ketone (2-Butanone)	78-93-3	2.8E+04	n	2.0E+05	nms	5.2E+03	n	2.2E+04	n	4.9E+03	n		1.0E+00	
		1.0E-03	X	1.0E-03	P	2.0E-05	X			1	0.1		Methyl Hydrazine	60-34-4	6.1E+01	n	6.1E+02	n	2.4E-03	c**	1.2E-02	c**	1.6E+01	n		3.5E-03	
				8.0E-02	H	3.0E+00	I	V		1		3.4E+03	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	5.3E+03	ns	5.3E+04	ns	3.1E+03	n	1.3E+04	n	1.0E+03	n		2.3E-01	
						1.0E-03	C	V		1	0.1	1.7E+04	Methyl Isocyanate	624-83-9	5.0E+00	n	2.1E+01	n	1.0E+00	n	4.4E+00	n	2.1E+00	n		5.9E-04	
				1.4E+00	I	7.0E-01	I	V		1		2.4E+03	Methyl Methacrylate	80-62-6	4.8E+03	ns	2.1E+04	ns	7.3E+02	n	3.1E+03	n	1.4E+03	n		3.0E-01	
				2.5E-04	I					1	0.1		Methyl Parathion	298-00-0	1.5E+01	n	1.5E+02	n					3.4E+00	n		5.7E-03	
				6.0E-02	X					1	0.1		Methyl Phosphonic Acid	993-13-5	3.7E+03	n	3.7E+04	n					9.4E+02	n		1.9E-01	
				6.0E-03	H	4.0E-02	H	V		1		3.9E+02	Methyl Styrene (Mixed Isomers)	25013-15-4	2.4E+02	n	1.5E+03	ns	4.2E+01	n	1.8E+02	n	3.2E+01	n		5.2E-02	
9.9E-02	C	2.8E-05	C							1	0.1		Methyl methanesulfonate	66-27-3	4.9E+00	c	1.7E+01	c	8.7E-02	c	4.4E-01	c	6.8E-01	c		1.4E-04	
1.8E-03	C	2.6E-07	C			3.0E+00	I	V		1		8.9E+03	Methyl tert-Butyl Ether (MTBE)	1634-04-4	4.3E+01	c	2.2E+02	c	9.4E+00	c	4.7E+01	c	1.2E+01	c		2.8E-03	
				3.0E-04	X					1	0.1		Methyl-1,4-benzenediamine dihydrochloride, 2-	615-45-2	1.8E+01	n	1.8E+02	n					4.7E+00	n		2.8E-03	
9.0E-03	P			2.0E-02	X					1	0.1		Methyl-5-Nitroaniline, 2-	99-55-8	5.4E+01	c*	1.9E+02	c*					7.0E+00	c*		3.9E-03	
8.3E+00	C	2.4E-03	C							1	0.1		Methyl-N-nitro-N-nitrosoguanidine, N-	70-25-7	5.9E-02	c	2.1E-01	c	1.0E-03	c	5.1E-03	c	8.1E-03	c		2.8E-06	
1.3E-01	C	3.7E-05	C							1	0.1		Methylaniline Hydrochloride, 2-	636-21-5	3.7E+00	c	1.3E+01	c	6.6E-02	c	3.3E-01	c	5.0E-01	c		2.1E-04	
				1.0E-02	A					1	0.1		Methylarsonic acid	124-58-3	6.1E+02	n	6.2E+03	n					1.6E+02	n			
				2.0E-04	X					1	0.1		Methylbenzene,1-4-diamine monohydrochloride, 2-	74612-12-7	1.2E+01	n	1.2E+02	n					3.1E+00	n			
1.0E-01	X			3.0E-04	X					1	0.1		Methylbenzene-1,4-diamine sulfate, 2-	615-50-9	4.9E+00	c**	1.7E+01	c*					6.7E-01	c**			
2.2E+01	C	6.3E-03	C						M	1	0.1		Methylcholanthrene, 3-	56-49-5	5.2E-03	c	7.8E-02	c	1.5E-04	c	1.9E-03	c	9.8E-04	c		1.9E-03	
2.0E-03	I	1.0E-08	I	6.0E-03	I	6.0E-01	I	V	M	1		3.3E+03	Methylene Chloride	75-09-2	5.6E+01	c**	9.6E+02	c**	9.6E+01	c**	1.2E+03	c**	9.9E+00	c**	5.0E+00	2.5E-03	1.3E-03
1.0E-01	P	4.3E-04	C	2.0E-03	P				M	1	0.1		Methylene-bis(2-chloroaniline), 4,4'-	101-14-4	1.2E+00	c	1.7E+01	c*	2.2E-03	c	2.9E-02	c	1.4E-01	c		1.6E-03	
4.6E-02	I	1.3E-05	C							1	0.1		Methylene-bis(N,N-dimethyl) Aniline, 4,4'-	101-61-1	1.1E+01	c	3.7E+01	c	1.9E-01	c	9.4E-01	c	4.1E-01	c		2.3E-03	
1.6E+00	C	4.6E-04	C			2.0E-02	C			1	0.1		Methylenebisbenzenamine, 4,4'-	101-77-9	3.0E-01	c	1.1E+00	c	5.3E-03	c	2.7E-02	c	4.1E-02	c		1.8E-04	
						6.0E-04	I			1	0.1		Methylenediphenyl Diisocyanate	101-68-8	8.5E+05	nm	3.6E+06	nm	6.3E-01	n	2.6E+00	n					
				7.0E-02	H			V		1		5.0E+02	Methylstyrene, Alpha-	98-83-9	5.5E+03	ns	7.2E+04	ns					5.8E+02	n		9.3E-01	

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SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				1.5E-01	I					1	0.1		Metolachlor	51218-45-2	9.2E+03	n	9.2E+04	n					2.1E+03	n		2.5E+00	
				2.5E-02	I					1	0.1		Metribuzin	21087-64-9	1.5E+03	n	1.5E+04	n					3.8E+02	n		1.2E-01	
				3.0E+00	P			V		1	0.1	3.4E-01	Mineral oils	8012-95-1	1.8E+05	nms	1.8E+06	nms					4.7E+04	n		1.9E+03	
1.8E+01	C	5.1E-03	C	2.0E-04	I					1	0.1		Mirex	2385-85-5	2.7E-02	c	9.6E-02	c	4.8E-04	c	2.4E-03	c	3.7E-03	c		2.7E-03	
				2.0E-03	I					1	0.1		Molinate	2212-67-1	1.2E+02	n	1.2E+03	n					2.3E+01	n		1.3E-02	
				5.0E-03	I					1			Molybdenum	7439-98-7	3.9E+02	n	5.1E+03	n					7.8E+01	n		1.6E+00	
				1.0E-01	I					1			Monochloramine	10599-90-3	7.8E+03	n	1.0E+05	nm					1.6E+03	n	4.0E+03		
				2.0E-03	P					1	0.1		Monomethylaniline	100-61-8	1.2E+02	n	1.2E+03	n					3.0E+01	n		1.1E-02	
				3.0E-04	X					1	0.1		N,N'-Diphenyl-1,4-benzenediamine	74-31-7	1.8E+01	n	1.8E+02	n					2.7E+00	n		2.8E-01	
				2.0E-03	I					1	0.1		Naled	300-76-5	1.2E+02	n	1.2E+03	n					3.1E+01	n		1.4E-02	
				3.0E-02	X	1.0E-01	P	V		1			Naphtha, High Flash Aromatic (HFAN)	64724-95-6	2.3E+03	n	3.1E+04	n	1.0E+02	n	4.4E+02	n	1.4E+02	n			
1.8E+00	C	0.0E+00	C							1	0.1		Naphthylamine, 2-	91-59-8	2.7E-01	c	9.6E-01	c					3.3E-02	c		1.7E-04	
				1.0E-01	I					1	0.1		Napropamide	15299-99-7	6.1E+03	n	6.2E+04	n					1.3E+03	n		8.3E+00	
				1.1E-02	C	1.4E-05	C			0.04			Nickel Carbonyl	13463-39-3	8.2E+02	n	9.9E+03	n	1.5E-02	n	6.1E-02	n	1.5E+02	n			
				1.1E-02	C	2.0E-05	C			1			Nickel Oxide	1313-99-1	8.4E+02	n	1.0E+04	n	2.1E-02	n	8.8E-02	n	1.7E+02	n			
		2.4E-04	I	1.1E-02	C	1.4E-05	C			0.04			Nickel Refinery Dust	NA	8.2E+02	n	9.9E+03	n	1.0E-02	c**	5.1E-02	c**	1.7E+02	n		2.5E+01	
		2.6E-04	C	2.0E-02	I	9.0E-05	A			0.04			Nickel Soluble Salts	7440-02-0	1.5E+03	n	2.0E+04	n	9.4E-03	c*	4.7E-02	c**	3.0E+02	n		2.0E+01	
1.7E+00	C	4.8E-04	I	1.1E-02	C	1.4E-05	C			0.04			Nickel Subsulfide	12035-72-2	3.8E-01	c	1.7E+00	c	5.1E-03	c**	2.6E-02	c**	3.9E-02	c			
				1.6E+00	I					1			Nitrate	14797-55-8	1.3E+05	nm	1.6E+06	nm					2.5E+04	n	1.0E+04		
										1			Nitrate + Nitrite (as N)	NA											1.0E+04		
				1.0E-01	I					1			Nitrite	14797-65-0	7.8E+03	n	1.0E+05	nm					1.6E+03	n	1.0E+03		
				1.0E-02	X	5.0E-05	X			1	0.1		Nitroaniline, 2-	88-74-4	6.1E+02	n	6.0E+03	n	5.2E-02	n	2.2E-01	n	1.5E+02	n		6.2E-02	
2.0E-02	P			4.0E-03	P	6.0E-03	P			1	0.1		Nitroaniline, 4-	100-01-6	2.4E+01	c*	8.6E+01	c*	6.3E+00	n	2.6E+01	n	3.3E+00	c*		1.4E-03	
		4.0E-05	I	2.0E-03	I	9.0E-03	I	V		1		3.1E+03	Nitrobenzene	98-95-3	4.8E+00	c*	2.4E+01	c*	6.1E-02	c	3.1E-01	c	1.2E-01	c*		7.9E-05	
				3.0E+03	P					1	0.1		Nitrocellulose	9004-70-0	1.8E+08	nm	1.8E+09	nm					4.7E+07	n		1.0E+04	
				7.0E-02	H					1	0.1		Nitrofurantoin	67-20-9	4.3E+03	n	4.3E+04	n					1.1E+03	n		4.7E-01	
1.3E+00	C	3.7E-04	C							1	0.1		Nitrofurazone	59-87-0	3.7E-01	c	1.3E+00	c	6.6E-03	c	3.3E-02	c	5.2E-02	c		4.6E-05	
1.7E-02	P			1.0E-04	P					1	0.1		Nitroglycerin	55-63-0	6.1E+00	n	6.2E+01	n					1.5E+00	n		6.6E-04	
				1.0E-01	I					1	0.1		Nitroguanidine	556-88-7	6.1E+03	n	6.2E+04	n					1.6E+03	n		3.8E-01	
		9.0E-06	P			2.0E-02	P	V		1		1.8E+04	Nitromethane	75-52-5	4.9E+00	c*	2.5E+01	c*	2.7E-01	c*	1.4E+00	c*	5.4E-01	c*		1.2E-04	
		2.7E-03	H			2.0E-02	I	V		1		4.9E+03	Nitropropane, 2-	79-46-9	1.3E-02	c	6.4E-02	c	9.0E-04	c	4.5E-03	c	1.8E-03	c		4.7E-07	
2.7E+01	C	7.7E-03	C						M	1	0.1		Nitroso-N-ethylurea, N-	759-73-9	4.3E-03	c	6.4E-02	c	1.2E-04	c	1.6E-03	c	7.9E-04	c		1.9E-07	
1.2E+02	C	3.4E-02	C						M	1	0.1		Nitroso-N-methylurea, N-	684-93-5	9.6E-04	c	1.4E-02	c	2.8E-05	c	3.6E-04	c	1.8E-04	c		4.0E-08	
5.4E+00	I	1.6E-03	I					V		1			Nitroso-di-N-butylamine, N-	924-16-3	8.7E-02	c	4.0E-01	c	1.5E-03	c	7.7E-03	c	2.4E-03	c		4.8E-06	
7.0E+00	I	2.0E-03	C							1	0.1		Nitroso-di-N-propylamine, N-	621-64-7	6.9E-02	c	2.5E-01	c	1.2E-03	c	6.1E-03	c	9.3E-03	c		7.0E-06	
2.8E+00	I	8.0E-04	C							1	0.1		Nitrosodiethanolamine, N-	1116-54-7	1.7E-01	c	6.2E-01	c	3.0E-03	c	1.5E-02	c	2.4E-02	c		4.8E-06	
1.5E+02	I	4.3E-02	I						M	1	0.1		Nitrosodiethylamine, N-	55-18-5	7.7E-04	c	1.1E-02	c	2.2E-05	c	2.9E-04	c	1.4E-04	c		5.2E-08	
5.1E+01	I	1.4E-02	I	8.0E-06	P	4.0E-05	X		M	1	0.1		Nitrosodimethylamine, N-	62-75-9	2.3E-03	c	3.4E-02	c	6.9E-05	c	8.8E-04	c	4.2E-04	c		1.0E-07	
4.9E-03	I	2.6E-06	C							1	0.1		Nitrosodiphenylamine, N-	86-30-6	9.9E+01	c	3.5E+02	c	9.4E-01	c	4.7E+00	c	1.0E+01	c		5.7E-02	
2.2E+01	I	6.3E-03	C							1	0.1		Nitrosomethylethylamine, N-	10595-95-6	2.2E-02	c	7.8E-02	c	3.9E-04	c	1.9E-03	c	3.0E-03	c		8.7E-07	
6.7E+00	C	1.9E-03	C							1	0.1		Nitrosomorpholine [N-]	59-89-2	7.3E-02	c	2.6E-01	c	1.3E-03	c	6.5E-03	c	1.0E-02	c		2.5E-06	
9.4E+00	C	2.7E-03	C							1	0.1		Nitrosopiperidine [N-]	100-75-4	5.2E-02	c	1.8E-01	c	9.0E-04	c	4.5E-03	c	7.1E-03	c		3.8E-06	
2.1E+00	I	6.1E-04	I							1	0.1		Nitrosopyrrolidine, N-	930-55-2	2.3E-01	c	8.2E-01	c	4.0E-03	c	2.0E-02	c	3.2E-02	c		1.2E-05	
				1.0E-04	X					1	0.1		Nitrotoluene, m-	99-08-1	6.1E+00	n	6.2E+01	n					1.3E+00	n		1.2E-03	
2.2E-01	P			9.0E-04	P			V		1		1.5E+03	Nitrotoluene, o-	88-72-2	2.9E+00	c*	1.3E+01	c*					2.7E-01	c*		2.5E-04	
1.6E-02	P			4.0E-03	P					1	0.1		Nitrotoluene, p-	99-99-0	3.0E+01	c**	1.1E+02	c*					3.7E+00	c*		3.4E-03	
				3.0E-04	X	2.0E-01	P	V		1		6.9E+00	Nonane, n-	111-84-2	2.1E+01	ns	2.3E+02	ns	2.1E+02	n	8.8E+02	n	4.6E+00	n		6.6E-02	
				4.0E-02	I					1	0.1		Norflurazon	27314-13-2	2.4E+03	n	2.5E+04	n					6.0E+02	n		3.9E+00	
				7.0E-04	I					1	0.1		Nustar	85509-19-9	4.3E+01	n	4.3E+02	n					8.3E+00	n		1.4E+00	
				3.0E-03	I					1	0.1		Octabromodiphenyl Ether	32536-52-0	1.8E+02	n	1.8E+03	n					4.7E+01	n		9.3E+00	
				5.0E-02	I					1	0.006		Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetra (HMX)	2691-41-0	3.8E+03	n	4.9E+04	n					7.8E+02	n		9.9E-01	
				2.0E-03	H					1	0.1		Octamethylpyrophosphoramide	152-16-9	1.2E+02	n	1.2E+03	n					3.1E+01	n		7.5E-03	
				1.0E-02	P					1	0.1		Octyl Phthalate, di-N-	117-84-0	6.1E+02	n	6.2E+03	n					1.6E+02	n		4.4E+01	
				5.0E-02	I					1	0.1		Oryzalin	19044-88-3	3.1E+03	n	3.1E+04	n					6.2E+02	n		1.1E+00	
				5.0E-03	I					1	0.1		Oxadiazon	19666-30-9	3.1E+02	n	3.1E+03	n					3.5E+01	n		3.6E-01	
				2.5E-02	I					1	0.1		Oxamyl	23135-22-0	1.5E+03	n	1.5E+04	n					3.9E+02	n	2.0E+02	8.6E-02	4.4E-02
				1.3E-02	I					1	0.1		Paclobutrazol	76738-62-0	7.9E+02	n	8.0E+03	n					1.7E+02	n		3.6E-01	
				4.5E-03	I					1	0.1		Paraquat Dichloride	1910-42-5	2.7E+02	n	2.8E+03	n					7.0E+01	n		9.7E-01	
				6.0E-03	H					1	0.1		Parathion	56-38-2	3.7E+02	n	3.7E+03	n					6.5E+01	n		3.3E-01	
				5.0E-02	H					1	0.1		Pebulate	1114-71-2	3.1E+03	n	3.1E+04	n					4.2E+02	n		3.3E-01	
				4.0E-02	I					1	0.1		Pendimethalin	40487-42-1	2.4E+03	n	2.5E+04	n					1.3E+02	n		1.5E+00	
				2.0E-03	I					1	0.1		Pentabromodiphenyl Ether	32534-81-9	1.2E+02	n	1.2E+03	n					3.1E+01	n		1.4E+00	
				1.0E-04	I					1	0.1		Pentabromodiphenyl ether, 2,2',4,4',5- (BDE-99)	60348-60-9	6.1E+00	n	6.2E+01	n					1.6E+00	n		6.8E-02	
				8.0E-04	I					1	0.1		Pentachlorobenzene	608-93-5	4.9E+01	n	4.9E+02	n					2.3E+00	n		1.7E-02	
9.0E-02	P									1	0.1		Pentachloroethane	76-01-7	5.4E+00	c	1.9E+01	c					5.6E-01	c		2.7E-04	

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; R = RBA applied (See User Guide for Arsenic notice) ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
2.6E-01	H			3.0E-03	I					1	0.1		Pentachloronitrobenzene	82-68-8	1.9E+00	c*	6.6E+00	c					1.0E-01	c		1.3E-03	
4.0E-01	I	5.1E-06	C	5.0E-03	I					1	0.25		Pentachlorophenol	87-86-5	8.9E-01	c	2.7E+00	c	4.8E-01	c	2.4E+00	c	3.5E-02	c	1.0E+00	3.6E-04	1.0E-02
4.0E-03	X			2.0E-03	P					1	0.1		Pentaerythritol tetranitrate (PETN)	78-11-5	1.2E+02	c**	4.3E+02	c**					1.6E+01	c**		2.4E-02	
						1.0E+00	P	V		1		3.9E+02	Pentane, n-	109-66-0	8.7E+02	ns	3.7E+03	ns	1.0E+03	n	4.4E+03	n	2.1E+03	n		1.0E+01	
													Perchlorates														
				7.0E-04	I					1			~Ammonium Perchlorate	7790-98-9	5.5E+01	n	7.2E+02	n					1.1E+01	n			
				7.0E-04	I					1			~Lithium Perchlorate	7791-03-9	5.5E+01	n	7.2E+02	n					1.1E+01	n			
				7.0E-04	I					1			~Perchlorate and Perchlorate Salts	14797-73-0	5.5E+01	n	7.2E+02	n					1.1E+01	n	1.5E+01(F)		
				7.0E-04	I					1			~Potassium Perchlorate	7778-74-7	5.5E+01	n	7.2E+02	n					1.1E+01	n			
				7.0E-04	I					1			~Sodium Perchlorate	7601-89-0	5.5E+01	n	7.2E+02	n					1.1E+01	n			
				5.0E-02	I					1	0.1		Permethrin	52645-53-1	3.1E+03	n	3.1E+04	n					7.8E+02	n		1.9E+02	
2.2E-03	C	6.3E-07	C							1	0.1		Phenacetin	62-44-2	2.2E+02	c	7.8E+02	c	3.9E+00	c	1.9E+01	c	3.0E+01	c		8.3E-03	
				2.5E-01	I					1	0.1		Phenmedipham	13684-63-4	1.5E+04	n	1.5E+05	nm					3.0E+03	n		1.6E+01	
				3.0E-01	I	2.0E-01	C			1	0.1		Phenol	108-95-2	1.8E+04	n	1.8E+05	nm	2.1E+02	n	8.8E+02	n	4.5E+03	n		2.6E+00	
				5.0E-04	X					1	0.1		Phenothiazine	92-84-2	3.1E+01	n	3.1E+02	n					3.2E+00	n		1.0E-02	
				6.0E-03	I					1	0.1		Phenylenediamine, m-	108-45-2	3.7E+02	n	3.7E+03	n					9.4E+01	n		2.5E-02	
4.7E-02	H									1	0.1		Phenylenediamine, o-	95-54-5	1.0E+01	c	3.7E+01	c					1.4E+00	c		3.8E-04	
				1.9E-01	H					1	0.1		Phenylenediamine, p-	106-50-3	1.2E+04	n	1.2E+05	nm					3.0E+03	n		7.9E-01	
1.9E-03	H									1	0.1		Phenylphenol, 2-	90-43-7	2.5E+02	c	8.9E+02	c					2.6E+01	c		3.5E-01	
				2.0E-04	H					1	0.1		Phorate	298-02-2	1.2E+01	n	1.2E+02	n					2.3E+00	n		2.6E-03	
						3.0E-04	I	V		1		1.6E+03	Phosgene	75-44-5	3.3E-01	n	1.4E+00	n	3.1E-01	n	1.3E+00	n					
				2.0E-02	I					1	0.1		Phosmet	732-11-6	1.2E+03	n	1.2E+04	n					2.9E+02	n		6.4E-02	
													Phosphates, Inorganic														
				4.9E+01	P					1			~Aluminum metaphosphate	13776-88-0	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Ammonium polyphosphate	68333-79-9	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Calcium pyrophosphate	7790-76-3	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Diammonium phosphate	7783-28-0	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Dicalcium phosphate	7757-93-9	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Dimagnesium phosphate	7782-75-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Dipotassium phosphate	7758-11-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Disodium phosphate	7558-79-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monoaluminum phosphate	13530-50-2	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monoammonium phosphate	7722-76-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monocalcium phosphate	7758-23-8	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monomagnesium phosphate	7757-86-0	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monopotassium phosphate	7778-77-0	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monosodium phosphate	7558-80-7	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Polyphosphoric acid	8017-16-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Potassium tripolyphosphate	13845-36-8	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium acid pyrophosphate	7758-16-9	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium aluminum phosphate (acidic)	7785-88-8	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium aluminum phosphate (anhydrous)	10279-59-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium aluminum phosphate (tetrahydrate)	10305-76-7	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium hexametaphosphate	10124-56-8	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium polyphosphate	68915-31-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium trimetaphosphate	7785-84-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium tripolyphosphate	7758-29-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Tetrapotassium phosphate	7320-34-5	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Tetrasodium pyrophosphate	7722-88-5	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Trialuminum sodium tetra decahydrogenoctaorthophosphate (dihydrate)	15136-87-5	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Tricalcium phosphate	7758-87-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Trimagnesium phosphate	7757-87-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Tripotassium phosphate	7778-53-2	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Trisodium phosphate	7601-54-9	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				3.0E-04	I	3.0E-04	I			1			Phosphine	7803-51-2	2.3E+01	n	3.1E+02	n	3.1E-01	n	1.3E+00	n	4.7E+00	n			
				4.9E+01	P	1.0E-02	I			1			Phosphoric Acid	7664-38-2	3.0E+06	nm	2.7E+07	nm	1.0E+01	n	4.4E+01	n	7.6E+05	n			
				2.0E-05	I					1			Phosphorus, White	7723-14-0	1.6E+00	n	2.0E+01	n					3.1E-01	n		1.1E-03	
				1.0E+00	H					1	0.1		Phthalic Acid, P-	100-21-0	6.1E+04	n	6.2E+05	nm					1.5E+04	n		5.3E+00	
				2.0E+00	I	2.0E-02	C			1	0.1		Phthalic Anhydride	85-44-9	1.2E+05	nm	1.2E+06	nm	2.1E+01	n	8.8E+01	n	3.0E+04	n		6.6E+00	
				7.0E-02	I					1	0.1		Picloram	1918-02-1	4.3E+03	n	4.3E+04	n					1.1E+03	n	5.0E+02	2.9E-01	1.4E-01
				1.0E-04	X					1	0.1		Picramic Acid (2-Amino-4,6-dinitrophenol)	96-91-3	6.1E+00	n	6.2E+01	n					1.5E+00	n		1.0E-03	
				1.0E-02	I					1	0.1		Pirimiphos, Methyl	29232-93-7	6.1E+02	n	6.2E+03	n					9.1E+01	n		8.7E-02	
3.0E+01	C	8.6E-03	C	7.0E-06	H					1	0.1		Polybrominated Biphenyls	59536-65-1	1.6E-02	c*	5.7E-02	c*	2.8E-04	c	1.4E-03	c	2.2E-03	c*			
													Polychlorinated Biphenyls (PCBs)														
7.0E-02	S	2.0E-05	S	7.0E-05	I					1	0.14		~Aroclor 1016	12674-11-2	3.9E+00	n	2.1E+01	c**	1.2E-01	c	6.1E-01	c	9.6E-01	c**		9.2E-02	

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Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vol	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
2.0E+00	S	5.7E-04	S					V		1	0.14	7.6E+02	~Aroclor 1221	11104-28-2	1.4E-01	c	5.4E-01	c	4.3E-03	c	2.1E-02	c	4.0E-03	c		6.9E-05	
2.0E+00	S	5.7E-04	S					V		1	0.14	7.3E+01	~Aroclor 1232	11141-16-5	1.4E-01	c	5.4E-01	c	4.3E-03	c	2.1E-02	c	4.0E-03	c		6.9E-05	
2.0E+00	S	5.7E-04	S							1	0.14		~Aroclor 1242	53469-21-9	2.2E-01	c	7.4E-01	c	4.3E-03	c	2.1E-02	c	3.4E-02	c		5.3E-03	
2.0E+00	S	5.7E-04	S							1	0.14		~Aroclor 1248	12672-29-6	2.2E-01	c	7.4E-01	c	4.3E-03	c	2.1E-02	c	3.4E-02	c		5.2E-03	
2.0E+00	S	5.7E-04	S	2.0E-05	I					1	0.14		~Aroclor 1254	11097-69-1	2.2E-01	c**	7.4E-01	c*	4.3E-03	c	2.1E-02	c	3.4E-02	c**		8.8E-03	
2.0E+00	S	5.7E-04	S							1	0.14		~Aroclor 1260	11096-82-5	2.2E-01	c	7.4E-01	c	4.3E-03	c	2.1E-02	c	3.4E-02	c		2.4E-02	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E			1	0.14		~Heptachlorobiphenyl, 2,3,3',4,4',5,5'- (PCB 189)	39635-31-9	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		1.2E-02	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E			1	0.14		~Hexachlorobiphenyl, 2,3',4,4',5,5'- (PCB 167)	52663-72-6	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		7.2E-03	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E			1	0.14		~Hexachlorobiphenyl, 2,3,3',4,4',5'- (PCB 157)	69782-90-7	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		7.4E-03	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E			1	0.14		~Hexachlorobiphenyl, 2,3,3',4,4',5- (PCB 156)	38380-08-4	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		7.4E-03	
3.9E+03	E	1.1E+00	E	2.3E-08	E	1.3E-06	E			1	0.14		~Hexachlorobiphenyl, 3,3',4,4',5,5'- (PCB 169)	32774-16-6	1.1E-04	c*	3.8E-04	c*	2.1E-06	c	1.1E-05	c	1.7E-05	c*		7.2E-06	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E			1	0.14		~Pentachlorobiphenyl, 2',3,4,4',5- (PCB 123)	65510-44-3	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		4.5E-03	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E			1	0.14		~Pentachlorobiphenyl, 2,3',4,4',5- (PCB 118)	31508-00-6	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		4.4E-03	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E			1	0.14		~Pentachlorobiphenyl, 2,3,3',4,4'- (PCB 105)	32598-14-4	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		4.5E-03	
3.9E+00	E	1.1E-03	E	2.3E-05	E	1.3E-03	E			1	0.14		~Pentachlorobiphenyl, 2,3,4,4',5- (PCB 114)	74472-37-0	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		4.5E-03	
1.3E+04	E	3.8E+00	E	7.0E-09	E	4.0E-07	E			1	0.14		~Pentachlorobiphenyl, 3,3',4,4',5- (PCB 126)	57465-28-8	3.4E-05	c*	1.1E-04	c*	6.4E-07	c	3.2E-06	c	5.2E-06	c*		1.3E-06	
2.0E+00	I	5.7E-04	I							1	0.14		~Polychlorinated Biphenyls (high risk)	1336-36-3	2.2E-01	c	7.4E-01	c	4.3E-03	c	2.1E-02	c					
4.0E-01	I	1.0E-04	I							1	0.14		~Polychlorinated Biphenyls (low risk)	1336-36-3					2.4E-02	c	1.2E-01	c	1.7E-01	c	5.0E-01	2.6E-02	7.8E-02
7.0E-02	I	2.0E-05	I							1	0.14		~Polychlorinated Biphenyls (lowest risk)	1336-36-3					1.2E-01	c	6.1E-01	c					
1.3E+01	E	3.8E-03	E	7.0E-06	E	4.0E-04	E			1	0.14		~Tetrachlorobiphenyl, 3,3',4,4'- (PCB 77)	32598-13-3	3.4E-02	c*	1.1E-01	c*	6.4E-04	c	3.2E-03	c	5.2E-03	c*		8.1E-04	
3.9E+01	E	1.1E-02	E	2.3E-06	E	1.3E-04	E			1	0.14		~Tetrachlorobiphenyl, 3,4,4',5- (PCB 81)	70362-50-4	1.1E-02	c*	3.8E-02	c*	2.1E-04	c	1.1E-03	c	1.7E-03	c*		2.7E-04	
						6.0E-04	I			1	0.1		Polymeric Methylene Diphenyl Diisocyanate (PMDI)	9016-87-9	8.5E+05	nm	3.6E+06	nm	6.3E-01	n	2.6E+00	n					
													Polynuclear Aromatic Hydrocarbons (PAHs)														
				6.0E-02	I			V		1	0.13		~Acenaphthene	83-32-9	3.4E+03	n	3.3E+04	n					4.0E+02	n		4.1E+00	
				3.0E-01	I			V		1	0.13		~Anthracene	120-12-7	1.7E+04	n	1.7E+05	nm					1.3E+03	n		4.2E+01	
7.3E-01	E	1.1E-04	C						M	1	0.13		~Benz[a]anthracene	56-55-3	1.5E-01	c	2.1E+00	c	8.7E-03	c	1.1E-01	c	2.9E-02	c		1.0E-02	
1.2E+00	C	1.1E-04	C							1	0.13		~Benzo(j)fluoranthene	205-82-3	3.8E-01	c	1.3E+00	c	2.2E-02	c	1.1E-01	c	5.6E-02	c		6.7E-02	
7.3E+00	I	1.1E-03	C						M	1	0.13		~Benzo[a]pyrene	50-32-8	1.5E-02	c	2.1E-01	c	8.7E-04	c	1.1E-02	c	2.9E-03	c	2.0E-01	3.5E-03	2.4E-01
7.3E-01	E	1.1E-04	C						M	1	0.13		~Benzo[b]fluoranthene	205-99-2	1.5E-01	c	2.1E+00	c	8.7E-03	c	1.1E-01	c	2.9E-02	c		3.5E-02	
7.3E-02	E	1.1E-04	C						M	1	0.13		~Benzo[k]fluoranthene	207-08-9	1.5E+00	c	2.1E+01	c	8.7E-03	c	1.1E-01	c	2.9E-01	c		3.5E-01	
7.3E-03	E	1.1E-05	C						M	1	0.13		~Chrysene	218-01-9	1.5E+01	c	2.1E+02	c	8.7E-02	c	1.1E+00	c	2.9E+00	c		1.1E+00	
7.3E+00	E	1.2E-03	C						M	1	0.13		~Dibenz[a,h]anthracene	53-70-3	1.5E-02	c	2.1E-01	c	8.0E-04	c	1.0E-02	c	2.9E-03	c		1.1E-02	
1.2E+01	C	1.1E-03	C							1	0.13		~Dibenzo(a,e)pyrene	192-65-4	3.8E-02	c	1.3E-01	c	2.2E-03	c	1.1E-02	c	5.6E-03	c		7.3E-02	
2.5E+02	C	7.1E-02	C						M	1	0.13		~Dimethylbenz(a)anthracene, 7,12-	57-97-6	4.3E-04	c	6.2E-03	c	1.4E-05	c	1.7E-04	c	8.6E-05	c		8.5E-05	
				4.0E-02	I					1	0.13		~Fluoranthene	206-44-0	2.3E+03	n	2.2E+04	n					6.3E+02	n		7.0E+01	
				4.0E-02	I			V		1	0.13		~Fluorene	86-73-7	2.3E+03	n	2.2E+04	n					2.2E+02	n		4.0E+00	
7.3E-01	E	1.1E-04	C						M	1	0.13		~Indeno[1,2,3-cd]pyrene	193-39-5	1.5E-01	c	2.1E+00	c	8.7E-03	c	1.1E-01	c	2.9E-02	c		2.0E-01	
2.9E-02	P			7.0E-02	A			V		1	0.13		~Methylnaphthalene, 1-	90-12-0	1.6E+01	c	5.3E+01	c					9.7E-01	c		5.1E-03	
				4.0E-03	I			V		1	0.13		~Methylnaphthalene, 2-	91-57-6	2.3E+02	n	2.2E+03	n					2.7E+01	n		1.4E-01	
		3.4E-05	C	2.0E-02	I	3.0E-03	I	V		1	0.13		~Naphthalene	91-20-3	3.6E+00	c*	1.8E+01	c*	7.2E-02	c*	3.6E-01	c*	1.4E-01	c*		4.7E-04	
1.2E+00	C	1.1E-04	C							1	0.13		~Nitropyrene, 4-	57835-92-4	3.8E-01	c	1.3E+00	c	2.2E-02	c	1.1E-01	c	1.6E-02	c		2.8E-03	
				3.0E-02	I			V		1	0.13		~Pyrene	129-00-0	1.7E+03	n	1.7E+04	n					8.7E+01	n		9.5E+00	
1.5E-01	I			9.0E-03	I					1	0.1		Prochloraz	67747-09-5	3.2E+00	c	1.1E+01	c					3.2E-01	c		1.6E-03	
				6.0E-03	H					1	0.1		Profluralin	26399-36-0	3.7E+02	n	3.7E+03	n					1.9E+01	n		1.2E+00	
				1.5E-02	I					1	0.1		Prometon	1610-18-0	9.2E+02	n	9.2E+03	n					1.9E+02	n		9.2E-02	
				4.0E-03	I					1	0.1		Prometryn	7287-19-6	2.4E+02	n	2.5E+03	n					4.5E+01	n		6.9E-02	
				1.3E-02	I					1	0.1		Propachlor	1918-16-7	7.9E+02	n	8.0E+03	n					1.9E+02	n		1.2E-01	
				5.0E-03	I					1	0.1		Propanil	709-98-8	3.1E+02	n	3.1E+03	n					6.3E+01	n		3.5E-02	
				2.0E-02	I					1	0.1		Propargite	2312-35-8	1.2E+03	n	1.2E+04	n					1.2E+02	n		8.8E+00	
				2.0E-03	I					1	0.1		Propargyl Alcohol	107-19-7	1.2E+02	n	1.2E+03	n					3.1E+01	n		6.4E-03	
				2.0E-02	I					1	0.1		Propazine	139-40-2	1.2E+03	n	1.2E+04	n					2.6E+02	n		2.3E-01	
				2.0E-02	I					1	0.1		Propham	122-42-9	1.2E+03	n	1.2E+04	n					2.7E+02	n		1.7E-01	
				1.3E-02	I					1	0.1		Propiconazole	60207-90-1	7.9E+02	n	8.0E+03	n					1.6E+02	n		5.3E-01	
						8.0E-03	I	V		1		3.3E+04	Propionaldehyde	123-38-6	8.0E+01	n	3.4E+02	n	8.3E+00	n	3.5E+01	n	1.7E+01	n		3.4E-03	
				1.0E-01	X	1.0E+00	X	V		1	0.1	2.6E+02	Propyl benzene	103-65-1	3.4E+03	ns	2.1E+04	ns	1.0E+03	n	4.4E+03	n	5.3E+02	n		9.9E-01	
						3.0E+00	C	V		1	0.1	3.5E+02	Propylene	115-07-1	2.4E+03	ns	1.0E+04	ns	3.1E+03	n	1.3E+04	n	6.3E+03	n		6.0E+00	
				2.0E+01	P					1	0.1		Propylene Glycol	57-55-6	1.2E+06	nm	1.2E+07	nm					3.1E+05	n		6.3E+01	
						2.7E-04	A			1	0.1		Propylene Glycol Dinitrate	6423-43-4	3.9E+05	nm	1.6E+06	nm	2.8E-01	n	1.2E+00	n					
				7.0E-01	H					1	0.1		Propylene Glycol Monoethyl Ether	1569-02-4	4.3E+04	n	4.3E+05	nm					1.1E+04	n		2.2E+00	
				7.0E-01	H	2.0E+00	I			1	0.1		Propylene Glycol Monomethyl Ether	107-98-2	4.3E+04	n	4.3E+05	nm	2.1E+03	n	8.8E+03	n	1.1E+04	n		2.2E+00	
2.4E-01	I	3.7E-06	I			3.0E-02	I	V		1		7.8E+04	Propylene Oxide	75-56-9	2.0E+00	c	9.0E+00	c	6.6E-01	c*	3.3E+00	c*	2.3E-01	c		4.8E-05	
				2.5E-01	I					1	0.1		Pursuit	81335-77-5	1.5E+04	n	1.5E+05	nm					3.6E+03	n		3.2E+00	
				2.5E-02	I					1	0.1		Pydrin	51630-58-1	1.5E+03	n	1.5E+04	n					3.9E+02	n		2.5E+02	
				1.0E-03	I			V		1		5.3E+05	Pyridine	110-86-1	7.8E+01	n	1.0E+03	n					1.5E+01	n		5.3E-03	
				5.0E-04	I					1	0.1		Quinalphos	13593-03-8	3.1E+01	n	3.1E+02	n					3.8E+00	n		3.2E-02	

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Toxicity and Chemical-specific Information												Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
3.0E+00	I									1	0.1		Quinoline	91-22-5	1.6E-01	c	5.7E-01	c					2.1E-02	c		6.8E-05	
						3.0E-02	A			1			Refractory Ceramic Fibers	NA	4.3E+07	nm	1.8E+08	nm	3.1E+01	n	1.3E+02	n					
				3.0E-02	I					1	0.1		Resmethrin	10453-86-8	1.8E+03	n	1.8E+04	n					4.8E+01	n		3.0E+01	
				5.0E-02	H					1	0.1		Ronnel	299-84-3	3.1E+03	n	3.1E+04	n					3.0E+02	n		2.7E+00	
				4.0E-03	I					1	0.1		Rotenone	83-79-4	2.4E+02	n	2.5E+03	n					4.7E+01	n		2.4E+01	
2.2E-01	C	6.3E-05	C						M	1	0.1		Safrole	94-59-7	5.2E-01	c	7.8E+00	c	1.5E-02	c	1.9E-01	c	8.3E-02	c		5.1E-05	
				2.5E-02	I					1	0.1		Savey	78587-05-0	1.5E+03	n	1.5E+04	n					8.1E+01	n		3.6E-01	
				5.0E-03	I					1			Selenious Acid	7783-00-8	3.9E+02	n	5.1E+03	n					7.8E+01	n			
				5.0E-03	I	2.0E-02	C			1			Selenium	7782-49-2	3.9E+02	n	5.1E+03	n	2.1E+01	n	8.8E+01	n	7.8E+01	n	5.0E+01	4.0E-01	2.6E-01
				5.0E-03	C	2.0E-02	C			1			Selenium Sulfide	7446-34-6	3.9E+02	n	5.1E+03	n	2.1E+01	n	8.8E+01	n	7.8E+01	n			
				9.0E-02	I					1	0.1		Sethoxydim	74051-80-2	5.5E+03	n	5.5E+04	n					7.8E+02	n		6.9E+00	
						3.0E-03	C			1			Silica (crystalline, respirable)	7631-86-9	4.3E+06	nm	1.8E+07	nm	3.1E+00	n	1.3E+01	n					
				5.0E-03	I					0.04			Silver	7440-22-4	3.9E+02	n	5.1E+03	n					7.1E+01	n		6.0E-01	
1.2E-01	H			5.0E-03	I					1	0.1		Simazine	122-34-9	4.1E+00	c*	1.4E+01	c					5.2E-01	c	4.0E+00	2.6E-04	2.0E-03
				1.3E-02	I					1	0.1		Sodium Acifluorfen	62476-59-9	7.9E+02	n	8.0E+03	n					2.0E+02	n		1.6E+00	
				4.0E-03	I					1			Sodium Azide	26628-22-8	3.1E+02	n	4.1E+03	n					6.2E+01	n			
2.7E-01	H			3.0E-02	I					1	0.1		Sodium Diethyldithiocarbamate	148-18-5	1.8E+00	c	6.4E+00	c					2.5E-01	c			
				5.0E-02	A	1.3E-02	C			1			Sodium Fluoride	7681-49-4	3.9E+03	n	5.1E+04	n	1.4E+01	n	5.7E+01	n	7.8E+02	n			
				2.0E-05	I					1	0.1		Sodium Fluoroacetate	62-74-8	1.2E+00	n	1.2E+01	n					3.1E-01	n		6.3E-05	
				1.0E-03	H					1			Sodium Metavanadate	13718-26-8	7.8E+01	n	1.0E+03	n					1.6E+01	n			
2.4E-02	H			3.0E-02	I					1	0.1		Stirofos (Tetrachlorovinphos)	961-11-5	2.0E+01	c*	7.2E+01	c					2.4E+00	c		7.0E-03	
				6.0E-01	I					1			Strontium, Stable	7440-24-6	4.7E+04	n	6.1E+05	nm					9.3E+03	n		3.3E+02	
				3.0E-04	I					1	0.1		Strychnine	57-24-9	1.8E+01	n	1.8E+02	n					4.6E+00	n		5.1E-02	
				2.0E-01	I	1.0E+00	I	V		1		8.7E+02	Styrene	100-42-5	6.3E+03	ns	3.6E+04	ns	1.0E+03	n	4.4E+03	n	1.1E+03	n	1.0E+02	1.2E+00	1.1E-01
				1.0E-03	P	2.0E-03	P			1	0.1		Sulfolane	126-33-0	6.1E+01	n	6.2E+02	n	2.1E+00	n	8.8E+00	n	1.6E+01	n		3.4E-03	
				8.0E-04	P					1	0.1		Sulfonylbis(4-chlorobenzene), 1,1'-	80-07-9	4.9E+01	n	4.9E+02	n					8.3E+00	n		4.9E-02	
						1.0E-03	C			1			Sulfuric Acid	7664-93-9	1.4E+06	nm	6.0E+06	nm	1.0E+00	n	4.4E+00	n					
				2.5E-02	I					1	0.1		Systhane	88671-89-0	1.5E+03	n	1.5E+04	n					3.5E+02	n		4.3E+00	
				3.0E-02	H					1	0.1		TCMTB	21564-17-0	1.8E+03	n	1.8E+04	n					3.7E+02	n		2.6E+00	
				7.0E-02	I					1	0.1		Tebuthiuron	34014-18-1	4.3E+03	n	4.3E+04	n					1.1E+03	n		3.0E-01	
				2.0E-02	H					1	0.1		Temephos	3383-96-8	1.2E+03	n	1.2E+04	n					3.1E+02	n		6.0E+01	
				1.3E-02	I					1	0.1		Terbacil	5902-51-2	7.9E+02	n	8.0E+03	n					2.0E+02	n		5.9E-02	
				2.5E-05	H					1	0.1		Terbufos	13071-79-9	1.5E+00	n	1.5E+01	n					1.8E-01	n		3.9E-04	
				1.0E-03	I					1	0.1		Terbutryn	886-50-0	6.1E+01	n	6.2E+02	n					1.0E+01	n		1.4E-02	
				1.0E-04	I					1	0.1		Tetrabromodiphenyl ether, 2,2',4,4'- (BDE-47)	5436-43-1	6.1E+00	n	6.2E+01	n					1.6E+00	n		4.2E-02	
				3.0E-04	I					1	0.1		Tetrachlorobenzene, 1,2,4,5-	95-94-3	1.8E+01	n	1.8E+02	n					1.2E+00	n		5.8E-03	
2.6E-02	I	7.4E-06	I	3.0E-02	I			V		1		6.8E+02	Tetrachloroethane, 1,1,1,2-	630-20-6	1.9E+00	c	9.3E+00	c	3.3E-01	c	1.7E+00	c	5.0E-01	c		1.9E-04	
2.0E-01	I	5.8E-05	C	2.0E-02	I			V		1		1.9E+03	Tetrachloroethane, 1,1,2,2-	79-34-5	5.6E-01	c	2.8E+00	c	4.2E-02	c	2.1E-01	c	6.6E-02	c		2.6E-05	
2.1E-03	I	2.6E-07	I	6.0E-03	I	4.0E-02	I	V		1		1.7E+02	Tetrachloroethylene	127-18-4	2.2E+01	c**	1.1E+02	c**	9.4E+00	c**	4.7E+01	c**	9.7E+00	c**	5.0E+00	4.4E-03	2.3E-03
				3.0E-02	I					1	0.1		Tetrachlorophenol, 2,3,4,6-	58-90-2	1.8E+03	n	1.8E+04	n					1.7E+02	n		1.1E+00	
2.0E+01	H									1	0.1		Tetrachlorotoluene, p- alpha, alpha, alpha-	5216-25-1	2.4E-02	c	8.6E-02	c					1.1E-03	c		3.9E-06	
				5.0E-04	I					1	0.1		Tetraethyl Dithiopyrophosphate	3689-24-5	3.1E+01	n	3.1E+02	n					5.3E+00	n		3.9E-03	
						8.0E+01	I	V		1		1.1E+03	Tetrafluoroethane, 1,1,1,2-	811-97-2	1.1E+05	nms	4.6E+05	nms	8.3E+04	n	3.5E+05	n	1.7E+05	n		9.3E+01	
				4.0E-03	P					1	0.1		Tetryl (Trinitrophenylmethylnitramine)	479-45-8	2.4E+02	n	2.5E+03	n					6.1E+01	n		5.8E-01	
				7.0E-06	X					1			Thallium (I) Nitrate	10102-45-1	5.5E-01	n	7.2E+00	n					1.1E-01	n			
				1.0E-05	X					1			Thallium (Soluble Salts)	7440-28-0	7.8E-01	n	1.0E+01	n					1.6E-01	n	2.0E+00	1.1E-02	1.4E-01
				6.0E-06	X					1			Thallium Acetate	563-68-8	4.7E-01	n	6.1E+00	n					9.3E-02	n			
				2.0E-05	X					1			Thallium Carbonate	6533-73-9	1.6E+00	n	2.0E+01	n					3.1E-01	n			
				6.0E-06	X					1			Thallium Chloride	7791-12-0	4.7E-01	n	6.1E+00	n					9.3E-02	n			
				2.0E-05	X					1			Thallium Sulfate	7446-18-6	1.6E+00	n	2.0E+01	n					3.1E-01	n			
				1.0E-02	I					1	0.1		Thiobencarb	28249-77-6	6.1E+02	n	6.2E+03	n					1.2E+02	n		4.2E-01	
				7.0E-02	X					1	0.008		Thiodiglycol	111-48-8	5.4E+03	n	6.8E+04	n					1.1E+03	n		2.2E-01	
				3.0E-04	H					1	0.1		Thiofanox	39196-18-4	1.8E+01	n	1.8E+02	n					4.1E+00	n		1.4E-03	
				8.0E-02	I					1	0.1		Thiophanate, Methyl	23564-05-8	4.9E+03	n	4.9E+04	n					1.2E+03	n		1.1E+00	
				5.0E-03	I					1	0.1		Thiram	137-26-8	3.1E+02	n	3.1E+03	n					7.6E+01	n		1.1E-01	
				6.0E-01	H					1			Tin	7440-31-5	4.7E+04	n	6.1E+05	nm					9.3E+03	n		2.3E+03	
						1.0E-04	A			1			Titanium Tetrachloride	7550-45-0	1.4E+05	nm	6.0E+05	nm	1.0E-01	n	4.4E-01	n					
				8.0E-02	I	5.0E+00	I	V		1		8.2E+02	Toluene	108-88-3	5.0E+03	ns	4.5E+04	ns	5.2E+03	n	2.2E+04	n	8.6E+02	n	1.0E+03	5.9E-01	6.9E-01
1.8E-01	X			2.0E-04	X					1	0.1		Toluene-2,5-diamine	95-70-5	2.7E+00	c**	9.6E+00	c*					3.7E-01	c**		1.2E-04	
3.0E-02	P			4.0E-03	X					1	0.1		Toluidine, p-	106-49-0	1.6E+01	c*	5.7E+01	c*					2.2E+00	c*		9.2E-04	
1.1E+00	I	3.2E-04	I							1	0.1		Toxaphene	8001-35-2	4.4E-01	c	1.6E+00	c	7.6E-03	c	3.8E-02	c	1.3E-02	c	3.0E+00	2.1E-03	4.6E-01
				7.5E-03	I					1	0.1		Tralomethrin	66841-25-6	4.6E+02	n	4.6E+03	n					1.2E+02	n		4.5E+01	
				3.0E-04	A					1	0.1		Tri-n-butyltin	688-73-3	1.8E+01	n	1.8E+02	n					2.8E+00	n		6.2E-02	
				8.0E+01	X					1	0.1		Triacetin	102-76-1	4.9E+06	nm	4.9E+07	nm					1.2E+06	n		3.5E+02	
				1.3E-02	I					1	0.1		Triallate	2303-17-5	7.9E+02	n	8.0E+03	n					8.7E+01	n		1.9E-01	

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Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	vo c	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				1.0E-02	I					1	0.1		Triasulfuron	82097-50-5	6.1E+02	n	6.2E+03	n					1.6E+02	n		1.6E-01	
				5.0E-03	I					1	0.1		Tribromobenzene, 1,2,4-	615-54-3	3.1E+02	n	3.1E+03	n					3.3E+01	n		4.7E-02	
9.0E-03	P			1.0E-02	P					1	0.1		Tributyl Phosphate	126-73-8	5.4E+01	c*	1.9E+02	c*					4.5E+00	c*		2.2E-02	
				3.0E-04	P					1	0.1		Tributyltin Compounds	NA	1.8E+01	n	1.8E+02	n					4.7E+00	n			
				3.0E-04	I					1	0.1		Tributyltin Oxide	56-35-9	1.8E+01	n	1.8E+02	n					4.4E+00	n		2.3E+02	
				3.0E+01	I	3.0E+01	H	V		1		9.1E+02	Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	4.3E+04	ns	1.8E+05	nms	3.1E+04	n	1.3E+05	n	5.3E+04	n		1.3E+02	
7.0E-02	I			2.0E-02	I					1	0.1		Trichloroacetic Acid	76-03-9	6.9E+00	c	2.5E+01	c					9.4E-01	c	6.0E+01	1.9E-04	1.2E-02
2.9E-02	H									1	0.1		Trichloroaniline HCl, 2,4,6-	33663-50-2	1.7E+01	c	5.9E+01	c					2.3E+00	c		6.4E-03	
7.0E-03	X			3.0E-05	X					1	0.1		Trichloroaniline, 2,4,6-	634-93-5	1.8E+00	n	1.8E+01	n					3.0E-01	n		2.7E-03	
				8.0E-04	X			V		1	0.1		Trichlorobenzene, 1,2,3-	87-61-6	4.9E+01	n	4.9E+02	n					5.2E+00	n		1.5E-02	
2.9E-02	P			1.0E-02	I	2.0E-03	P	V		1		4.0E+02	Trichlorobenzene, 1,2,4-	120-82-1	2.2E+01	c**	9.9E+01	c**	2.1E+00	n	8.8E+00	n	9.9E-01	c**	7.0E+01	2.9E-03	2.0E-01
				2.0E+00	I	5.0E+00	I	V		1		6.4E+02	Trichloroethane, 1,1,1-	71-55-6	8.7E+03	ns	3.8E+04	ns	5.2E+03	n	2.2E+04	n	7.5E+03	n	2.0E+02	2.6E+00	7.0E-02
5.7E-02	I	1.6E-05	I	4.0E-03	I	2.0E-04	X	V		1		2.2E+03	Trichloroethane, 1,1,2-	79-00-5	1.1E+00	c**	5.3E+00	c**	1.5E-01	c**	7.7E-01	c**	2.4E-01	c**	5.0E+00	7.7E-05	1.6E-03
4.6E-02	I	4.1E-06	I	5.0E-04	I	2.0E-03	I	V	M	1		6.9E+02	Trichloroethylene	79-01-6	9.1E-01	c**	6.4E+00	c**	4.3E-01	c**	3.0E+00	c**	4.4E-01	c**	5.0E+00	1.6E-04	1.8E-03
				3.0E-01	I	7.0E-01	H	V		1		1.2E+03	Trichlorofluoromethane	75-69-4	7.9E+02	n	3.4E+03	ns	7.3E+02	n	3.1E+03	n	1.1E+03	n		6.9E-01	
				1.0E-01	I					1	0.1		Trichlorophenol, 2,4,5-	95-95-4	6.1E+03	n	6.2E+04	n					8.9E+02	n		3.3E+00	
1.1E-02	I	3.1E-06	I	1.0E-03	P					1	0.1		Trichlorophenol, 2,4,6-	88-06-2	4.4E+01	c**	1.6E+02	c**	7.8E-01	c	4.0E+00	c	3.5E+00	c**		1.3E-02	
				1.0E-02	I					1	0.1		Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	6.1E+02	n	6.2E+03	n					1.2E+02	n		5.2E-02	
				8.0E-03	I					1	0.1		Trichlorophenoxypropionic acid, -2,4,5	93-72-1	4.9E+02	n	4.9E+03	n					8.4E+01	n	5.0E+01	4.6E-02	2.8E-02
				5.0E-03	I			V		1		1.3E+03	Trichloropropane, 1,1,2-	598-77-6	3.9E+02	n	5.1E+03	ns					6.8E+01	n		2.7E-02	
3.0E+01	I			4.0E-03	I	3.0E-04	I	V	M	1		1.4E+03	Trichloropropane, 1,2,3-	96-18-4	5.0E-03	c	9.5E-02	c	3.1E-01	n	1.3E+00	n	6.5E-04	c		2.8E-07	
				3.0E-03	X	3.0E-04	P	V		1		4.5E+02	Trichloropropene, 1,2,3-	96-19-5	7.8E-01	n	3.3E+00	n	3.1E-01	n	1.3E+00	n	6.2E-01	n		3.1E-04	
				2.0E-02	A					1	0.1		Tricresyl Phosphate (TCP)	1330-78-5	5.6E+03	n	3.1E+04	n					1.2E+02	n		1.1E+01	
				3.0E-03	I					1	0.1		Tridiphane	58138-08-2	1.8E+02	n	1.8E+03	n					1.3E+01	n		9.3E-02	
						7.0E-03	I	V		1		2.8E+04	Triethylamine	121-44-8	1.2E+02	n	5.2E+02	n	7.3E+00	n	3.1E+01	n	1.5E+01	n		4.4E-03	
7.7E-03	I			7.5E-03	I					1	0.1		Trifluralin	1582-09-8	6.3E+01	c**	2.2E+02	c*					2.2E+00	c*		7.2E-02	
2.0E-02	P			1.0E-02	P					1	0.1		Trimethyl Phosphate	512-56-1	2.4E+01	c*	8.6E+01	c*					3.4E+00	c*		7.4E-04	
						5.0E-03	P	V		1		2.9E+02	Trimethylbenzene, 1,2,3-	526-73-8	5.3E+01	n	2.2E+02	n	5.2E+00	n	2.2E+01	n	1.0E+01	n		1.5E-02	
						7.0E-03	P	V		1		2.2E+02	Trimethylbenzene, 1,2,4-	95-63-6	6.2E+01	n	2.6E+02	ns	7.3E+00	n	3.1E+01	n	1.5E+01	n		2.1E-02	
				1.0E-02	X			V		1		1.8E+02	Trimethylbenzene, 1,3,5-	108-67-8	7.8E+02	ns	1.0E+04	ns					8.7E+01	n		1.2E-01	
				3.0E-02	I					1	0.019		Trinitrobenzene, 1,3,5-	99-35-4	2.2E+03	n	2.7E+04	n					4.6E+02	n		1.7E+00	
3.0E-02	I			5.0E-04	I					1	0.032		Trinitrotoluene, 2,4,6-	118-96-7	1.9E+01	c**	7.9E+01	c**					2.2E+00	c**		1.3E-02	
				2.0E-02	P					1	0.1		Triphenylphosphine Oxide	791-28-6	1.2E+03	n	1.2E+04	n					2.8E+02	n		1.2E+00	
				2.0E-02	A					1	0.1		Tris(1,3-Dichloro-2-propyl) Phosphate	13674-87-8	1.2E+03	n	1.2E+04	n					2.8E+02	n		6.2E+00	
				1.0E-02	X					1	0.1		Tris(1-chloro-2-propyl)phosphate	13674-84-5	6.1E+02	n	6.2E+03	n					1.5E+02	n		5.0E-01	
2.0E-02	P			7.0E-03	P					1	0.1		Tris(2-chloroethyl)phosphate	115-96-8	2.4E+01	c*	8.6E+01	c*					3.3E+00	c*		3.2E-03	
3.2E-03	P			1.0E-01	P					1	0.1		Tris(2-ethylhexyl)phosphate	78-42-2	1.5E+02	c*	5.4E+02	c					2.1E+01	c*		1.0E+02	
				3.0E-03	I	4.0E-05	A			1			Uranium (Soluble Salts)	NA	2.3E+02	n	3.0E+03	n	4.2E-02	n	1.8E-01	n	4.7E+01	n	3.0E+01	2.1E+01	1.4E+01
1.0E+00	C	2.9E-04	C						M	1	0.1		Urethane	51-79-6	1.2E-01	c	1.7E+00	c	3.3E-03	c	4.2E-02	c	2.1E-02	c		4.8E-06	
		8.3E-03	P	9.0E-03	I	7.0E-06	P			0.026			Vanadium Pentoxide	1314-62-1	4.0E+02	c**	2.0E+03	c**	2.9E-04	c*	1.5E-03	c*	1.1E+02	n			
				5.0E-03	S	1.0E-04	A			0.026			Vanadium and Compounds	7440-62-2	3.9E+02	n	5.1E+03	n	1.0E-01	n	4.4E-01	n	6.3E+01	n		6.3E+01	
				1.0E-03	I					1	0.1		Vernolate	1929-77-7	6.1E+01	n	6.2E+02	n					8.3E+00	n		6.6E-03	
				2.5E-02	I					1	0.1		Vinclozolin	50471-44-8	1.5E+03	n	1.5E+04	n					3.4E+02	n		2.6E-01	
				1.0E+00	H	2.0E-01	I	V		1		2.8E+03	Vinyl Acetate	108-05-4	9.7E+02	n	4.1E+03	ns	2.1E+02	n	8.8E+02	n	4.1E+02	n		8.7E-02	
		3.2E-05	H			3.0E-03	I	V		1		3.4E+03	Vinyl Bromide	593-60-2	1.1E-01	c*	5.6E-01	c*	7.6E-02	c*	3.8E-01	c*	1.5E-01	c*		4.4E-05	
7.2E-01	I	4.4E-06	I	3.0E-03	I	1.0E-01	I	V	M	1		3.9E+03	Vinyl Chloride	75-01-4	6.0E-02	c	1.7E+00	c	1.6E-01	c	2.8E+00	c	1.5E-02	c	2.0E+00	5.3E-06	6.9E-04
				3.0E-04	I					1	0.1		Warfarin	81-81-2	1.8E+01	n	1.8E+02	n					4.4E+00	n		4.6E-03	
				2.0E-01	S	1.0E-01	S	V		1		3.9E+02	Xylene, P-	106-42-3	6.0E+02	ns	2.6E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n		1.8E-01	
				2.0E-01	S	1.0E-01	S	V		1		3.9E+02	Xylene, m-	108-38-3	5.9E+02	ns	2.5E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n		1.8E-01	
				2.0E-01	S	1.0E-01	S	V		1		4.3E+02	Xylene, o-	95-47-6	6.9E+02	ns	3.0E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n		1.9E-01	
				2.0E-01	I	1.0E-01	I	V		1		2.6E+02	Xylenes	1330-20-7	6.3E+02	ns	2.7E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n	1.0E+04	1.9E-01	9.8E+00
				3.0E-04	I					1			Zinc Phosphide	1314-84-7	2.3E+01	n	3.1E+02	n					4.7E+00	n			
				3.0E-01	I					1			Zinc and Compounds	7440-66-6	2.3E+04	n	3.1E+05	nm					4.7E+03	n		2.9E+02	
				5.0E-02	I					1	0.1		Zineb	12122-67-7	3.1E+03	n	3.1E+04	n					7.7E+02	n		2.2E+00	
				8.0E-05	X					1			Zirconium	7440-67-7	6.3E+00	n	8.2E+01	n					1.2E+00	n		3.7E+00	

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DISCLAIMER

Notice: The Soil Screening Guidance is based on policies set out in the Preamble to the Final Rule of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), which was published on March 8, 1990 (55 *Federal Register* 8666).

This guidance document sets forth recommended approaches based on EPA's best thinking to date with respect to soil screening. Alternative approaches for screening may be found to be more appropriate at specific sites (e.g., where site circumstances do not match the underlying assumptions, conditions, and models of the guidance). The decision whether to use an alternative approach and a description of any such approach should be placed in the Administrative Record for the site.

The policies set out in both the Soil Screening Guidance: User's Guide and the supporting Soil Screening Guidance: Technical Background Document are intended solely as guidance to the U.S. Environmental Protection Agency (EPA) personnel; they are not final EPA actions and do not constitute rulemaking. These policies are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States government. EPA officials may decide to follow the guidance provided in this document, or to act at variance with the guidance, based on an analysis of specific site circumstances. EPA also reserves the right to change the guidance at any time without public notice.

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PREFACE

This document provides the technical background for the development of methodologies described in the *Soil Screening Guidance: User's Guide* (EPA/540/R-96/018), along with additional information useful for soil screening. Together, these documents define the framework and methodology for developing Soil Screening Levels (SSLs) for chemicals commonly found at Superfund sites. This document is an updated version of the background document developed in support of the December 30, 1994, draft Soil Screening Guidance. The methodologies described in this document and the guidance have been revised in response to public comment and extensive peer review. The revisions, along with other technical analyses conducted to address the comments, are described herein.

This background document is presented in five parts. Part 1 describes the soil screening process and its application and implementation at Superfund sites. Part 2 describes the methodology used to develop SSLs, including the assumptions and theories used. Part 3 provides information on more detailed models that may be used to develop site-specific SSLs. Part 4 addresses sampling schemes for measuring soil contaminant levels during the soil screening process. Part 5 provides technical background on the determination of chemical-specific properties for calculating SSLs.

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The project team especially wishes to note the contributions of the late Craig Mann of EQ, whose expert assistance in modeling inhalation exposures was critical to the development of both this document and the original Soil Screening Guidance. Craig was a prominent researcher in the air modeling field and programmer of the widely-used spreadsheet version of the Johnson and Ettinger (1991) model. We dedicate this document to him.

Disclaimer

This document provides guidance to EPA Regions concerning how the Agency intends to exercise its discretion in implementing one aspect of the CERCLA remedy selection process. The guidance is designed to implement national policy on these issues.

The statutory provisions and EPA regulations described in this document contain legally binding requirements. However, this document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances. Any decisions regarding a particular remedy selection decision will be made based on the statute and regulations, and EPA decisionmakers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. EPA may change this guidance in the future.

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LIST OF ACRONYMS

ABS	Absorption fraction
AF	Skin-soil Adherence Factor
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
AT	Averaging Time
ATSDR	Agency for Toxic Substances and Disease Registry
BW	Body Weight
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
C/I	Commercial/Industrial
C_{sat}	Soil Saturation Limit
CSF	Cancer Slope Factor
CSGWPP	Comprehensive State Ground Water Protection Plan
CSM	Conceptual Site Model
DAF	Dilution Attenuation Factor
DDT	p,p'-Dichlorodiphenyltrichloroethane
DOD	Department of Defense
DOE	Department of Energy
DQO	Data Quality Objectives
Eco-SSLs	Ecological Soil Screening Levels
ED	Exposure Duration
EF	Exposure Frequency
EPA	Environmental Protection Agency
EV	Event Frequency
HBL	Health Based Level
HEAST	Health Effects Assessment Summary Tables
HELP	Hydrologic Evaluation of Landfill Performance
HI	Hazard Index
HQ	Hazard Quotient
IC	Institutional Control
IF	Age-adjusted Soil Ingestion Factor
IR	Soil Ingestion Rate
IRIS	Integrated Risk Information System
ISC3	Industrial Source Complex Dispersion Model
MCL	Maximum Contaminant Level (in water)
MCLG	Maximum Contaminant Level Goal (in water)
MRL	Minimal Risk Level
NAPL	Nonaqueous Phase Liquid
NPDWR	National Primary Drinking Water Regulations
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response

LIST OF ACRONYMS
(Continued)

PAH	Polycyclic Aromatic Hydrocarbon
PA/SI	Preliminary Assessment/Site Inspection
PCB	Polychlorinated biphenyl
PEF	Particulate Emission Factor
PRG	Preliminary Remediation Goal
QA/QC	Quality Assurance/Quality Control
Q/C	Site-Specific Dispersion Factor
RAGS	Risk Assessment Guidance for Superfund
RAS	Regulatory Analytical Services
RBCA	Risk-based Corrective Action
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
SA	Surface Area
SAP	Sampling and Analysis Plan
SCDM	Superfund Chemical Data Matrix
SCS	Soil Classification System
SPLP	Synthetic Precipitation Leachate Procedure
SSG	Soil Screening Guidance
SSL	Soil Screening Level
TBD	Technical Background Document
TC	Soil-to-dust Transfer Coefficient
THQ	Target Hazard Quotient
TR	Target Cancer Risk
TRW	Technical Review Workgroup for Lead
UCL	Upper Confidence Limit
URF	Unit Risk Factor
VF	Volatilization Factor
VOC	Volatile Organic Compound

1.0 INTRODUCTION

In 1996, EPA issued the *Soil Screening Guidance (SSG)*, a tool developed by the Agency to help standardize and accelerate the evaluation and cleanup of contaminated soils at sites on the National Priorities List (NPL). The *SSG* provides site managers with a tiered framework for developing risk-based, site-specific soil screening levels (SSLs).[1] SSLs are not national cleanup standards; instead, they are used to identify areas, chemicals, and pathways of concern at NPL sites that need further investigation (i.e., through the Remedial Investigation/Feasibility Study) and those that require no further attention under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).[2] The three-tiered framework includes a set of conservative, generic SSLs; a simple site-specific approach for calculating SSLs; and a detailed site-specific modeling approach for more comprehensive consideration of site conditions in establishing SSLs. The *SSG* emphasizes the simple site-specific approach as the most useful method for calculating SSLs.

In developing the 1996 *SSG*, EPA chose to focus exclusively on future residential use of NPL sites. At the time the guidance was developed, defining levels that would be safe for residential use was very important because of the significant number of NPL sites with people living on-site or in close proximity. In addition, the assumptions needed to calculate SSLs for residential use were better established and more widely accepted than those for other land uses.

One of the most prevalent suggestions made during the public comment period on the 1996 *SSG* was that EPA should develop additional screening approaches for non-residential land uses. This concern reflected the large number of NPL sites with anticipated non-residential future land uses and the desire on the part of site managers to develop SSLs that are not overly conservative for these sites.

Another concern raised during public comment addressed the risk to workers and others from exposures to soil contaminants during construction activity. In the 1996 *SSG*, EPA presented equations for developing SSLs for the inhalation of volatiles and fugitive dusts assuming that a site was undisturbed by anthropogenic processes. This is likely to be a reasonable assumption for many potential future activities at these sites, but not for construction that may be required to redevelop a site. Activities such as excavation and traffic on unpaved roads can result in extensive soil

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[1] EPA uses the term "site manager" in this guidance to refer to the primary user of this document. However, EPA encourages site managers to obtain technical support from risk assessors, site engineers, and others during all steps of the soil screening process.

[2] SSLs also can be incorporated into the framework for risk assessment planning, reporting, and review that EPA has described in the *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Part D (RAGS, Part D)* (U.S. EPA, 1998). Specifically, SSLs can be incorporated into Standard Table 2 within this guidance, which is designed to compile data to support the identification of chemicals of concern at sites.

disturbance and dust generation that may lead to increased emissions of volatiles and particulates for the duration of the construction project. Such increased short-term exposures are not addressed by the 1996 *SSG*.

With this guidance document, EPA addresses the development of SSLs for residential land use, non-residential land use, and construction activities.

1.1 Purpose and Scope

This document is intended as companion guidance to the 1996 *SSG* for residential use scenarios at NPL sites. It builds upon the soil screening framework established in the original guidance, adding new scenarios for soil screening evaluations. It also updates the residential scenario in the 1996 *SSG*, adding exposure pathways and incorporating new modeling data. The following specific changes included in this document supersede the 1996 *SSG*:

- New methods for developing SSLs based on non-residential land use[3] and construction activities;
- New residential SSL equations for combined exposures via ingestion and dermal absorption[4];
- Updated dispersion modeling data for the soil screening guidance air exposure model; and
- New methods to develop residential and non-residential SSLs for the migration of volatiles from subsurface sources into indoor air.

RELATIONSHIP OF NON-RESIDENTIAL SSL FRAMEWORK TO *RAGS*

EPA has previously provided guidance on evaluating exposure and risk for non-residential use scenarios at NPL sites in the following documents:

- *Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual (HHEM), Supplemental Guidance, Standard Default Exposure Factors, Interim Guidance* (U.S. EPA, 1991a).
- *Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual (HHEM), Part B, Development of Risk-based Preliminary Remediation Goals* (U.S. EPA, 1991b).

These two documents include default values and exposure equations for a generic commercial/industrial exposure scenario that have been widely used and that form the basis of many state site cleanup programs, as well as RCRA's *Risk Based Corrective Action (RBCA) Provisional Standard for Chemical Releases.* However, the approaches detailed in these documents may not always account for the full range of activities and exposures within commercial and industrial land uses. The models, equations, and default assumptions presented in this guidance supersede those presented in the *RAGS Supplemental Guidance* and *RAGS Part B* documents for evaluating exposures under non-residential land use assumptions.

[3] A detailed discussion of EPA's recommended practices for identifying reasonably anticipated future land use can be found in the EPA directive *Land Use in the CERCLA Remedy Selection Process* (1995a).

[4] This document may be used in conjunction with the draft *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) - Interim Guidance* (U.S. EPA, 2001)

Except for these new equations and updated modeling data, the soil screening process remains the same as the one presented in the 1996 *SSG*. Therefore, this document presents the process in less detail than the original guidance and focuses instead on the specific elements of soil screening evaluation that differ for residential, non-residential, and construction scenarios. Users of this guidance should refer to the *SSG User's Guide* and *Technical Background Document* (U.S. EPA, 1996c and 1996b) for additional information on modeling approaches, data sources, and other important details of conducting soil screening evaluations at NPL sites.

Although certain exposure pathways can be addressed using generic assumptions, this document emphasizes the simple site-specific approach for developing SSLs. EPA believes that this approach provides the best combination of site-specificity and ease of use. Exhibits 1-1 and 1-2 summarize the simple site-specific screening approaches discussed in this document. They address three soil exposure scenarios: residential, non-residential (commercial/industrial), and construction. Exhibit 1-1 describes the exposure characteristics and pathways of concern for each of the receptors under these scenarios, and Exhibit 1-2 presents the relevant exposure factors. Pathways and exposure factors listed in bold typeface under the residential scenario indicate changes from the residential soil screening scenario originally presented in the 1996 *SSG*. These changes reflect updates to EPA's method for evaluating exposures via the dermal contact and inhalation of indoor vapors pathways. (See Chapter 3 for a detailed explanation of these methods.)

This document also discusses the detailed site-specific modeling approach to developing SSLs. This approach can be used to conduct a more in-depth evaluation of any residential or commercial/industrial scenario, but also is needed to develop SSLs for exposure scenarios associated with additional non-residential land uses, such as recreational or agricultural use. These land uses may involve exposure pathways that are not included in the generic and simple site-specific approaches (e.g., ingestion of contaminated foods) and, therefore, require detailed site-specific modeling.

The flowchart in Exhibit 1-3 provides an overview of the residential, commercial/industrial, and construction exposure scenarios, illustrating the relationships among them and indicating the sections of this document relevant to developing SSLs under each of the scenarios. As shown in the flowchart, a soil screening evaluation involves identifying the likely anticipated future land use of a site; selecting an approach to SSL development; developing SSLs according to EPA's seven-step process; calculating supplemental construction SSLs (if necessary); and comparing site soil concentrations to all applicable SSLs. In addition, because SSLs are based on conceptual site models comprised of a complex set of assumptions about future land use and exposure scenarios, care should be taken to ensure that future site activities are consistent with these assumptions (e.g., through the use of institutional controls).

This guidance document focuses solely on risks to humans from exposure to soil contamination; it does not address ecological risks. For any soil screening evaluation (residential or non-residential), an ecological assessment should be performed, independently of the soil screening process for human health, to evaluate potential risks to ecological receptors. Assumptions about human exposure pathways under specific land use scenarios are not relevant to assessing ecological risks. Therefore, site managers should conduct a separate evaluation of risks to ecological receptors.

Exhibit 1-1
SUMMARY OF EXPOSURE SCENARIO CHARACTERISTICS AND PATHWAYS OF CONCERN FOR SIMPLE SITE-SPECIFIC SOIL SCREENING EVALUATIONS

Scenario[1]	Residential[2]	Non-Residential (Commercial/Industrial)		Construction	
Receptor	**On-site Resident**	**Outdoor Worker**	**Indoor Worker**	**Construction Worker**	**Off-site Resident**
Exposure Characteristics	C Substantial soil exposures (esp. children) C Significant time spent indoors C Long-term exposure	C Substantial soil exposures C Long-term exposure	C Minimal soil exposures (no direct contact with outdoor soils, potential for contact through ingestion of soil tracked in from outside) C Long-term exposure	C Exposed during construction activities only C Potentially high ingestion and inhalation exposures to surface and subsurface soil contaminants C Short-term exposure	C Located at the site boundary C Exposed during and post-construction C Potentially high inhalation exposures to soil contaminants C Short- and long-term exposure
Pathways of Concern	C Ingestion (surface and shallow sub-surface soils) C **Dermal absorption (surface and shallow sub-surface soils)**[2] C Inhalation (fugitive dust, outdoor vapors) C **Inhalation (indoor vapors)** C Migration to ground water	C Ingestion (surface and shallow sub-surface soils) C Dermal absorption (surface and shallow sub-surface soils) C Inhalation (fugitive dust, outdoor vapors) C Migration to ground water	C Inhalation (indoor vapors) C Ingestion (indoor dust) C Migration to ground water	C Ingestion (surface and subsurface soil) C Dermal absorption (surface and subsurface soil) C Inhalation (fugitive dust, outdoor vapors)	C Inhalation (fugitive dust)

[1] This exhibit presents information on simple site-specific soil screening evaluations for three exposure scenarios -- residential, commercial/industrial, and construction. Additional exposure scenarios (e.g., agricultural and recreational) may be appropriate for certain sites. Given the lack of generic information available for these scenarios, site managers typically will need to use detailed site-specific modeling to develop SSLs for them.

[2] Bold typeface indicates residential pathways that have changed since the 1996 *SSG*.

Exhibit 1-2
SUMMARY OF DEFAULT EXPOSURE FACTORS FOR SIMPLE SITE-SPECIFIC SOIL SCREENING EVALUATIONS

Scenario[1]	Residential	Non-Residential (Commercial/Industrial)		Construction	
Receptor	**On-site Resident[2]**	**Outdoor Worker**	**Indoor Worker**	**Construction Worker**	**Off-site Resident**
Exposure Frequency (d/yr)	350	225	250	site-specific	site-specific
Exposure Duration (yr)	30 [6 (child)[4] for non-cancer effects]	25	25	site-specific	site-specific
Event Frequency (events/d)	**1**	1	NA	1	NA
Soil Ingestion Rate (mg/d)	200 (child) 100 (adult)	100	50	330	NA
Ground Water Ingestion Rate[3] (L/d)	2	2	2	NA	NA
Inhalation Rate (m^3/d)	20[5]	20	20	20	20
Surface Area Exposed (cm^2)	**2,800 (child) 5,700 (adult)**	3,300	NA	3,300	NA
Adherence Factor (mg/cm^2)	**0.2 (child) 0.07 (adult)**	0.2	NA	0.3	NA
Body Weight (kg)	15 (child) 70 (adult)	70	70	70	70
Lifetime (yr)	70	70	70	70	70

1 This exhibit presents information on simple site-specific soil screening evaluations for three exposure scenarios -- residential, commercial/industrial, and construction. Additional exposure scenarios (e.g., agricultural and recreational) may be appropriate for certain sites. Given the lack of generic information available for these scenarios, site managers will typically need to use detailed site-specific modeling to develop SSLs for them.

2 Items in bold represent changes to the residential soil screening exposure scenario presented in the 1996 *SSG*.

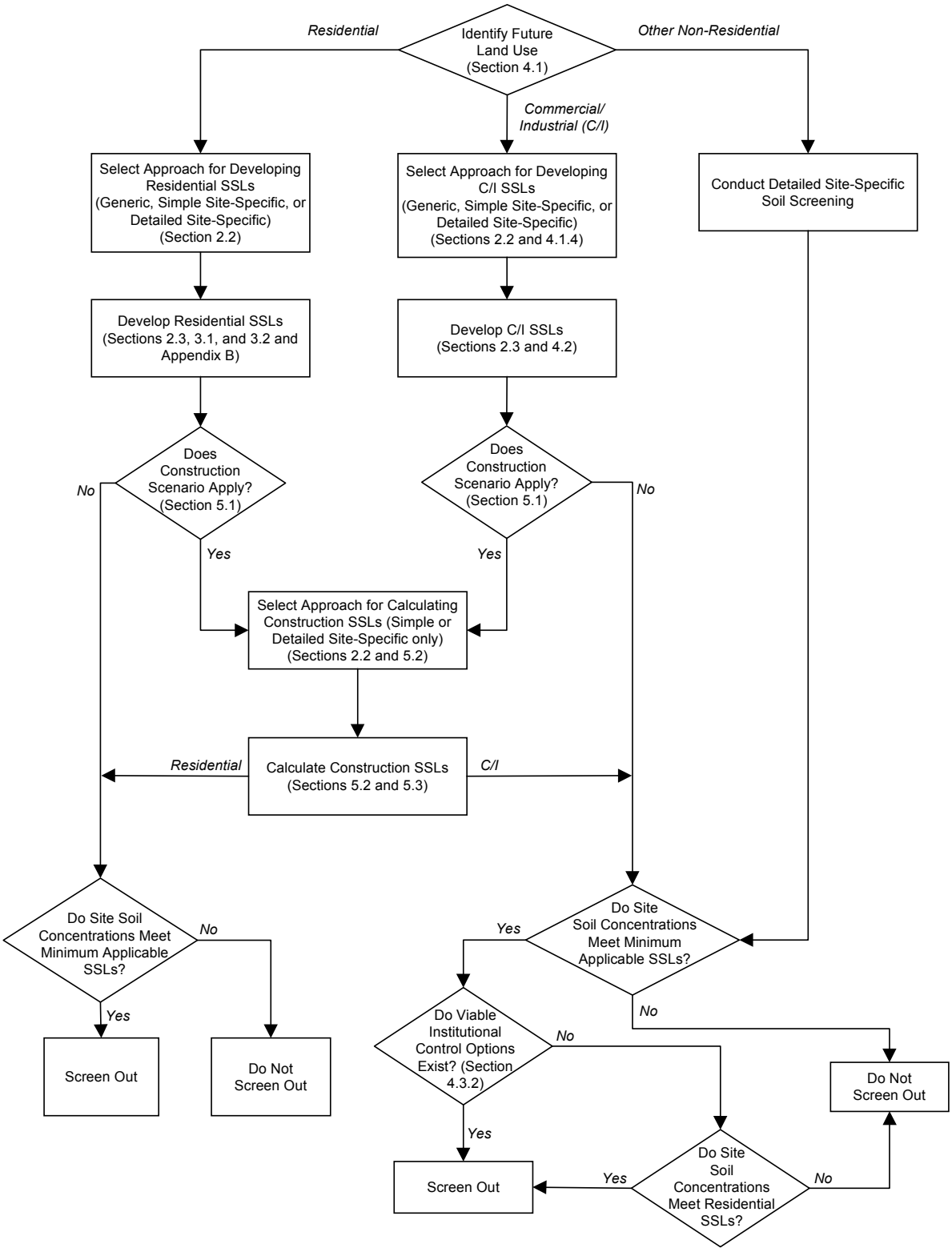
3 SSLs for the migration to ground water pathway are based on acceptable ground water concentrations, which are, in order of preference: a non-zero Maximum Contaminant Level Goal (MCLG), a Maximum Contaminant Level (MCL), or a health-based level (HBL) based on a 1×10^{-6} incremental lifetime cancer risk or a hazard quotient of one due to ingestion of contaminated ground water. When an HBL is used, it is based on these ground water ingestion rate values.

4 A child is defined as an individual between one and six years of age.

5 We evaluate residential inhalation exposure to children and adults using the RfC toxicity criterion, which is based on an inhalation rate of 20 m^3/day. No comparable toxicity criterion specific to childhood exposures is currently available. EPA has convened a workgroup to identify suitable default values for modeling childhood inhalation exposures, as well as possible approaches for adjusting toxicity values for application to such exposures.

Exhibit 1-3

SOIL SCREENING OVERVIEW



EPA is currently working with a multi-stakeholder workgroup to develop scientifically sound, ecologically-based soil screening levels. The workgroup includes representatives from EPA, Environment Canada, Department of Energy (DOE), Department of Defense (DOD), academia, states, industry, and private consulting. This collaborative project will result in a Superfund guidance document that includes a look-up table of generic ecological soil screening levels (Eco-SSLs) for up to 24 chemicals that frequently are of ecological concern at Superfund sites. These Eco-SSLs will be soil concentrations that are expected to be protective of the mammalian, avian, plant, and invertebrate populations or communities that could be exposed to these chemicals.

1.2 Organization of Document

The remainder of this document is organized into four major chapters. Chapter 2 presents a brief overview of soil screening evaluations. It discusses the soil screening concept, the three-tiered screening framework, and the seven-step soil screening process. Chapter 3 focuses on the exposure pathways considered in soil screening evaluation. It lists the key exposure pathways for the three soil screening scenarios (residential, commercial/industrial, and construction) and presents new methods for calculating SSLs for two exposure pathways — dermal absorption (which addresses the potential for concurrent exposure via the direct ingestion and dermal pathways) and the migration of volatiles into indoor air. Chapter 4 addresses the development of non-residential SSLs. It discusses approaches to identifying future land use, presents a non-residential exposure framework, and provides equations for calculating site-specific non-residential SSLs. In addition, Chapter 4 also discusses issues related to the derivation and application of non-residential SSLs, including the importance of involving community representatives in identifying future land uses; the selection and implementation of institutional controls to ensure that future site activities are consistent with non-residential land use assumptions; and the relative roles of SSLs and OSHA standards in protecting future workers from exposure to residual contamination at non-residential sites. Finally, Chapter 5 describes methods for the development of construction SSLs that address exposures due to construction activities occurring during site redevelopment.

Five appendices to this document provide supporting information for the development of SSLs. Appendix A presents generic SSLs for residential and non-residential exposure scenarios. The generic residential SSLs in Appendix A have been updated to reflect the changes discussed in this document and supersede all previously published generic SSLs. Appendix B presents the complete set of simple site-specific SSL equations for the residential exposure scenario that incorporates changes to the 1996 *SSG*. Appendix C consists of chemical-specific information on chemical and physical properties, as well as human health toxicity values for use in developing SSLs. Appendix D provides tables of coefficients for calculating site-specific dispersion factors for inclusion in the air dispersion equations used to calculate simple site-specific SSLs for the inhalation pathway. Finally, Appendix E describes suggested modeling approaches that can be used to develop detailed site-specific inhalation SSLs for the non-residential and construction scenarios.

2.0 OVERVIEW OF SOIL SCREENING

This chapter of the guidance document provides a brief overview of soil screening evaluations for sites on the NPL. It begins with a definition of the soil screening concept and a discussion of its applicability and limitations, then describes three approaches to conducting soil screening evaluations, and concludes with a review of EPA's seven-step soil screening process. For a more in-depth and comprehensive discussion of these topics, please refer to Chapter 1.0 of EPA's 1996 *SSG*.

2.1 The Screening Concept

As used in this guidance, screening refers to the process of identifying and defining areas, contaminants, and conditions at a site that do not warrant further federal attention under CERCLA. Site managers make these determinations by comparing measured soil contaminant concentrations to soil screening levels (SSLs). SSLs are soil contaminant concentrations below which no further action or study regarding the soil at a site is warranted under CERCLA, provided that conditions associated with the SSLs are met. In general, areas with measured concentrations of contaminants below SSLs may be screened from further federal attention; if actual concentrations in the soil are at or above SSLs, further study, though not necessarily cleanup action, is warranted.[4] Exhibit 2-1 summarizes the definition and the applicability of the soil screening process and the associated SSLs.

SSLs are risk-based soil concentrations derived for individual chemicals of concern from standardized sets of equations. These equations combine EPA chemical toxicity data with parameters defined by assumed future land uses and exposure scenarios, including receptor characteristics and potential exposure pathways. Residential SSLs, initially described in the 1996 *SSG* and updated in this document, are based on exposure scenarios associated with residential activities, while non-residential SSLs are based on scenarios associated with non-residential activities.

For each chemical, SSLs are back-calculated from target risk levels. For the inhalation pathway and for the combined direct ingestion/dermal absorption pathway (see Section 3.2), target risk levels for soil exposures are a one-in-a-million ($1x10^{-6}$) excess lifetime cancer risk for carcinogens and a hazard quotient (HQ) of one for non-carcinogens. SSLs for the migration to ground water pathway are back-calculated from the following ground water concentration limits (in order of preference): non-zero maximum contaminant level goals (MCLGs); maximum contaminant levels (MCLs); or health-based limits (based on a cancer risk of $1x10^{-6}$ or an HQ of one).

[4] Areas meeting federal SSLs may still warrant further study. Some EPA Regional Offices and states have developed separate soil screening levels and/or preliminary remediation goals (PRGs) that may be more stringent than those presented in this guidance (though these alternative levels are based on the same general methodology described in this guidance). It is important that site managers confer with regional and state risk assessors when conducting soil screening evaluations to ensure that any SSLs developed will be consistent with their accepted soil levels.

Exhibit 2-1 A GENERAL GUIDE TO THE SCREENING AND SSL CONCEPTS	
Screening **Is:**	Screening **Is Not:**
• A method for identifying and defining areas, contaminants, and conditions at a site that generally do not warrant further federal attention; • A means of focusing the Remedial Investigation/ Feasibility Study (RI/FS) and site risk assessment; • A means for gathering data for later phases of the Superfund site remediation process.	• Mandatory; • A substitute for an RI/FS or risk assessment; • Valid unless conditions associated with SSLs (e.g., assumed future land use and site activities) are met.
SSLs **Are:**	SSLs **Are Not:**
• Human health risk-based concentrations; • Levels below which no further action or study is warranted under CERCLA, provided conditions concerning potential exposures and receptors (e.g., future land use) are met; • Specific to assumed exposures and site conditions; C Potentially suitable for use as PRGs.	• National cleanup standards; • Uniform across all sites; • Applicable to radioactive contaminants.

Although SSLs are "risk-based," the soil screening process does not eliminate the need to conduct site-specific risk assessments as part of the Superfund cleanup process. However, the screening process can help focus the risk assessment for a site on specific areas, contaminants, and pathways, and data collected during the screening process can be used in the risk assessment. Similarly, SSLs are not national cleanup standards, and exceedances of SSLs do not trigger the need for response actions at NPL sites.

In addition, because SSLs are based on a set of assumptions about likely future land use and site activities, they are only pertinent to the extent that future activities are consistent with these assumptions. Institutional controls may serve to limit future land uses and associated exposures to those assumed in a non-residential screening analysis, helping to ensure that the non-residential SSLs (which may be based on less conservative exposure assumptions than residential SSLs) are adequately protective. Institutional controls are not generally necessary for sites screened using residential SSLs because the conservative assumptions incorporated in the residential exposure scenario yield SSLs that are protective of non-residential uses as well. Further discussion of these issues can be found in *Land Use in the CERCLA Remedy Selection Process* (U.S. EPA 1995a).

The use of SSLs for screening purposes during site investigation at CERCLA sites is not mandatory. However, it is recommended by EPA as a tool to focus the RI/FS and site risk assessment by identifying the contaminants and areas of concern, and to gather necessary information for later phases of the RI/FS process.[5]

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[5] SSLs developed in accordance with this guidance can also be applied to Resource Conservation and Recovery Act (RCRA) corrective action sites as "action levels," where appropriate, since the RCRA corrective action program currently views the role of action levels as generally serving the same purpose as soil screening levels. For more information, see 61 *Federal Register* 19432, 19439, and 19446 (May 1, 1996).

SSLs also can be used as Preliminary Remediation Goals (PRGs) provided conditions found during subsequent investigations at a specific site are the same as the conditions assumed in developing the SSLs. EPA recognizes, however, that certain conservative assumptions built into the generic and simple site-specific approaches to SSL development, while appropriate for a screening analysis, may be overly conservative for setting PRGs and, ultimately, site cleanup levels. For example, as described in the 1996 *SSG*, EPA chose to base generic and simple site-specific SSLs for non-carcinogenic contaminants via soil ingestion on a conservative, childhood-only, six-year exposure duration because several studies suggest that inadvertent soil ingestion is common among children age 6 and younger (Calabrese et al., 1989; Davis et al., 1990; and VanWinjen et al., 1990). The SAB noted that the combination of the six-year childhood exposure with a chronic RfD may be appropriate for chemicals with toxic endpoints specific to children or with steep dose-repsonse curves, but is likely to be overly protective for most contaminants (U.S. EPA, 1993). EPA believes this protectiveness is appropriate for soil screening evaluations, but such conservatism may not be necessary for developing PRGs and cleanup levels for many contaminants. Therefore, site managers wishing to use SSLs as a basis for developing PRGs should carefully consider the assumptions built into the SSLs and whether it may be appropriate to relax any of these assumptions for calculating PRGs.

2.2 The Tiered Screening Framework /Selecting a Screening Approach

EPA's framework for soil screening assessment provides site managers with three approaches to establish SSLs for comparison to soil contaminant concentrations:

- Apply **generic** SSLs developed by EPA;
- Develop SSLs using a **simple site-specific** methodology; or
- Develop SSLs using a more **detailed site-specific** modeling approach.

These approaches involve using increasingly detailed site-specific information to replace generic assumptions, thereby tailoring the screening model to more accurately reflect site conditions, potential exposure pathways, and receptor characteristics. Additionally, progression from generic to detailed site-specific methods generally results in less stringent screening levels because conservative assumptions are often replaced with site-specific information while maintaining a constant target risk level.

The first approach for developing screening levels is the simplest and least site-specific. This approach assumes a generic exposure scenario, intended to be broadly protective under a wide array of site conditions. The site manager simply compares measured soil concentrations to chemical-specific SSLs derived by EPA based on the conservative generic scenario and provided in a look-up table. (These tables, together with additional guidance on applying the generic SSLs to individual sites, are presented in Appendix A of this document.) While this approach offers the benefits of simplicity and ease of use, the generic SSLs are calculated using conservative assumptions about site conditions and are thus likely to be more stringent than SSLs developed using more site-specific approaches. Where site conditions differ substantially from the scenario used to

derive the generic SSLs, generic levels may not be appropriate for identifying areas that can be "screened out." The specific assumptions underlying the generic SSLs are identified in the equations presented in Section 4.2.3 (non-residential exposure scenario) and in Appendix B (residential exposure scenario).

The second approach, the simple site-specific methodology, allows site managers to calculate SSLs using the same equations used to derive the generic SSLs. Unlike the generic approach, the simple site-specific methodology offers some flexibility in the use of site-specific data for developing SSLs. Though the target risk for SSLs remains the same, some of the generic default input values may be replaced by site-specific information such as data on hydrological, soil, and meteorological conditions. Thus, the simple site-specific approach retains much of the ease and simplicity of the generic approach, while providing site managers increased freedom to replace the conservative assumptions of the generic approach with data that more accurately reflect site conditions. The result will be more tailored SSLs that are likely to be less stringent than the generic values. As site managers change the assumptions used in developing the SSLs to reflect site-specific information, they should have the changes reviewed by the regional risk assessor associated with the site. Site managers should also document any changes they make to the exposure parameters from the default values in order to develop simple site-specific SSLs.

As the name suggests, the detailed site-specific modeling approach is the most rigorous of the three approaches and incorporates site-specific data to the greatest extent. This approach is useful for developing SSLs that take into account more complex site conditions than those assumed in the simple site-specific approach. The detailed approach may be appropriate, for example, to demonstrate that the migration of soil contaminants to ground water does not apply at a particular site, or to model distinct or unusual site conditions. Technical details supporting the use of this approach can be found in Appendices D and E of this document and in the *Technical Background Document* (*TBD*) for the 1996 *SSG*.

The decision regarding which of the three approaches is most appropriate for a given site must balance the need for accuracy with considerations of cost and timeliness. While progression from generic SSLs to a detailed site-specific modeling approach increases the accuracy of the screening process, it also generally involves an increase in the resources, time, and costs required. Deciding which option to use typically requires balancing the increased investigation effort with the potential savings associated with higher (but still protective) SSLs. In general, EPA believes the most useful approach to apply is the simple site-specific methodology, which provides a reasonable compromise in terms of effort and site-specificity.

Although the simple site-specific approach is generally expected to be the most useful, there are times when the generic or the detailed site-specific modeling approaches may be more appropriate. The former can be used as an initial screening tool or as a “crude yardstick” to quickly identify those areas which clearly do not pose threats to human health or the environment. In such cases where exclusion appears clearly warranted, there is little need for more site-specific information to justify this decision. The generic approach can also be used to quickly screen out chemicals and focus the subsequent investigation on the key chemicals of concern. Generally, detailed site-specific modeling is most useful in cases where: 1) the ability to conduct sophisticated analyses, incorporating mostly site-specific data, could result in substantial savings in site

investigation and cleanup costs due to an increase in the site area "screened out" of the remedial process under CERCLA; or 2) site conditions are unique. For example, the detailed approach could be used to assess unusual exposure pathways or conditions or to conduct fate and transport analyses that describe the leaching of contaminants to ground water in a specific hydrogeologic setting.

2.3 The Seven-Step Soil Screening Process

Regardless of the screening approach chosen, the soil screening analysis consists of the seven steps discussed in this section. EPA emphasizes that the overall seven-step site screening process is not changing, and the same process is applied to residential and non-residential scenarios. However, the evaluation of the non-residential and construction exposure scenarios described in this guidance requires modifications to the steps of the screening process, especially to Steps 1, 2, and 5. These modifications are described in Section 4.2 and Section 5.3 of this document for the non-residential and construction scenarios, respectively.

The seven-step soil screening process established in the 1996 *SSG* was designed to evaluate the significance of soil contaminant concentrations at residential sites. Although some of the default values and assumptions of the residential approach do not apply to commercial/industrial or construction exposure scenarios, the same overall screening framework can be used to evaluate sites under these scenarios. The basic elements of the seven steps are described below. Exhibit 2-2 presents a useful one-page summary of the full soil screening process. Please refer to the 1996 *SSG* for additional information on the soil screening steps.

Step 1: Develop Conceptual Site Model

Developing a conceptual site model (CSM) is a critical step in properly implementing the soil screening process at a site. The CSM is a comprehensive representation of the site that documents current site conditions. It characterizes the distribution of contaminant concentrations across the site in three dimensions and identifies all potential exposure pathways, migration routes, and potential receptors. The CSM is initially developed from existing site data. This site data should include input from community members about their site knowledge, concerns, and interests. The CSM is a key component of the RI/FS and EPA's Data Quality Objectives (DQO) process, and should be continually revised as new site investigations produce updated or more accurate information. CSM summary forms and detailed information on the development of CSMs are presented in Attachment A of the 1996 *SSG User's Guide*.

In addition, *RAGS Part D*, which is intended to assist site managers in standardizing risk assessment planning, reporting, and review at CERCLA sites, provides a template that site mangers can use to summarize and update data on the CSM. This template is the first in a series of standard tables that EPA has developed to document important parameters, data, calculations, and conclusions from all stages of Superfund human health risk assessments.

Exhibit 2-2

SOIL SCREENING PROCESS

Step 1: **Develop Conceptual Site Model**

- Collect existing site data (historical records, aerial photographs, maps, PA/SI data, available background information, state soil surveys, etc.)
- Collect community input
- Organize and analyze existing site data
  - -- Identify known sources of contamination
  - -- Identify affected media
  - -- Identify potential migration routes, exposure pathways, and receptors
- Construct a preliminary diagram of the CSM
- Perform site reconnaissance
  - -- Confirm and/or modify CSM
  - -- Identify remaining data gaps

Step 2: **Compare CSM to SSL Scenario**

- Identify sources, pathways, and receptors likely to be present at the site and addressed by the soil screening scenario
- Identify additional sources, pathways, and receptors likely to be present at the site but not addressed by the soil screening scenario

Step 3: **Define Data Collection Needs for Soils**

- Develop hypothesis about distribution of soil contamination
- Develop sampling and analysis plan for determining soil contaminant concentrations
  - -- Sampling strategy for surface soils following Data Quality Objectives (DQOs)
  - -- Sampling strategy for subsurface soils following Data Quality Objectives (DQOs)
  - -- Sampling strategy to measure soil characteristics (bulk density, moisture and organic carbon content, porosity, pH)
- Determine appropriate field methods and establish QA/QC protocols

Step 4: **Sample and Analyze Soils**

- Identify contaminants
- Delineate area and depth of sources
- Determine soil characteristics
- Revise CSM, as appropriate

Step 5: **Calculate Site- and Pathway-Specific SSLs**

- Identify SSL equations for relevant pathways
- Identify chemicals of concern for dermal exposure
- Obtain site-specific input parameters from CSM summary
- Replace variables in SSL equations with site-specific data gathered in Step 4
- Calculate SSLs
  - -- Account for exposure to multiple contaminants

Step 6: **Compare Site Soil Contaminant Concentrations to Calculated SSLs**

- For surface soils characterized using composite samples, screen out exposure areas where all composite samples do not exceed SSLs by a factor of two
- For surface soils characterized using discrete samples, screen out areas where the 95 percent upper confidence limit (UCL_{95}) on the mean concentration for each contaminant does not exceed the corresponding SSL
- For subsurface soils with indirect exposures, screen out source areas where the mean concentration of each contaminant in each soil boring does not exceed the applicable SSL
- For subsurface soils with direct exposures, screen out source areas where the highest soil boring concentration for each contaminant does not exceed the applicable SSL
- Evaluate whether background levels exceed SSLs

Step 7: **Address Areas Identified for Further Study**

- Consider likelihood that additional areas can be screened out with more data
- Integrate soil data with other media in the baseline risk assessment to estimate cumulative risk at the site
- Determine the need for action
- Use SSLs as PRGs, if appropriate

Step 2: Compare CSM to SSL Scenario

In this step, the CSM for a site is compared to the SSL scenario and assumptions for calculating generic and simple site-specific SSLs. This comparison should determine whether the CSM is sufficiently similar to the SSL scenario so that use of the generic or simple site-specific SSL scenario is appropriate. If the CSM contains sources, pathways, or receptors not covered by the general SSL scenario, comparison to generic or simple site-specific SSLs alone may not be sufficient to fully evaluate the site, suggesting the need to conduct detailed site-specific modeling. However, it may be sufficient to eliminate some pathways or chemicals from further consideration. It is crucial to engage in these efforts at this early stage in order to identify areas or conditions where generic or simple site-specific SSLs are not sufficiently informative, so that other characterization and response efforts can be considered when planning the sampling strategy (Step 3).

Step 3: Define Data Collection Needs for Soils

Upon initiating a soil screening evaluation, a site manager develops a Sampling and Analysis Plan (SAP). The SAP should identify sampling strategies for filling any data gaps in the CSM requiring collection of site-specific information. These strategies typically address contaminant concentrations in surface and subsurface soil, as well as soil characteristics.

Before developing the SAP, the site manager should define the specific areas(s) to which the soil screening process will be applied. Existing data can be used to determine what level and type of investigation may be appropriate. Areas with known contamination will be thoroughly investigated and characterized in the RI/FS. Areas that are unlikely to be contaminated based on good historical documentation of the location of current and past storage, handling, or disposal of hazardous materials at the site may generally be screened out at this stage; however, samples should be taken to confirm this hypothesis. The remaining areas, those with uncertain contamination levels and historical activities, are most appropriate for the soil screening sampling strategy outlined in the 1996 *SSG*.

For purposes of soil screening analyses, EPA distinguishes between surface and subsurface soils as follows: surface soils are located within two centimeters of the ground surface, and subsurface soils are located more than two centimeters below the surface. Because exposure to contaminants in these two soil regions may occur via different mechanisms, sampling plans for these two categories of soil should be designed to collect reliable data appropriate to the exposure models involved. For example, the surface soil strategy should collect data appropriate for evaluating exposure via direct ingestion, dermal contact, and inhalation of fugitive dusts as individuals move randomly around a site. Typically, this requires a reliable estimate of the arithmetic mean of contaminant concentrations in surface soils in exposure areas of concern. In general, the subsurface soil sampling strategy should provide data to model the types of indirect exposure to subsurface contamination that occurs when chemicals migrate up to the soil surface or down to an underlying aquifer. Modeling these pathways usually requires an estimate of the average contaminant concentration through each source, estimates of the dimensions of the source, and average soil properties within the source. However, as discussed below, at some sites a sampling plan designed to evaluate direct contact exposures may be appropriate for some subsurface soils.

Site managers have two options for developing an SAP for surface soils: composite sampling or discrete sampling. Either approach should allow you to calculate a reliable estimate of the arithmetic mean of contaminant concentrations in surface soils. Composite sampling involves the physical mixing of soils from multiple locations and then collecting one or more sub-samples from the mixture. Details of a composite-based SAP are presented in the 1996 *SSG*. The maximum contaminant concentration from composite sampling is a conservative estimate of the mean concentration and can be used for soil screening evaluations. This approach can be an effective way to estimate the mean contaminant concentration with lower sampling costs, because fewer samples are needed. However, the mixing of soils in composite samples may disperse volatile contaminants and also may dilute concentrations of other contaminants, resulting in less sensitivity to hot spots and to other variations in contaminant concentrations. Alternatively, site managers can collect discrete un-composited samples using a simple random sampling scheme (SRS), a stratified SRS[6], or systematic grid sampling with a random starting point. Details of alternative SAPs for discrete sampling can be found in *Guidance for Choosing a Sampling Design for Environmental Data Collection* (EPA 2000a). Because there is no spatial averaging of soil concentrations with this method, a much larger number of soil samples is required to produce a reliable estimate of the mean contaminant concentration. As a result, EPA recommends estimating the 95th percentile upper confidence limit (UCL_{95}) on the mean contaminant concentration as a conservative estimate of the mean when performing a soil screening evaluation with data sets of un-composited samples.[7]

The 1996 *SSG* subsurface soil sampling strategy addresses exposure to subsurface contamination that occurs when chemicals migrate up to the soil surface or down to an underlying aquifer. It focuses on collecting the data required for modeling volatilization and migration to ground water. As a result, the goals of this strategy are to measure the area and depth of contamination, the average contaminant concentration in each source area, and the characteristics of the soil. Accurately determining the mean concentration of subsurface soils using current investigative techniques and statistical methods would require a costly and intensive sampling program that is beyond the level of effort required for a screening analysis. Therefore, EPA recommends that conservative assumptions be used to develop hypotheses on likely contaminant distributions. EPA recommends taking 2 or 3 soil borings located in the areas suspected of having the highest contaminant concentrations within each source. Because the subsurface sampling approach is likely to be less comprehensive than the surface soil SAP, the soil screening analysis focuses on the highest mean soil boring contaminant concentration within the source as a conservative estimate of the mean contaminant concentration for the entire source area. The subsurface SAP also should include the collection of site characteristics needed to determine site-specific SSLs, including the following soil parameters: Soil Classification System (SCS) soil type, dry bulk density (ρ_b), soil organic carbon content (f_{oc}), and pH. Additional detail on this approach can be found in the 1996 *SSG User's Guide* and *Technical Background Document*.

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[6]Stratified SRS allows for random sample collection within sampling blocks designed to reflect anticipated site activity patterns; thus, it more effectively targets areas where exposures are expected to occur.

[7]EPA's *Calculating Upper Confidence Limits For Exposure Point Concentrations at Hazardous Waste Sites*, provides a survey of statistical methods that may be used by site managers to estimate UCL_{95} values (U.S. EPA,2002a).

For some CSMs, these three sampling approaches will suffice to characterize exposures to contaminants in soil. However, other CSMs may feature residential activities (e.g., gardening) or commercial/industrial (e.g., outdoor maintenance or landscaping) or construction activities that may disturb soils to a depth of up to two feet, potentially exposing receptors to contaminants in subsurface soil via direct contact pathways such as ingestion and dermal absorption. In such cases, EPA anticipates that site managers will need to characterize contaminant levels by taking shallow subsurface borings where appropriate. The specific locations of such borings should be determined by the likelihood of direct contact with these subsurface soils and by the likelihood that soil contamination is present at that depth. Given that contamination in these deeper soils is unlikely to be characterized to the same extent as contamination in surface soils, the maximum measured concentration of each contaminant in these borings should used as a conservative estimate of the mean contaminant concentration for purposes of the soil screening evaluation.

Alternatively, if available evidence strongly indicates that contaminated subsurface soils will be disturbed and brought to the surface (e.g., as the result of redevelopment activities), site managers will need to characterize subsurface contamination more thoroughly and should collect a sufficient number of samples to develop a UCL_{95} value for use in the soil screening evaluation.

For both surface and subsurface soils, site managers should use the Data Quality Objectives (DQO) process in developing SAPs to ensure that sufficient data are collected to properly assess site contamination and support decision-making concerning future Superfund site activities. The DQO process is a systematic planning process designed to ensure that sufficient data are collected to support EPA decision-making. Section 2.3 of the 1996 *SSG* describes this process in detail.

Step 4: Sample and Analyze Site Soils

Once sampling strategies have been developed and implemented, the samples are analyzed according to the methods specified in the SAP. The analytic results provide the concentration data for contaminants of concern that are used in the comparison to SSLs (Step 6). Soil analysis also helps to define the areal extent and depth of contamination, as well as soil characteristics data. This information is needed to calculate site-specific SSLs for the inhalation of volatiles and migration to ground water pathways.

The analyses of soil contaminants and characteristics may reveal new information about site conditions. It is critical that the CSM be updated to reflect this information.

Step 5: Calculate Site- and Pathway-Specific SSLs

Using the data collected in Step 4 above, site-specific soil screening levels can be calculated according to the methods presented under this step of the *SSG*. (If generic SSLs are used for comparison with site contaminant concentrations, this step may be omitted.) Both the 1996 *SSG* and this guidance document provide equations necessary to develop simple site-specific SSLs. Also, an interactive SSL calculator for simple site-specific equations is available online at http://risk.lsd.ornl.gov/calc_start.htm.[8] Descriptions of how these equations were developed and background information on underlying assumptions and limitations are available in the *TBD* for the 1996 *SSG* as well as in Chapters 3, 4, and 5 of this document. The default exposure assumptions and equations for calculating residential SSLs can be found in Chapter 3 and in Appendix B of this document. Additional information on default residential assumptions can be found in the 1996 *SSG User's Guide* and *TBD*. The default assumptions and equations for calculating non-residential SSLs are presented in Chapter 4. (Alternatively, tables of generic SSLs for these two scenarios are presented in Appendix A.) The equations used to calculate SSLs based on construction activities are presented in Chapter 5.

All SSL equations in the 1996 *SSG* were designed to be consistent with the concept of Reasonable Maximum Exposure (RME) in the residential setting. In following the Superfund program's approach for estimating RME, EPA uses reasonably conservative defaults for intake and exposure duration, combined with values for site-specific parameters (e.g., for soil or hydrologic conditions) that reflect average or typical site conditions, to develop risk-based SSLs. EPA bases SSLs on RME assumptions rather than central tendency conditions because this approach results in a conservative (though not a worst case) estimate of long-term exposure that is protective of the majority of the population.

The 1996 *SSG* quantitatively addresses four exposure pathways — direct ingestion, inhalation of fugitive dusts, inhalation of volatiles in outdoor air, and ingestion of ground water contaminated by the migration of contaminants through soil to an underlying potable aquifer. This guidance includes these four pathways plus dermal contact exposures and inhalation of volatiles in indoor air from vapor intrusion.

Step 6: Compare Site Soil Contaminant Concentrations to Calculated SSLs

Once site-specific SSLs have been calculated (or the appropriate generic SSLs from Appendix A have been identified), they are compared to the measured concentrations of contaminants of concern. At this point, it is important to review the CSM to confirm its accuracy in light of the actual site data that have been collected in previous steps of the soil screening process. This also will help to ensure that the SSL scenarios are applicable to the site.

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[8] The SSL calculator currently includes default values for residential exposures; however, users can adjust these defaults to reflect non-residential exposure scenarios.

The following are four methods for deciding whether an exposure area can be screened from further investigation — two for surface soil contamination and two for subsurface soil contamination. Each method specifies a particular estimator of the true mean concentration to be used in a screening evaluation, as well as the screening level to which the estimate is compared.

- **Compare Maximum Composite Concentration to 2 x SSL (Surface Soils).** For surface soils that have been sampled using composite samples in accordance with the DQOs discussed in the 1996 *SSG*, the maximum composite sample concentration is compared to two times the SSL; areas where the maximum composite sample concentration is less than two times the SSL can be screened out. Further study is needed for areas where any composite sample concentration equals or exceeds twice the applicable SSL for one or more contaminants.[9] The 1996 *SSG* notes that the surface soil max test strategy that employs composites is applicable for semivolatiles, inorganics, and pesticides only.

- **Compare 95 Percent Upper Confidence Limit on the Mean to SSL (Surface Soils).** For data sets consisting of discrete samples or data sets of limited sample size, EPA uses statistical methods to calculate a conservative estimate of the arithmetic mean concentration for each contaminant in an exposure area. This estimate, the 95 percent upper confidence limit (UCL_{95}) on the mean is used to avoid underestimating the true mean (and thereby ensure that the screening process is protective of human health). The UCL_{95} may be estimated by a variety of statistical methods depending on the characteristics of the data set (e.g., the Chebyshev inequality, the bootstrap method, and the jackknife method); these methods are described in *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (U.S. EPA, 2002a).

- **Compare Mean Concentration in Soil Borings to SSL (Subsurface Soils/Indirect Exposure).** Where direct contact exposure to subsurface soil is not an issue, subsurface soil sampling under the SSL DQOs is generally limited to two or three borings *per source area*. As discussed in Step 3, subsurface soil sampling strategies focus on the collection of data for modeling the volatilization and migration to ground water pathways (i.e., the area and depth of contamination, soil characteristics, and the average contaminant concentration in each source area. Because the expense and level of effort involved in a precise determination of these values for a subsurface contamination source is well beyond the level of effort generally

[9] Given the sampling approach described in the 1996 *SSG*, which focused on a strategy of collecting composite samples, two times the SSL was determined to be a reasonable upper limit for comparison that would still be protective of human health. See the 1996 *SSG TBD* for a complete discussion of the protectiveness of this level (U.S. EPA, 1996b).

appropriate for a screening evaluation, these soils tend not to be characterized to the same extent as surface soils. Therefore, for these soils, the *SSG* adopts a conservative approach for soil screening decisions of comparing mean concentrations from each boring directly to the SSL. In areas where the mean concentrations of all borings fall below the SSL, the area may be screened out. In all other areas, further study is required.[10]

- **Compare Maximum Concentration in Soil Borings to SSL (Subsurface Soils/Direct Exposure).** At sites where activities may disturb subsurface soils and result in direct contact exposures to contaminants in those soils, EPA anticipates that site managers will characterize contaminant levels by taking samples from additional subsurface borings in areas of soil likely to be disturbed. Given that contamination in these deeper soils is unlikely to be characterized to the same extent as contamination in surface soils, the maximum measured concentration of each contaminant in these borings should used as a conservative estimate of the mean contaminant concentration and compared directly with the appropriate SSL. If the maximum concentration of each contaminant in a given area falls below its SSL, the area may be screened out. For all other areas, additional study is required.[11]

Exposures to Multiple Chemicals

Exposures to multiple chemicals are treated similarly for non-residential and residential soil screening evaluations. The project manager should coordinate with the risk assessor to determine the health end points caused by each chemical and combinations of several chemicals. EPA believes that the $1x10^{-6}$ target cancer risk level for individual chemicals and pathways generally will lead to cumulative site risks within the $1x10^{-4}$ to $1x10^{-6}$ risk range for the combinations of chemicals typically found at NPL sites. For non-carcinogens, EPA recommends that non-carcinogenic contaminants be grouped according to the critical effect listed as the basis for the RfD/RfC. If more than one chemical detected at a site affects the same target organ or organ system, SSLs for those chemicals should be divided by the number of chemicals present in the group

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[10] The SSL DQO sampling approach will not yield sufficient data for calculating a 95 percent UCL for the arithmetic mean contaminant concentration in subsurface soil. However, should there be sufficient data for this calculation, site managers have the option of comparing either the 95 UCL value for the site or the contaminant concentrations in each boring to the SSL.

[11] Alternatively, if available evidence indicates that contaminated subsurface soils will be disturbed and brought to the surface (e.g., as the result of redevelopment activities), site managers will need to characterize subsurface contamination more thoroughly and should collect a sufficient number of samples to develop a UCL_{95} value for comparison to the SSL.

Step 7: Address Areas Identified for Further Study

Areas that have been identified for further study become the subject of the RI/FS. The results of the baseline risk assessment, which is part of the RI/FS, will establish the basis for taking any remedial action; however, the threshold for initiating this action differs from the screening criteria. As outlined in *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (U.S. EPA, 1991c), remedial action at NPL sites is generally warranted where cumulative risks (i.e., total risk from exposure to multiple contaminants at a site) for a current or future land use exceed $1x10^{-4}$ for carcinogens or a hazard index (HI) of one for non-carcinogens. The data collected for soil screening evaluations will be useful in developing the baseline risk assessment. However, site managers will probably need to collect additional data during future site investigations conducted as part of the RI/FS. These additional data will allow site managers to better define the risks at a site and could ultimately indicate that no action is required. If a decision is made to initiate remedial action, the SSLs may then serve as PRGs. For further guidance on this issue, please consult Sections 1.2 and 2.7 of the 1996 *SSG*.

3.0 EXPOSURE PATHWAYS

The 1996 *SSG* provides quantitative methods to derive SSLs for the following exposure pathways under a residential soil exposure scenario:

- Direct ingestion,
- Inhalation of volatiles outdoors,
- Inhalation of fugitive dust outdoors, and
- Ingestion of ground water contaminated by the migration of soil leachate to an underlying aquifer.

In addition, that document qualitatively addressed dermal absorption of contaminants from soil exposure. Together, these five pathways formed the basis for EPA's generic and simple site-specific approaches to residential soil screening evaluations.

This chapter updates the 1996 *SSG* in three ways. First, it presents a list of key exposure pathways for three soil screening exposure scenarios: residential, commercial/industrial, and construction. Second, it presents equations for a combined soil ingestion/dermal absorption SSL that includes a new quantitative approach for evaluating dermal absorption. Third, it presents a new quantitative approach for evaluating the inhalation of volatile contaminants present in indoor air as the result of vapor intrusion.

3.1 Exposure Pathways by Exposure Scenario

Exhibit 3-1 lists default soil exposure pathways for each of three soil screening exposure scenarios: residential, commercial/industrial, and construction. The list of pathways for each scenario is not intended to be exhaustive; instead, each list represents a set of typical exposure pathways likely to account for the majority of exposure to soil contaminants at a site. The actual exposure pathways evaluated in a soil screening evaluation depend on the contaminants present, the site conditions, and the expected receptors and site activities described in the CSM. A CSM may include additional receptors or exposure pathways not addressed by this document or by the 1996 *SSG* (e.g., ingestion of contaminated fish by subsistence anglers). Conversely, not all the pathways listed in Exhibit 3-1 for a particular scenario may apply to a given site. As a result, it is important to compare the CSM with the assumptions and limitations associated with each applicable exposure scenario to identify whether additional or more detailed assessments are needed for particular exposure pathways. Early identification of the need for additional analysis is important because it facilitates development of a comprehensive sampling strategy.

Exhibit 3-1

RECOMMENDED EXPOSURE PATHWAYS FOR SOIL SCREENING EXPOSURE SCENARIOS

Potential Exposure Pathways	Residential		Commercial/Industrial				Construction			
			Outdoor Worker		Indoor Worker		Construction Worker		Off-Site Resident	
	Surface Soil[1]	Subsurface Soil	Surface Soil	Subsurface Soil	Surface Soil	Subsurface Soil	Surface Soil	Subsurface Soil	Surface Soil	Subsurface Soil
Direct ingestion	T	T	T	T	T		T	T		
Dermal absorption	T	T	T	T			T	T		
Inhalation of volatiles outdoors		T		T				T		
Inhalation of fugitive dust outdoors	T		T				T		T	
Migration of volatiles into indoor air		T				T				
Ingestion of ground water contaminated by the migration of leachate to an underlying aquifer		T		T		T				

[1] For the purposes of soil screening evaluations, EPA defines surface soil as consisting of the top two centimeters of soil, and subsurface soil as soils located beneath the top two centimeters. However, at sites where the CSM suggests that receptors will frequently come into direct contact with soils at depths greater than two centimeters, contaminant concentrations in these soils should be compared to SSLs developed for surface soils.

The methods for evaluating exposures via the inhalation of volatiles outdoors, the inhalation of fugitive dust outdoors, and the ingestion of leachate-contaminated ground water under the residential scenario have not changed since the publication of the 1996 *SSG*; detailed information about the modeling approaches for these exposure pathways can be found in the 1996 *SSG User's Guide* and *Technical Background Document.* Section 3.2 of this document discusses new methods for developing SSLs for combined exposures via soil ingestion and dermal absorption and for the migration of volatiles into indoor air. It also presents residential SSL equations for the soil ingestion/dermal absorption pathway and directs readers to the spreadsheet models that can be used to evaluate the indoor air pathway. For convenience, the complete set of residential SSL equations and default assumptions has been reproduced in Appendix B. (SSL equations for the commercial/industrial and construction scenarios are presented in Chapters 4 and 5, respectively.) In addition, an interactive SSL calculator is available online at http://risk.lsd.ornl.gov/calc_start.htm.

In general, each exposure scenario uses a similar modeling approach for a given exposure pathway. Differences in exposure scenarios are reflected primarily in the specific default model input values associated with the different types of exposures. However, in the case of the migration to ground water pathway, both the modeling approach and model inputs for the residential and commercial/industrial scenarios are identical, and hence so are the associated SSLs. [10] This approach is consistent with EPA's policy to protect potentially potable ground water resources. The treatment of migration to ground water SSLs for commercial/industrial scenarios is discussed further in Section 4.2.3.

3.2 Exposure Pathway Updates

Since publishing the 1996 *SSG*, EPA has developed new technical approaches for two exposure pathways relevant to soil screening evaluations: dermal absorption and inhalation of volatiles present in indoor air as the result of vapor intrusion. In addition, although EPA has not changed the way it models soil ingestion exposures, this guidance provides site managers with new SSL equations that combine soil ingestion and dermal absorption. This section presents an overview of these new approaches to SSL development and includes the associated SSL equations for residential exposure scenarios. (The residential SSL equations presented in this guidance supersede the equations described in the 1996 *SSG*.) Chapter 4 of this document includes a discussion of the application of these methods to non-residential exposure scenarios, and Chapter 5 addresses the application of the ingestion/dermal approach for construction scenarios.

[10] This pathway is not evaluated under the construction exposure scenario. Since the construction scenario supplements either the residential or commercial/industrial scenario, migration to ground water SSLs from either of those chronic exposure scenarios are expected to be protective of subchronic exposures via this pathway during construction.

3.2.1 Direct Ingestion and Dermal Absorption of Soil Contaminants

EPA has developed an approach that site managers can use to calculate SSLs for concurrent exposures to contaminants via the direct ingestion and dermal absorption pathways. This approach consists of a set of equations that allows a site manager to estimate the soil contaminant concentration for which the combined potential exposure via these two pathways is equivalent to an incremental lifetime cancer risk of $1x10^{-6}$ or an HQ of one — the same target risks used for other pathways. This yields SSLs that are protective of exposures that occur via these pathways simultaneously. EPA developed this approach because concurrent exposures via these two pathways are very likely during activities such as gardening, outdoor work, children's outdoor play, and excavation.[11]

Equations 3-1 and 3-2 present EPA's approach to developing combined SSLs for the ingestion and dermal pathways. Equation 3-1 is appropriate for addressing exposure to carcinogenic compounds, and Equation 3-2 covers exposure to non-carcinogenic compounds. Site data may be used to derive site-specific input values for the model parameters that appear in bold typeface. EPA provides default values for these parameters that can be used when site-specific data are not available. Appendix A presents generic ingestion/dermal SSLs for the residential exposure scenario that were calculated using these equations and the specified default values.

[11] Although these activities also may lead to exposure via inhalation, EPA will continue to evaluate these exposures separately because of the potential for different health effects via the inhalation route. Differences in health effects can be associated with differences in metabolic processes for contaminants entering the body via the ingestion/dermal and inhalation exposure routes. As a result, EPA recommends developing separate SSLs for exposures via inhalation.

Equation 3-1
Screening Level Equation for Combined Ingestion and Dermal Absorption Exposure to Carcinogenic Contaminants in Soil - Residential Scenario

$$\text{Screening Level (mg/kg)} = \frac{TR \times AT \times 365\ d/yr}{(EF \times 10^{-6} kg/mg)[(SF_o \times IF_{soil/adj}) + (SF_{ABS} \times SFS \times ABS_d \times EV)]}$$

Parameter/Definition (units)	Default
TR/target cancer risk (unitless)	10^{-6}
AT/averaging time (years)	70
EF/exposure frequency (days/year)	350
SF_{ABS}/dermally adjusted cancer slope factor $(mg/kg\text{-}d)^{-1}$	chemical-specific (Equation 3-3)
SFS/age-adjusted dermal factor (mg-yr/kg-event)	**360 (Equation 3-5)**
ABS_d/dermal absorption fraction (unitless)	chemical-specific (Exhibit 3-3 and Appendix C)
EV/event frequency (events/day)	1
SF_o/oral cancer slope factor $(mg/kg\text{-}d)^{-1}$	chemical-specific (Appendix C)
$IF_{soil/adj}$/age-adjusted soil ingestion factor (mg-yr/kg-d)	114[a]

[a] Calculated per *RAGS, PART B* Equation 3. (U.S. EPA, 1991b)

Direct Ingestion

The components of Equations 3-1 and 3-2 that reflect modeling of exposures via soil ingestion remain unchanged from the approach used in the 1996 *SSG*. For carcinogens, Equation 3-1 assumes a high end exposure duration (30 years) and incorporates a time-weighted average soil ingestion rate for children and adults (incorporated in the soil ingestion factor, $IF_{soil/adj}$), because exposure is higher during childhood and decreases with age. For non-carcinogens, Equation 3-2 focuses on childhood ingestion exposures only, a conservative approach that EPA believes is appropriate for a screening analysis and is consistent with RME exposure.

Equation 3-2
Screening Level Equation for Combined Ingestion and Dermal Absorption Exposure to Non-Carcinogenic Contaminants in Soil - Residential Scenario

$$\text{Screening Level (mg/kg)} = \frac{THQ \times BW \times AT \times 365\,d/yr}{(EF \times ED \times 10^{-6}\,kg/mg)\left[\left(\frac{1}{RfD_o} \times IR\right) + \left(\frac{1}{RfD_{ABS}} \times AF \times ABS_d \times EV \times SA\right)\right]}$$

Parameter/Definition (units)	Default
THQ/target hazard quotient (unitless)	1
BW/body weight (kg)	15
AT/averaging time (years)	6[a]
EF/exposure frequency (days/year)	350
ED/exposure duration (years)	6
RfD_o/oral reference dose (mg/kg-d)	chemical-specific (Appendix C)
IR/soil ingestion rate (mg/d)	200
RfD_{ABS}/dermally-adjusted reference dose (mg/kg-d)	chemical-specific (Equation 3-4)
AF/skin-soil adherence factor (mg/cm^2-event)	**0.2**
ABS_d/dermal absorption factor (unitless)	chemical-specific (Exhibit 3-3 and Appendix C)
EV/event frequency (events/day)	1
SA/skin surface area exposed-child (cm^2)	**2,800**

[a] For non-carcinogens, averaging time equals exposure duration.

Dermal Absorption

Although the 1996 *SSG* acknowledged that contaminant exposure through dermal absorption could be a significant source of human health risks at contaminated sites, data limitations precluded the development of broadly applicable simple site-specific equations for this pathway. EPA's original approach recommended that dermal screening levels be calculated by dividing ingestion SSLs in half for those compounds exhibiting significant (i.e., greater that ten percent) dermal absorption. EPA based this approach on the assumption that exposures via the dermal route would

be roughly equivalent to the ingestion route when dermal absorption from soil exceeds ten percent.[12] At the time, only pentachlorophenol had been shown to exceed the ten percent absorption threshold; for all other compounds, the dermal route did not need to be considered.

Since 1996, EPA has expanded its dermal absorption database to include more contaminants. This information can be found in EPA's *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment* (*RAGS Part E - Interim Guidance,* U.S. EPA, 2001). The modeling approach presented in this soil screening guidance is derived from the risk assessment methodology presented in *RAGS Part E*. This revised approach provides a consistent and more broadly applicable methodology for assessing the dermal pathway for Superfund human health risk assessments.

Exhibit 3-2

SOIL CONTAMINANTS EVALUATED FOR DERMAL EXPOSURES

Arsenic
Benzo(*a*)pyrene
Cadmium
Chlordane
DDT
Lindane
PAHs
Pentachlorophenol
Semi-volatile organic compounds

The dermal pathway should be evaluated for both residential and non-residential soil exposure scenarios depending on the types of activities occurring at a site (e.g., landscaping) and on the contaminants of concern present. The approach to modeling dermal absorption in this guidance supersedes EPA's original approach and should therefore be used instead of the dermal absorption method presented in the 1996 *SSG*. Exhibit 3-2 presents a list of contaminants for which data are available to develop dermal SSLs.[13] This exhibit includes seven individual compounds and two classes of compounds — polycyclic aromatic hydrocarbons (PAHs) and semi-volatile organic compounds — demonstrating significant dermal absorption potential in EPA's dermal absorption database. EPA will provide updates to this list as adequate absorption data are developed for additional chemicals.

[12]Dermal absorption efficiency is a function of the length of time that contaminated soils (or other media) contact the skin of a receptor. Consistent with EPA's RAGS Part E interim guidance document for evaluating dermal exposures to contaminants (U.S. EPA, 2001), all dermal absorption efficiency values reported in this document assume 24-hour exposure events.

[13] Dermal absorption data are also available for PCBs and for 2,3,7,8-tetrachlorodibenzodioxin (TCDD); however, EPA is developing separate guidance to address risks from release of these compounds. For PCBs, EPA is in the process of updating its 1990 *Guidance on Remedial Actions for Superfund Sites with PCB Contamination*. For TCDD and other chlorinated dioxins and furans, please consult the *Draft Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds* (U.S. EPA, 2000c).

Because no toxicity data are presently available for directly evaluating dermal exposures to contaminants, EPA has developed a method to extrapolate oral toxicity values for use in dermal risk assessments. This extrapolation method, shown in Equations 3-3 and 3-4, is necessary because most oral RfDs and cancer slope factors are based on an administered dose (e.g., in food or water) while dermal exposure equations estimate an absorbed dose. Specifically, dermal exposure equations account for the relative ability of a given contaminant to pass through the skin and into the bloodstream. The extrapolation method applies a gastro-intestinal absorption factor (ABS_{GI}) to the available oral toxicity values to account for the absorption efficiency of an administered dose across the gastro-intestinal tract and into the bloodstream. Oral toxicity values should be adjusted when the gastro-intestinal absorption of the chemical in question is significantly less than 50 percent; this cutoff reflects the intrinsic variability in the analysis of absorption studies. A list of chemical-specific ABS_{GI} factors for specific compounds is presented as Exhibit C-7 in Appendix C.

Equation 3-3
Calculation of Carcinogenic Dermal Toxicity Values

$$SF_{ABS} = \frac{SF_O}{ABS_{GI}}$$

Parameter/Definition (units)	Default
SF_{ABS}/dermally adjusted slope factor $(mg/kg\text{-}d)^{-1}$	chemical-specific
SF_O/oral slope factor $(mg/kg\text{-}d)^{-1}$	chemical-specific (Appendix C)
ABS_{GI}/gastro-intestinal absorption factor (unitless)	chemical-specific (Appendix C)

Equation 3-4
Calculation of Non-Carcinogenic Dermal Toxicity Values

$$RfD_{ABS} = RfD_O \times ABS_{GI}$$

Parameter/Definition (units)	Default
RfD_{ABS}/dermally adjusted reference dose (mg/kg-d)	chemical-specific
RfD_O/oral reference dose (mg/kg-d)	chemical-specific (Appendix C)
ABS_{GI}/gastro-intestinal absorption factor (unitless)	chemical-specific (Appendix C)

To be protective of exposures to carcinogens in a residential setting, Superfund focuses on individuals who may live in an area for an extended period of time (e.g., 30 years) from childhood through adulthood. Equation 3-1 uses an age-adjusted dermal factor (SFS) to account for changes in skin surface area, body weight, and adherence factor. The SFS, presented in Equation 3-5, is a time-weighted average of these parameters for receptors exposed from age one to 31. EPA recommends that a default SFS of 360 mg-yr/kg-event be used. For more information regarding the derivation of this time-weighted average value, please consult *RAGS, Part E* Section 3.2.2.5, Equation 3.20.

Equation 3-5
Derivation of the Age-Adjusted Dermal Factor

$$SFS = \left[\frac{SA_{1\&6} \times AF_{1\&6} \times ED_{1\&6}}{BW_{1\&6}}\right] + \left[\frac{SA_{7\&31} \times AF_{7\&31} \times ED_{7\&31}}{BW_{7\&31}}\right]$$

Parameter/Definition (units)	Default
SFS/age-adjusted dermal factor (mg-yr/kg-event)	360
SA_{1-6}/skin surface area exposed-child (cm^2)	**2,800**
SA_{7-31}/skin surface area exposed-adult (cm^2)	**5,700**
AF_{1-6}/skin-soil adherence factor-child (mg/cm^2 - event)	**0.2**
AF_{7-31}/skin-soil adherence factor-adult (mg/cm^2 - event)	**0.07**
ED_{1-6}/exposure duration-child (years)	6
ED_{7-31}/exposure duration-adult (years)	24
BW_{1-6}/body weight-child (kg)	15
BW_{7-31}/body weight-adult (kg)	70

Although children will have a smaller total skin surface area (SA) exposed than adult receptors, they are assumed to have a much higher soil to skin adherence factor (AF). Recent data provide evidence to demonstrate that: 1) soil properties influence adherence, 2) soil adherence varies considerably across different parts of the body, and 3) soil adherence varies with activity (Kissel *et al.,* 1996, Kissel *et al.,*1998, Holmes *et al.,* 1999). Because children are assumed to have additional, more sensitive body parts exposed (e.g., feet) and to engage in higher soil contact activities (e.g., playing in wet soil), this guidance recommends the use of a body part-weighted AF of 0.2 for children and 0.07 for adults in residential exposure scenarios. In order to remain adequately protective, EPA bases SSLs for residential exposures to non-carcinogenic contaminants via the ingestion/dermal absorption pathways on a conservative "childhood only" scenario in which the receptor is assumed to be between ages one through six. This is the approach reflected in Equation 3-2. For more information regarding the calculation of body part-weighted adherence factors, please refer to Section 3.2.2 in *RAGS, Part E*.

Suggested default RME values in *RAGS, Part E* are appropriate for the dermal absorption-related inputs to Equations 3-1, 3-2, and 3-5. The default values for these inputs are also consistent with the residential scenario presented in the 1996 *SSG*. In addition to those inputs described above, default values have been developed for event frequency (EV) and skin surface area exposed (SA). Event frequency (EV, the number of events per day) is assumed to be equal to one. Children are assumed to have 2,800 cm^2 of exposed skin surface area (face, forearms, hands, lower legs, and feet), while adults are assumed to have 5,700 cm^2 exposed (face, forearms, hands, and lower legs). These SA values represent the median (50th percentile) values for all children and adults (U.S. EPA, 1997a).

The last input needed to calculate the dermal portion of the ingestion/dermal SSLs is the chemical-specific dermal absorption fraction (ABS_d). Values for seven individual compounds and two classes of compounds are presented in Exhibit 3-3.[14] For those compounds that are classified as both semi-volatile and as a PAH, the ABS_d default for PAHs should be applied.

Exhibit 3-3

RECOMMENDED DERMAL ABSORPTION FRACTIONS

Compound	Dermal Absorption Fraction (ABS_d)
Arsenic	0.03
Benzo(*a*)pyrene	0.13
Cadmium	0.001
Chlordane	0.04
DDT	0.03
Lindane	0.04
PAHs	0.13
Pentachlorophenol	0.25
Semi-volatile organic compounds	0.1

Source: U.S. EPA, *RAGS, Part E, Supplemental Guidance for Dermal Risk Assessment, Interim Guidance, 2001*.

3.2.2 Migration of Volatiles Into Indoor Air

Subsurface contamination in either soil or ground water may adversely affect indoor air quality through the infiltration of contaminant vapors into the basement or ground floor of an on-site building. The potential for inhalation exposure via this pathway elicited substantial comment during the development of the 1996 *SSG*.

In this update, EPA is incorporating vapor intrusion and the subsequent inhalation of volatiles in indoor air into the soil screening process. This pathway may apply to both residential and non-residential scenarios. A site manager's decision to evaluate this pathway should be based

[14] The U.S. Environmental Protection Agency is developing separate guidance documents which address the dermal risk from exposure to PCBs (*Guidance on Remedial Actions for Superfund Sites with PCB Contamination*, U.S. EPA 1990, currently being updated) and dioxins (*Draft Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds*, U.S. EPA, 2000c).

on current and expected future site conditions (i.e., the current and/or potential future existence of a building on or near a source area) and on the contaminants of concern at the site. Compounds most likely to pose a significant risk via this pathway include volatile organic compounds (VOCs), such as benzene, trichloroethylene, and vinyl chloride. This pathway may also apply to mercury, the only metal that has an appreciable vapor pressure.

EPA recommends that this pathway be evaluated at sites where volatile contaminants have been detected in subsurface soil or soil gas, or in groundwater above MCLs, and where buildings either currently exist or are expected to be developed above or near the contamination. OSWER has developed a draft guidance document that includes a tiered approach to help site managers identify whether the vapor intrusion exposure pathway is complete at a given site, and if so, whether it results in exposures above levels of concern (U.S. EPA, 2002b). We recommend site managers consult this document if uncertain about the applicability of this exposure pathway at a given site.

The Johnson and Ettinger (1991) vapor intrusion model can by used by site managers if the inhalation of volatile contaminants in indoor air is an exposure pathway of concern. This model simulates both convective and diffusive transport of contaminant vapors from a contaminated source area into a building directly above the source. The model may be used for buildings with basements or with slab-on-grade foundations. The model treats the entire building as a single chamber, and therefore does not consider room to room variation in ventilation. It uses chemical-specific data, soil characteristics, and the structural properties of the building to generate an attenuation coefficient that relates the indoor air contaminant concentration to the contaminant vapor concentration at the source area. The output is a risk-based soil-screening concentration derived from a steady-state concentration indoors that represents either a $1x10^{-6}$ individual lifetime cancer risk or a hazard quotient of one for non-cancer effects, whichever yields the more stringent SSL.

EPA has developed a series of computer spreadsheets that allow for site-specific application of the Johnson and Ettinger model (1991). Because there is substantial variation in the values for the parameters used in the Johnson and Ettinger model, it is very difficult to identify suitable default values for inputs such as building dimensions and the distance between contamination and a building's foundation. As a result, EPA has not developed generic values for soil or other media for this pathway. Instead, site managers are encouraged to calculate site-specific values for this pathway using the spreadsheets provided and site-specific values for key input parameters (e.g. building size and ventilation rate).

The vapor intrusion spreadsheets are available for calculating risk or risk-based concentrations for contaminants in soil, soil gas, or ground water. Each medium-specific spreadsheet is available in two versions: one designed for a simple site-specific screening approach (e.g., SL-SCREEN) and one designed for a detailed site-specific modeling approach (e.g., SL-ADV). The simple site-specific version employs conservative default values for many model input parameters but allows the user to define values for several key variables (e.g., soil porosity, depth of contamination). The detailed modeling version allows the user to select values for all model variables and define multiple soil strata between the area of contamination and the building.

Although EPA provides Johnson and Ettinger model spreadsheets for the calculation of risk-based soil concentrations, these values are likely to be characterized by significant uncertainty. As noted in EPA's draft vapor intrusion guidance document (2002b), this uncertainty arises from both measurement error associated with the analysis of volatile compounds in soil samples and from uncertainties in modeling the partitioning of volatile compounds in soil. If the CSM for a site indicates that vapor intrusion may be an exposure pathway of concern, EPA recommends that the pathway be evaluated using measured soil gas data and, if applicable, ground water data. These data may be used in conjunction with the advanced versions of the Johnson and Ettinger model as part of a site-specific analysis of the vapor intrusion pathway.

The model includes default input values based on a review of data for existing hazardous waste sites. Although the default values used are conservative, because of the natural variation in key parameters across sites, EPA recommends taking a range of outcomes into consideration, as opposed to a single value, when conducting a soil screening evaluation. The site manager can assess a range of values after focusing on the most sensitive input variables. In general, the default inputs will yield conservative values. The vapor intrusion SSL spreadsheets and a user's guide that describes the Johnson and Ettinger model in greater detail can be downloaded from the EPA web site at http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm.[15]

[15]Revised spreadsheets consistent with the draft vapor intrusion guidance are currently being developed, and are expected to be posted to the EPA website in January 2003.

4.0 DEVELOPING SSLS FOR NON-RESIDENTIAL EXPOSURE SCENARIOS

This chapter of the guidance document presents soil screening procedures for developing SSLs for sites with non-residential future land use. It first discusses approaches to identifying and categorizing future non-residential land use and presents EPA's framework for developing non-residential SSLs. Next, it presents the specific modifications to the soil screening process required to calculate non-residential SSLs. Finally, it highlights key issues to be considered when conducting a non-residential soil screening assessment.

4.1 Identification of Non-Residential Land Use

The appropriate characterization of future land use at a site during the development of the conceptual site model (CSM) enables a site manager to identify or calculate proper soil screening levels for the site. It also enables future site investigations, such as the baseline risk assessment and feasibility study, to focus on the development of practical and cost-effective remedial alternatives that are consistent with the anticipated future land use. This section discusses the process for identifying anticipated future site land uses and describes the implications of the results for the soil screening process. It begins with a brief discussion of factors to consider when identifying future land use, then provides an overview of the types of land uses included in the "non-residential" universe, and concludes with a description of EPA's approach to integrating non-residential land use into the soil screening framework.

4.1.1 Factors to Consider in Identifying Future Land Use

A detailed discussion of EPA's recommended practices for identifying reasonably anticipated future land use can be found in the EPA directive *Land Use in the CERCLA Remedy Selection Process* (1995a).[1] In brief, that document stresses the importance of developing realistic assumptions about the likely future uses of NPL sites through community involvement, including early discussions with local land use planning authorities, local officials, and the public. The Community Contact Coordinator could facilitate these discussions with the community. The directive also provides examples of information sources that can be useful in identifying likely future land uses such as: current land use, zoning laws and maps, population growth patterns, existing institutional controls and land use designations, presence of endangered or threatened species, and adjacent and nearby land uses.

Identification of future land use in the context of soil screening evaluations goes beyond simply making assumptions about categories of use. It involves identifying the kinds of human receptors that may be present (e.g., workers) and the types of activities they are likely to engage in at the site. Risk from contamination at a site is a function of the specific activities that receptors

[1] This document may be obtained from the EPA web site at: http://www.epa.gov/superfund/resources/landuse.htm.

undertake and the exposures to contaminants that are associated with those activities. The activities can vary considerably, even across sites that fall within the same land use category; thus, when developing the CSM, the assumptions about receptor activities at a site are as critical to the screening process as assumptions about land use.

4.1.2 Categories of Non-Residential Land Use and Exposure Activities

The term "non-residential land use" encompasses a broad range of possible site uses, including commercial, industrial, agricultural, and recreational. The commercial and industrial categories are each individually quite broad as well; commercial uses range from churches and day care centers to automobile repair shops and large-scale warehouse operations, and industrial uses can include public utilities, transportation services, and a wide range of manufacturing activities.

The range of human activities at sites with non-residential uses may also vary considerably in terms of location (e.g., indoors versus outdoors), physical exertion, frequency, and the potential for contact with site contamination. These differences determine the types and intensity of exposures likely to be experienced by receptors. For example, an indoor office worker is generally not engaged in physically strenuous labor during the work day and experiences minimal exposures to potentially contaminated site soil compared to a construction worker performing excavation work. The office worker, however, may inhale volatilized compounds that migrate from contaminated soil or ground water into the office space. Activities may vary even between sites within the same land use category. For example, activities (and receptors) at a day care center are quite different from activities at a store, though both would be considered commercial establishments. Thus, as mentioned earlier, careful identification of activities associated with the likely future use of a site is critical to proper assessment of potential exposure.

4.1.3 Framework for Developing SSLs for Non-Residential Land Uses

The non-residential screening framework focuses on a single non-residential land use category that encompasses both commercial and industrial land uses. EPA selected this approach for two reasons. First, as discussed in Section 3.2, it can be difficult to distinguish between commercial and industrial sites on the basis of exposure potential. A wide range of potential exposure levels (as determined by the range of potential site activities) characterizes both the commercial and industrial categories, and because these ranges overlap, one category can not be considered to have a consistently higher exposure potential than the other. Second, the screening process focuses on *future* land use, and for many NPL sites, considerable uncertainty exists about the specific activities likely to occur in the future. Therefore, the non-residential soil screening framework includes one set of generic SSLs and SSL equations that apply to both commercial and industrial land uses. In addition, the simple site-specific approach allows site managers to differentiate between commercial and industrial sites when calculating SSLs by focusing on the receptors and activities specific to the assumed future use.

Normally, under the generic and simple site-specific screening methodologies, the receptors for the commercial/industrial scenario are limited to workers. EPA does not warrant evaluation of exposures to members of the public under a non-residential land use scenario for two reasons. First, because public access is generally restricted at industrial sites, workers are the sole on-site receptor. Second, even though the public usually has access to commercial sites (e.g., as customers), SSLs that are protective of workers, who have a much higher exposure potential because they spend substantially more time at a site, will also be protective of customers. **However, if a future commercial or industrial land use is likely to involve substantial exposure to the public (e.g., nursing homes, day care centers), the site should be evaluated using the residential soil screening framework or a detailed site-specific screening methodology.**

As shown in Exhibit 4-1, two potential worker receptors are addressed under the commercial/industrial scenario. They are characterized by the intensity and location of their activities, and by the frequency and duration of their exposures.

- **Outdoor Worker.** This is a long-term receptor exposed during the work day who is a full time employee of the company operating on-site and who spends most of the workday conducting maintenance activities outdoors. The activities for this receptor (e.g., moderate digging, landscaping) typically involve on-site exposures to surface and shallow subsurface soils (at depths of zero to two feet). The outdoor worker is expected to have an elevated soil ingestion rate (100 mg per day) and is assumed to be exposed to contaminants via the following pathways: incidental ingestion of soil, dermal absorption of contaminants from soil, inhalation of fugitive dust, inhalation of volatiles outdoors, and ingestion of ground water contaminated by leachate.[2, 3] The outdoor worker is expected to be the most highly exposed receptor in the outdoor environment under commercial/industrial conditions. Thus, SSLs for this receptor are protective of other reasonably anticipated outdoor activities at commercial/industrial facilities.

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[2] The soil ingestion rate of 100 mg per day for the outdoor worker is equal to the default residential adult ingestion rate recommended in *RAGS Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors,* OSWER Directive 9285.6-03 (U.S. EPA, 1991a). The document recommends an ingestion rate of 50 mg per day for a commercial/industrial worker and 100 mg per day for an adult resident. EPA selected the latter value to reflect the increased ingestion exposures experienced by outdoor workers during landscaping or other soil disturbing activities. Research is ongoing to gain better information on soil ingestion rates. The recommended default values are subject to change as better data become available.

[3] The ingestion of contaminated ground water exposure pathway for non-residential receptors is addressed by SSLs for the migration of contaminants from soil into an underlying potable aquifer. The SSL equations and default values used to model this pathway are identical to those used for residential exposure scenarios (See Section 3.1). In addition, the rationale for a consistent set of migration to ground water SSLs across residential and commercial/industrial uses is described in detail on page 4-24.

Exhibit 4-1 SUMMARY OF THE COMMERCIAL/INDUSTRIAL EXPOSURE FRAMEWORK FOR SOIL SCREENING EVALUATIONS		
	Receptors	
	Outdoor Worker	**Indoor Worker**
Exposure Characteristics	C Substantial soil exposures C Long-term exposure	C Minimal soil exposures (little or no direct contact with outdoor soils, potential for contact through ingestion of soil tracked in from outside) C Long-term exposure
Pathways of Concern	C Ingestion (surface and shallow subsurface soils) C Dermal absorption (surface and shallow subsurface soils) C Inhalation (fugitive dust, outdoor vapors) C Ingestion of contaminated ground water[1]	C Ingestion (indoor dust) C Inhalation (indoor vapors) C Ingestion of contaminated ground water[1]
Default Exposure Factors		
Exposure Frequency (d/yr)	225	250
Exposure Duration (yr)	25	25
Soil Ingestion Rate (mg/d)	100	50
Inhalation Rate (m^3/d)	20	20
Body Weight (kg)	70	70
Lifetime (yr)	70	70

[1] The same equations and default inputs (e.g., ground water ingestion rates) are used to calculate both residential and commercial/industrial SSLs for this pathway because of concern for off-site residents who may be exposed to contaminated ground water that migrates off-site.

- **Indoor Worker.** This receptor spends most, if not all, of the workday indoors. Thus, an indoor worker has no direct contact with outdoor soils. This worker may, however, be exposed to contaminants through ingestion of contaminated soils that have been incorporated into indoor dust, ingestion of contaminated ground water, and the inhalation of contaminants present in indoor air as the result of vapor intrusion.[4] SSLs calculated for this receptor

[4] The soil ingestion rate for the indoor worker, 50 mg per day, reflects decreased soil exposures relative to the outdoor worker and is consistent with the default commercial/industrial soil ingestion rate recommended in *RAGS Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors,* OSWER directive 9285.6-03 (U.S. EPA, 1991a). Research is ongoing to gain better information on soil ingestion rates. The recommended default values are subject to change as better data become available.

are expected to be protective of both workers engaged in low intensity activities such as office work and those engaged in more strenuous activity (e.g., factory or warehouse workers).

The commercial/industrial scenario does not include exposures during construction activities. However, EPA recognizes that construction is likely to occur at many NPL sites and that it may lead to significant short-term exposures. A separate soil screening scenario and SSL methodology for construction activities designed to supplement either the residential or commercial/industrial SSL is presented in Chapter 5.

4.1.4 Land Use and the Selection of a Screening Approach

The assumptions about future land use and future site activities may influence the selection of a soil screening approach. In general, sites where the reasonably anticipated future use is either commercial or industrial may be evaluated using any of the three screening approaches: the generic approach, the simple site-specific approach, or the detailed site-specific modeling approach. However, commercial sites with exposures akin to residential scenarios (i.e., where the future use involves the housing, education, and/or care of children, the elderly, the infirm, or other sensitive subpopulations) should be evaluated using the residential soil screening framework, if appropriate, or using a detailed site-specific screening approach. Examples of such uses include, but are not limited to: schools or other educational facilities, day care centers, nursing homes, elder care facilities, hospitals, and churches.

Sites where the anticipated future land use is agricultural or recreational typically require site managers to apply the detailed site-specific modeling approach for developing SSLs. For example, agricultural sites may require site-specific modeling to address exposure pathways that are not included in the generic and simple site-specific approaches (e.g., ingestion of contaminated foods). In other situations, such as an evaluation of future recreational use, exposure scenarios may be analogous to residential exposures, and application of residential SSLs to the site may be a reasonable alternative to the detailed site-specific modeling approach.

Lastly, a soil screening evaluation of a construction scenario, which is described separately in Chapter 5, should be conducted using either the simple site-specific or detailed site-specific modeling approaches. Because of the difficulty of establishing default input values for a "standard" construction project, these screenings can not be conducted using the generic approach.

4.2 Modifications to the Soil Screening Process for Sites With Non-Residential Exposure Scenarios

To conduct a soil screening evaluation for a non-residential exposure scenario, a site manager should employ the same basic seven-step soil screening process outlined in Section 2.3. However, there are some fundamental differences in the potential for exposure under non-residential scenarios that necessitate modifications to certain steps of the framework. This section describes in detail the key differences in these steps for the non-residential soil screening process.

Of the seven steps in the screening process, three must be adjusted for a non-residential soil screening evaluation — Step 1: Develop Conceptual Site Model (CSM); Step 2: Compare CSM to SSL Scenario; and Step 5: Calculate Site- and Pathway-specific SSLs. The remaining steps, consisting of Step 3: Define Data Collection Needs for Soils; Step 4: Sample and Analyze Site Soils; Step 6: Compare Site Soil Contaminant Concentrations to Calculated SSLs; and Step 7: Address Areas Identified for Further Study, are essentially unchanged. For detailed guidance on performing these latter steps, please consult the 1996 *SSG*.

Regarding Step 3, EPA recommends that site managers develop a sampling plan for surface soil that will provide a reliable estimate of the arithmetic mean of contaminant concentrations. Section 2.3.2 of the 1996 *SSG* describes such a sampling plan utilizing composite samples. Guidance on developing other sampling plans using discrete samples can be found in *Guidance for Choosing a Sampling Design for Environmental Data Collection* (U.S. EPA 2000a). Although there may be differences in the activities and exposures likely to occur under non-residential and residential use scenarios, EPA is not recommending specific changes to the surface soil sampling approach when performing non-residential soil screening evaluations. Unless there is site-specific evidence to the contrary, an individual receptor is assumed to have random exposure to surface soils at both residential and non-residential sites.

However, as in the 1996 *SSG*, EPA emphasizes that the depth over which soils are sampled should reflect the type of exposures expected. Activities typical for non-residential site uses (e.g., landscaping and other outdoor maintenance activities) may result in direct contact exposure for certain receptors to contaminants in shallow subsurface soils at depths of up to two feet. EPA expects that site managers will characterize contaminant levels in the top two feet of the soil column by taking shallow subsurface borings where appropriate. The specific locations of such borings should be determined by the likelihood of direct contact with these subsurface soils and by the likelihood that soil contamination is present at that depth. Given that these deeper soils are not characterized to the same extent as the top two centimeters of soil, the maximum measured contaminant concentration in the borings in a given exposure area should be compared directly with the SSLs, as described in Section 2.3, Step 6. Alternatively, if available evidence indicates that contaminated subsurface soils will be disturbed and brought to the surface (e.g., as the result of redevelopment activities), site managers will need to characterize subsurface contamination more thoroughly and should collect a sufficient number of samples to develop a UCL_{95} value for use in the soil screening evaluation.

4.2.1 Step 1: Develop Conceptual Site Model

The process of developing a CSM — a comprehensive representation of a site that illustrates contaminant distributions in three dimensions, along with release mechanisms, exposure pathways, migration routes, and potential receptors — is similar for non-residential and residential soil screening evaluations. The key differences in developing a CSM for a site with anticipated non-residential future land use are:

- **Identification of Land Use.** Identifying the reasonably anticipated future land use for an NPL site is critical to the development of the CSM. It is the first step toward identifying the future site receptors and activities that determine the key exposure pathways of concern. Future land use may also influence the selection of a screening approach by a site manager. Future industrial or commercial sites may be evaluated using any of the three screening approaches (generic, simple site-specific, or detailed site-specific modeling); sites with other non-residential future land uses (e.g., agriculture, recreation) are appropriately addressed using a detailed site-specific modeling approach.

- **Receptors for Non-Residential Uses.** When developing CSMs for commercial or industrial sites, the focus should be on worker receptors, unless anticipated future site activities are expected to result in substantial exposures to members of the public and/or children visiting the site (see Section 4.1.3). CSMs for commercial or industrial sites should include long-term receptors (e.g., indoor workers and outdoor workers) and, if appropriate, short-term, high intensity receptors (e.g., construction workers). For sites with future agricultural or recreational uses, CSMs should address a wider range of potential receptors (e.g., farm workers and children/adults exposed to contamination through consumption of agricultural products or children/adults engaged in recreational activities).

- **Activities for Non-Residential Uses.** In order to identify the exposure pathways pertinent to future exposures, site managers should consider the potential future site activities that may contribute to exposure. Examples of activities likely to occur at commercial/industrial sites include: outdoor maintenance work and landscaping, indoor commercial activities (e.g. wholesale or retail sales) and office work.

A key part of CSM development for all soil screening evaluations is the identification of ground water use. Site managers should consult EPA's policy on ground water classification (presented in Section 4.2.3) and should coordinate with state or local authorities responsible for ground water use and classification to determine whether the aquifer beneath or adjacent to the site is a potential source of drinking water. The migration to ground water pathway is applicable to all potentially potable aquifers, regardless of current or future land use.

4.2.2 Step 2: Compare Conceptual Site Model to SSL Scenario

The non-residential soil screening scenario used in the generic and simple site-specific screening approaches is likely to be appropriate for a wide range of commercial and industrial sites. However, the CSM for agricultural or recreational sites, as well as for some commercial or industrial sites, may include sources, exposure pathways, and receptors not covered by the commercial/industrial scenario described in this document. Comparison of the CSM with this scenario enables site managers to determine whether additional or more detailed assessments are needed to address specific site contaminants or characteristics.

Six exposure pathways are included in the commercial/industrial soil screening scenario. These pathways, as well as the relevant receptors for each pathway, are listed below:

Surface soil pathways:

- Incidental direct ingestion — indoor worker and outdoor worker.
- Dermal absorption — outdoor worker.
- Inhalation of fugitive dusts — outdoor worker.

Subsurface soil pathways:

- Inhalation of volatiles resulting from vapor intrusion into indoor air — indoor worker.
- Inhalation of volatiles migrating from soil to outdoor air — outdoor worker.
- Ingestion of contaminated ground water caused by migration of chemicals through soil to an underlying potable aquifer — indoor worker and outdoor worker.

Site managers should consider these pathways and make thoughtful determinations about whether receptors are likely to be exposed via each pathway.

It is important to carefully consider each of the possible pathways as part of the screening process, even though a site manager may quickly decide that one or more specific pathways are not relevant for a site. If, based on an analysis of reasonably anticipated future site activities, the site manager identifies pertinent exposure pathways other than those listed above, these additional pathways should be addressed using a detailed site-specific modeling approach.

The commercial/industrial soil screening scenario does not evaluate exposures to off-site receptors, except via the ingestion of ground water contaminated by soil leachate. In general, off-site receptors are assumed to have very limited or no access to the site, which precludes direct exposures. Indirect exposure to off-site residents (e.g., outdoor exposure to soil vapors and to particulates due to wind erosion) is possible. Modeling results indicate that the on-site outdoor worker is exposed to higher particulate and vapor concentrations than an off-site receptor located at the site property line. As a result, outdoor worker SSLs for the inhalation of volatiles and particulates outdoors should be protective of an off-site worker with similar exposure frequency and duration. Off-site residents, however, have a higher exposure frequency and duration than workers, and therefore SSLs based on modeling for these off-site receptors could be slightly lower than SSLs based on outdoor worker exposures.

An analysis of these pathways that used very conservative (i.e., health protective) assumptions to model emissions and transport of vapors and particulates to an off-site receptor indicates that for most contaminants, SSLs calculated for on-site receptors would be protective of indirect exposures to off-site residents.[5] For some compounds, the modeled SSL for indirect off-site exposure is less than the most protective SSL for commercial/industrial on-site receptors; however, for most of these, the off-site SSL is within 30 percent of the on-site value.[6] The significance of this difference depends on several factors that need to be evaluated on a site-specific basis, such as the nature and toxicity of the chemicals of concern, source characteristics, and the actual distance to off-site receptors. Also, if the migration to ground water pathway is being evaluated at a site (assuming a DAF of 20), on-site SSLs will likely be protective of indirect inhalation exposures to off-site residents for nearly all contaminants in Appendix A, even using conservative modeling assumptions.[7] Given the results of this analysis, the Agency does not recommend evaluating volatile or particulate exposures to off-site residents under the simple site-specific commercial/industrial scenario.[8] If a CSM suggests that off-site receptors may experience significant exposures to site contaminants via pathways other than ingestion of ground water, these exposures should be evaluated using a detailed site-specific modeling approach.

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[5]The conservative assumptions include the presence of an infinite source, the presence of volatiles in surface soils, and the location of the off-site receptor just beyond the site boundary.

[6]Exceptions for the inhalation of volatiles pathway include 1,1,2-trichloroethane (36 percent lower for off-site receptor), hexachlorobenzene (37 percent lower for off-site receptor), mercury (94 percent lower for off-site receptor), and tetrachloroethylene (32 percent lower for off-site receptor). Chromium (VI) was the lone exception for the inhalation of particulates pathway (50 percent lower for off-site receptor). If the migration to ground water pathway is being evaluated, on-site SSLs would be sufficiently protective (using the conservative default assumptions) for all but hexachlorobenzene, mercury, and chromium (VI).

[7]The only four contaminants for which on-site SSLs would not be protective under this scenario are chloroform (27 percent lower for off-site receptor), hexachlorobenzene (37percent lower for off-site receptor), hexachloropentadiene (6 percent lower for off-site receptor), and mercury (94 percent lower for off-site receptor).

[8] As discussed in Chapter 5, exposures to an off-site resident receptor may need to be evaluated if a future construction event is reasonably likely.

4.2.3 Step 5: Calculate Site- and Pathway-Specific SSLs

This section presents equations appropriate for calculating SSLs for the generic and simple site-specific soil screening approaches for each pathway in the commercial/industrial soil screening scenario (with the exception of the indoor vapor intrusion pathway, which requires a spreadsheet model to calculate SSLs). These equations and the default input values are designed to reflect reasonable maximum exposure (RME) for chronic exposures in a commercial or industrial setting. They incorporate reasonably conservative values for intake and duration and average or typical values for all site-specific inputs describing soil, aquifer, and meteorologic characteristics.

For each equation, site-specific input parameters are indicated in bold.[9] Where possible, default values are provided for these parameters for use when site-specific data are not available. These defaults were not selected to represent worst case conditions; however, they are conservative. The generic SSLs for the commercial/industrial scenario were calculated using these equations and the specified default values. Generic commercial/industrial SSLs are presented in Appendix A. In addition, an interactive SSL calculator for the simple site-specific equations is available on-line at http://risk.lsd.ornl.gov/calc_start.htm.[10] The SSL calculator is updated periodically to reflect changes in Agency guidance (e.g., additional pathways, updated toxicity values); users should confirm that the calculator's chemical-specific inputs are consistent with the latest values available.

Chemical-specific data, including toxicity values, for use in developing simple site-specific SSLs are provided in Appendix C. **Prior to calculating SSLs at a site, each relevant chemical-specific value in Appendix C should be checked against the most recent version of its source and updated, if necessary.** Toxicity values for the inhalation exposure route are not available for all chemicals. The *TBD* to the 1996 *SSG* presents the results of EPA's review of methods for extrapolating inhalation toxicity values from oral values. EPA found that route-to-route extrapolations are not necessary if migration to ground water is considered, because the SSLs for that pathway are sufficiently protective to address any underestimation of risk resulting from the lack of inhalation toxicity data. If the migration to ground water pathway is not applicable to the site, oral-to-inhalation extrapolations should be considered on a case-by-case basis. For information on extrapolation methods, please consult EPA's *Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry* (U.S. EPA, 1994).

In general, the basic forms of the SSL equations presented here are the same as those used for the residential scenario; however, EPA has developed the following default input values that reflect a commercial/industrial RME scenario:

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[9] The use of distributions for exposure factors (in a probabilistic risk assessment) is reserved for a detailed site-specific modeling approach. Refer to EPA's *Guiding Principles for Monte Carlo Analysis* (U.S. EPA, 1997b) and *Policy for Use of Probabilistic Analysis in Risk Assessment* (U.S. EPA, 1997d) for further information.

[10] The SSL calculator currently includes default values for residential exposure scenarios; however, users can adjust these defaults to reflect the non-residential exposure scenarios.

- **Exposure frequency.** For outdoor workers, EPA has established a default exposure frequency of 225 days/year. This value is based on data from the U.S. Census Bureau's *1990 Earnings by Occupation and Education Survey* and represents the average number of days worked per year by male and female workers engaged in activities likely to be similar to those of the outdoor worker receptor.[11] Because we assume exposure frequency is equal to the number of days worked per year, we recognize that this value may overestimate exposures for receptors in regions of the U.S. where extreme winters preclude exposure to site soils for extended periods during the year. Similarly, the default may potentially underestimate exposures in more temperate climates. Therefore, site managers conducting simple or detailed site-specific soil screening evaluations may propose alternative, site-specific values for this parameter that are supported by specific information on climatic influences. For indoor workers, EPA has established a default exposure frequency of 250 days/year. This value is based on a work scenario of five days per week for 50 weeks per year (assuming two weeks of vacation).

- **Exposure duration.** Exposure duration is assumed to be equivalent to job tenure for receptors in the non-residential soil screening scenario. EPA has selected a value of 25 years as the default for this exposure factor. This is the same value used in *RAGS Part B* (U.S. EPA, 1991b). It is supported by an analysis of Bureau of Labor Statistics data which shows that the 95th percentile value for job tenure for men and women in the manufacturing sector are 25 years and 19 years, respectively (Burmaster, 1999). Job tenure for non-industrial workers varies widely. The 95th percentile job tenure values for workers in the transportation/utility and wholesale sectors are only somewhat less than manufacturing workers — 22 years and 18 years for men and women, respectively. Values are lower for other non-industrial sectors — approximately 13 years for workers in the finance and service sectors, and seven years for retail workers. Thus, the 25-year default value is protective of workers across a wide spectrum of industrial and commercial sectors. Site managers conducting simple or detailed site-specific screening evaluations may propose alternative exposure durations supported by job tenure data and the anticipated site use.

Other changes to default exposure factors that apply to individual pathways are discussed below, along with their respective SSL equations.

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[11] The exposure frequency value of 225 days/year for outdoor workers assumes an eight-hour workday and is based on data from the following occupational categories in the U.S. Census Bureau's *1990 Earnings by Occupation and Education Survey:* groundskeepers and gardeners, except farm; specified mechanics and repairers, not elsewhere classified; not specified mechanics and repairers; painters, construction and maintenance; and construction laborers.

SSL Equations for Surface Soils

The relevant pathways for exposure to surface soils for the commercial/industrial use scenarios include direct ingestion, dermal absorption, and inhalation of fugitive dusts. As in the residential soil screening process, the SSL equations for direct ingestion and dermal absorption have been combined to reflect the concurrent nature of these exposures. The combined direct ingestion/dermal absorption exposure pathway should be routinely considered in screening evaluations that use the commercial/industrial scenario, though dermal absorption can not be evaluated currently for all contaminants. (Where dermal absorption data are not available, the ingestion/dermal SSL equations can be used to calculate an SSL based on the ingestion pathway only.)

Typical activities for commercial/industrial site use, such as landscaping and outdoor maintenance, may result in direct exposure to soils at depths of up to two feet. Thus, site managers may need to extend the analysis of exposure through the direct ingestion, dermal absorption, and inhalation of fugitive dusts pathways to include contaminants found in these subsurface soils. The likelihood of these receptor activities occurring at a site should be addressed in the CSM and reflected in the development of site-specific SSLs.

Direct Ingestion and Dermal Absorption. Equations 4-1 and 4-2 are appropriate for addressing chronic ingestion and dermal absorption exposure of commercial/industrial receptors to carcinogens and non-carcinogens, respectively. The equations produce SSLs protective of concurrent exposures to these receptors via these two pathways.

As mentioned in Section 4.1.3, the commercial/industrial scenario does not evaluate exposures to children. Thus, unlike the residential SSLs, the commercial/industrial direct ingestion/dermal absorption SSLs for non-carcinogens are based on exposures to adults only.

The default recommended soil ingestion rate for workers depends on the type of activity being performed. EPA recommends a 50 mg/day dust ingestion rate for indoor workers, as suggested in *RAGS Volume I: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors*, OSWER directive 9285.6-03 (U.S. EPA, 1991a). The soil ingestion SSLs for indoor employees protect against the ingestion of contaminants in indoor dust that are derived from contaminated outdoor soil. In setting a default ingestion rate for outdoor workers, we follow the same rationale as EPA's Technical Review Workgroup for Lead (TRW); we assume that a higher ingestion rate is reasonable for a commercial/industrial worker engaged in contact-intensive activities. Because outdoor workers are likely to experience more significant exposures to surface soils than their indoor counterparts, EPA has adopted a default soil ingestion rate of 100 mg/day for this receptor.

SSLs for chronic exposures to contaminants via dermal absorption under the commercial/industrial scenario are calculated based on the same methodology discussed in Section 3.2.1. The suggested default input values for the dermal exposure portion of the direct ingestion/dermal absorption equations are consistent with those recommended in EPA's *RAGS, Part E* with the exception of exposure frequency (U.S. EPA, 2001). This soil screening guidance recommends that a default of 225 days per year be used for workers at commercial or industrial sites as opposed to the 250 days per year suggested in *RAGS, Part E*. As described above, this recommendation is based on occupational data from the U.S. Census Bureau. Event frequency (EV, the number of events per day) is assumed to be equal to one. Adults are assumed to have their face, forearms, and hands exposed. Therefore, this guidance recommends that a value of 3,300 cm^2 be used as an estimate of the skin surface area exposed (SA). We also assume a default adherence factor (AF) of 0.2 mg soil per square centimeter of exposed skin. Both the SA and AF default values represent the median (50th percentile) values for all adult workers at commercial and industrial sites based on EPA studies (U.S. EPA, 1997a). The chemical-specific dermal absorption fractions (ABS_d) are presented in Appendix C. For those compounds classified as both semi-volatile and as a PAH, the ABS_d default for PAHs should be applied.

Equation 4-1
Screening Level Equation for Combined Ingestion and Dermal Absorption Exposure to Carcinogenic Contaminants in Soil - Commercial/Industrial Scenario

$$\text{Screening Level (mg/kg)} = \frac{TR \times BW \times AT \times 365\,d/yr}{(EF \times ED \times 10^{-6}\,kg/mg)((SF_o \times IR) + (SF_{ABS} \times AF \times ABS_d \times SA \times EV))}$$

Parameter/Definition (units)	Default
TR/target cancer risk (unitless)	10^{-6}
BW/body weight (kg)	70
AT/averaging time (years)	70
EF/exposure frequency (days/year)	
outdoor worker	**225**
indoor worker	250
ED/exposure duration (years)	
outdoor worker	**25**
indoor worker	25
SF_o/oral cancer slope factor $(mg/kg\text{-}d)^{-1}$	chemical-specific (Appendix C)
IR/soil ingestion rate (mg/d)	
outdoor worker	100
indoor worker	50
SF_{ABS}/dermally-adjusted cancer slope factor $(mg/kg\text{-}d)^{-1}$	chemical-specific (Equation 3-3)
AF/skin-soil adherence factor (mg/cm^2-event)	**0.2**
ABS_d/dermal absorption fraction (unitless)	chemical-specific (Exhibit 3-3 and Appendix C)
SA/skin surface exposed (cm^2)	**3,300**
EV/event frequency (events/day)	
outdoor worker	**1**
indoor worker	**0**

Equation 4-2
Screening Level Equation for Combined Ingestion and Dermal Absorption Exposure to Non-Carcinogenic Contaminants in Soil - Commercial/Industrial Scenario

$$\text{Screening Level (mg/kg)} = \frac{THQ \times BW \times AT \times 365\,d/yr}{(EF \times ED \times 10^{-6}\,kg/mg)\left[\left(\frac{1}{RfD_o} \times IR\right) + \left(\frac{1}{RfD_{ABS}} \times AF \times ABS_d \times SA \times EV\right)\right]}$$

Parameter/Definition (units)	Default
THQ/target hazard quotient (unitless)	1
BW/body weight (kg)	70
AT/averaging time (years)	25[a]
EF/exposure frequency (days/year)	
outdoor worker	**225**
indoor worker	250
ED/exposure duration (years)	
outdoor worker	**25**
indoor worker	25
RfD_o/oral reference dose (mg/kg-d)	chemical-specific (Appendix C)
IR/soil ingestion rate (mg/d)	
outdoor worker	100
indoor worker	50
RfD_{ABS}/dermally-adjusted reference dose (mg/kg-d)	chemical-specific (Equation 3-4)
AF/skin-soil adherence factor (mg/cm^2-event)	**0.2**
ABS_d/dermal absorption fraction (unitless)	chemical-specific (Exhibit 3-3 and Appendix C)
SA/skin surface exposed (cm^2)	**3,300**
EV/event frequency (events/day)	
outdoor worker	**1**
indoor worker	**0**

[a] For non-carcinogens, averaging time equals exposure duration.

Inhalation of Fugitive Dusts. Inhalation of fugitive dusts generated by wind erosion may be of concern under the commercial/industrial scenario for semi-volatile organic compounds and metals in surface soils. However, as in the residential scenario, the fugitive dust exposure route need not be routinely considered for semi-volatile organics under the commercial/industrial scenario for two reasons: (1) the default ingestion/dermal absorption SSLs for these compounds are often several orders of magnitude lower (i.e., more stringent) than the corresponding default fugitive dust SSLs; and (2) EPA believes the ingestion/dermal absorption route always should be evaluated when screening surface soils. Thus, EPA considers ingestion/dermal absorption SSLs to be adequately protective of fugitive dust exposures to semi-volatile organic chemicals in surface soils under typical commercial/industrial conditions.

Similarly, generic ingestion/dermal absorption SSLs for most metals are more conservative than the fugitive dust SSLs. Thus, fugitive dust SSLs do not need to be calculated for most metals with the exception of chromium. The carcinogenicity of the hexavalent form of chromium (Cr^{+6}) via the inhalation route results in a generic fugitive dust SSL that is more stringent than the ingestion/dermal absorption SSL. As a result the fugitive dust pathway should be evaluated routinely for chromium.

The fugitive dust pathway should be considered carefully when developing the CSM at sites with future commercial/industrial land use. The above rules of thumb for fugitive dust SSLs may not be valid for site conditions or activities at sites that are expected to result in particularly high fugitive dust emissions. Examples of conditions that contribute to potentially high fugitive dust emissions include dry soils (moisture content less than approximately eight percent), finely divided or dusty soils (high silt or clay content); high average annual wind speeds (greater than approximately 5.3 m/s); and less than 50 percent vegetative cover. Examples of activities likely to generate high dust levels include heavy truck traffic on unpaved roads and other construction-related activities. Chapter 5 presents a method for addressing increased particulate exposures during construction. For other scenarios characterized by high fugitive dust calculations, EPA recommends using a detailed site-specific modeling approach to develop fugitive dust SSLs (see Appendix E).

Equations 4-3 and 4-4 are appropriate for calculating fugitive dust SSLs for carcinogens and non-carcinogens. These equations are unchanged from the 1996 *SSG*. However, different default values are provided that reflect appropriate exposure frequency, exposure duration, and averaging time (for exposures to non-carcinogens) for workers.

Equation 4-5 is used to calculate the particulate emission factor (PEF). This factor represents an estimate of the relationship between soil contaminant concentrations and the concentration of these contaminants in air as a consequence of particle suspension. Equation 4-5 is unchanged and includes the same defaults as those provided in the 1996 *SSG*, with the exception of the dispersion factor for wind erosion, Q/C_{wind}, which has been modified slightly to reflect updated dispersion modeling.

Equation 4-3
Screening Level Equation for Inhalation of Carcinogenic Fugitive Dusts
- Commercial/Industrial Scenario

$$\text{Screening Level (mg/kg)} = \frac{TR \times AT \times 365\,d/yr}{URF \times 1{,}000\,\mu g/mg \times EF \times ED \times \frac{1}{PEF}}$$

Parameter/Definition (units)	Default
TR/target cancer risk (unitless)	10^{-6}
AT/averaging time (yr)	70
URF/inhalation unit risk factor $(\mu g/m^3)^{-1}$	chemical-specific (Appendix C)
EF/exposure frequency (d/yr)	
Outdoor Worker	**225**
ED/exposure duration (yr)	
Outdoor Worker	**25**
PEF/particulate emission factor (m^3/kg)	**1.36×10^9 (Equation 4-5)**

Equation 4-4
Screening Level Equation for Inhalation of Non-carcinogenic Fugitive Dusts
- Commercial/Industrial Scenario

$$\text{Screening Level (mg/kg)} = \frac{THQ \times AT \times 365\,d/yr}{EF \times ED \times [\frac{1}{RfC} \times \frac{1}{PEF}]}$$

Parameter/Definition (units)	Default
THQ/target hazard quotient (unitless)	1
AT/averaging time (yr)	
Outdoor Worker	**25[a]**
EF/exposure frequency (d/yr)	
Outdoor Worker	**225**
ED/exposure duration (yr)	
Outdoor Worker	**25**
RfC/inhalation reference concentration (mg/m^3)	chemical-specific (Appendix C)
PEF/particulate emission factor (m^3/kg)	**1.36×10^9 (Equation 4-5)**

[a] For non-carcinogens, averaging time equals exposure duration.

Equation 4-5
Derivation of the Particulate Emission Factor
- Commercial/Industrial Scenario

$$PEF\ '\ Q/C_{wind} \times \frac{3{,}600 s/h}{0.036 \times (1\&V) \times (U_m/U_t)^3 \times F(x)}$$

Parameter/Definition (units)	Default
PEF/particulate emission factor (m^3/kg)	1.36×10^9
Q/C_{wind}/inverse of the ratio of the geometric mean air concentration to the emission flux at the center of a square source (g/m^2-s per kg/m^3)	**93.77[a]**
V/fraction of vegetative cover (unitless)	**0.5 (50%)**
U_m/mean annual windspeed (m/s)	**4.69**
U_t/equivalent threshold value of windspeed at 7m (m/s)	**11.32**
F(x)/function dependent on U_m/U_t derived using Cowherd et al. (1985) (unitless)	**0.194**

[a] Assumes a 0.5 acre emission source; for site-specific values, consult Appendix D.

As a result of the updated modeling, Q/C_{wind} can now be derived for any source size between 0.5 and 500 acres using the equation and look-up table in Appendix D, Exhibit D-2. (The default Q/C_{wind} factor assumes a 0.5 acre source size, the size of a typical exposure unit.) The look-up table in Exhibit D-2 provides the three constants for the Q/C_{wind} equation (A, B, and C) for each of 29 cities selected to be representative of the range of meteorologic conditions across the country. The Q/C_{wind} constants for each city were derived from the results of EPA's Industrial Source Complex (ISC3) dispersion model run in short-term mode using five years of hourly meteorological data.

To calculate a site-specific Q/C_{wind} factor, the site manager must first identify the climatic zone and city most representative of meteorological conditions at the site. Appendix D includes a map of climatic zones to help site managers select the appropriate Q/C_{wind} equation constants for the site. Once the equation constants have been identified, Q/C_{wind} can be calculated for any source size between 0.5 and 500 acres and input into Equation 4-5 to derive a site-specific PEF.

SSL Equations for Subsurface Soils

This guidance addresses three exposure pathways that are pertinent to contamination in subsurface soils. These pathways include:

- Inhalation of volatiles migrating from soil to indoor air;
- Inhalation of volatiles migrating from soil to outdoor air; and

- Ingestion of contaminated ground water resulting from the leaching of chemicals from soil and their migration to an underlying potable aquifer.

Because the equations developed to calculate SSLs for the last two of these three pathways assume an infinite source, they can violate mass-balance considerations, especially for small sources. To address this concern, the guidance also includes SSL equations for these pathways that allow for mass-limits. These equations can be used only when the volume (i.e., area and depth) of the contaminated soil source is known or can be estimated with confidence.

Exhibit 4-2 lists site-specific parameters necessary to calculate SSLs for the outdoor inhalation of volatiles and the ingestion of ground water pathways, along with recommended sources and measurement methods. The exhibit includes both key parameters used directly in the SSL equations (solid dots) and supporting data or assumptions (hollow dots) used to estimate key parameter values. Site-specific parameters for the migration of volatiles into indoor air pathway are described in spreadsheets developed by EPA (described below).

Inhalation of Volatiles — Indoors. As discussed in Section 3.2.2, vapors resulting from the volatilization of contaminants in soil may be transported into indoor spaces through cracks or gaps in a building's foundation. The inhalation of these vapors by indoor workers may be an important exposure pathway at sites with current or future commercial/industrial land use. To facilitate the development of SSLs for this pathway, EPA has constructed a series of spreadsheets that allow for the site-specific application of a screening-level model for indoor vapor intrusion developed by Johnson and Ettinger (1991). These spreadsheets are available from the EPA web site at http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm.

The vapor intrusion spreadsheets are available for calculating risk or risk-based concentrations for contaminants in soil, soil gas, or ground water. Each medium-specific spreadsheet is available in two versions: one designed for a simple site-specific screening approach (e.g., SL-SCREEN) and one designed for a detailed site-specific modeling approach (e.g., SL-ADV). The simple site-specific version employs conservative default values for many model input parameters but allows the user to define values for several key variables (e.g., soil porosity, depth of contamination). The detailed modeling version allows the user to select values for all model input parameters and define multiple soil strata between the area of contamination and the building. Thus, site managers wanting to develop vapor intrusion SSLs using site-specific building parameters should use the SL-ADV spreadsheets.

These spreadsheets employ toxicity values (inhalation unit risk values for cancer and reference concentrations for non-cancer effects) based on an adult inhalation rate of 20 m^3/day to calculate SSLs for indoor vapor intrusion. This is the same rate used to develop residential SSLs for this pathway. Because workers are typically exposed via this pathway for shorter periods than residents, (eight to 10 hours each day versus up to 24 hours) the 20 m^3/day inhalation rate is likely to be a conservative estimate for some workers. However, data on worker activity levels and

Exhibit 4-2

SITE-SPECIFIC PARAMETERS FOR CALCULATING SUBSURFACE SSLs

Parameter	SSL Pathway: Inhalation of Volatiles - Outdoors	SSL Pathway: Ingestion of Ground Water	Data Source	Method for Estimating Parameter
Source Characteristics				
Source area (A)	!		Sampling data	Measure total area of contaminated soil.
Source length (L)	!	!	Sampling data	Measure length of source parallel to ground water flow.
Source depth	!	!	Sampling data	Measure depth of contamination or use conservative assumption.
Soil Characteristics				
Soil texture	"	"	Lab measurement	Particle size analysis (Gee & Bauder, 1986) and USDA classification; used to estimate θ_W & l
Dry soil bulk density (ρ_b)	!	!	Field measurement	All soils: ASTM D 2937; shallow soils: ASTM D 1556, ASTM D 2167, ASTM D 2922
Soil moisture content (w)	"	"	Lab measurement	ASTM D 2216; used to estimate dry soil bulk density
Soil organic carbon (f_{oc})	!	!	Lab measurement	Nelson and Sommers (1982)
Soil pH	"	"	Field measurement	McLean (1982); used to select pH-specific K_{OC} (ionizable organics) and K_d (metals)
Moisture retention exponent (b)	"	"	Look-up	Attachment A to 1996 SSG; used to calculate θ_W
Saturated Hydraulic conductivity (K_S)	"	"	Look-up	Attachment A to 1996 SSG; used to calculate θ_W
Avg. soil moisture content (θ_W)	!	!	Calculated	Attachment A to 1996 SSG
Meteorological Data				
Air dispersion factor (Q/C)	!		Q/C tables (Appendix D)	Select value corresponding to source area, climatic zone, and city with conditions similar to site.
Hydrogeologic Characteristics (DAF)				
Hydrogeologic setting		"	Conceptual site model	Place site in hydrogeologic setting from Aller et al. (1987) for estimation of parameters below (see Attachment A to 1996 TBD).
Infiltration/recharge (l)		!	HELP model; Regional estimates	HELP (Schroeder et al., 1984) may be used for site-specific infiltration estimates; recharge estimates also may be taken from Aller et al. (1987) or may be based on knowledge of local meteorologic and hydrogeologic conditions.
Hydraulic conductivity (K)		!	Field measurement; Regional estimates	Aquifer tests (i.e., pump tests, slug tests) preferred; estimates also may be taken from Aller et al. (1987) or Newell et al. (1990) or may be based on knowledge of local hydrogeologic conditions.
Hydraulic gradient (i)		!	Field measurement; Regional estimates	Measured on map of site's water table (preferred); estimates also may be taken from Newell et al. (1990) or may be based on knowledge of local hydrogeologic conditions.
Aquifer thickness (d)		!	Field measurement; Regional estimates	Site-specific measurement (i.e., from soil boring logs) preferred; estimates also may be taken from Newell et al. (1990) or may be based on knowledge of local hydrogeologic conditions.

! Indicates key parameters used in the SSL equation for each pathway.
" Indicates supporting data/assumptions used to develop estimates of the values of the key parameters.

inhalation rates reveal two distinct sets of indoor workers: those working primarily in an office setting (daily inhalation rates ranging from 5.4 m^3/day to 12.6 m^3/day, with an average of 9.3 m^3/day), and those engaged in physically demanding tasks for roughly half of their work day (daily inhalation rates ranging from 13.6 m^3/day to 18.5 m^3/day, with an average of 16.2 m^3/day) (U.S. Department of Commerce, 1985; US EPA, 1989a; US EPA, 1997a). Thus, EPA believes that the 20 m^3/day rate is a reasonable estimate of RME that is protective of indoor workers engaged in strenuous workday activities associated with elevated breathing rates.

As noted in Section 3.2.2, risk-based concentrations for contaminants in soil calculated using the Johnson and Ettinger spreadsheets may be highly uncertain. If the CSM for a site indicates that vapor intrusion may be an exposure pathway of concern, EPA recommends that the pathway be evaluated using measured soil gas data and, if applicable, ground water data. These data may be used in conjunction with the advanced versions of the Johnson and Ettinger model as part of a site-specific analysis of the vapor intrusion pathway.

Inhalation of Volatiles — Outdoors. Equations 4-6 through 4-9 are appropriate for calculating SSLs for the outdoor inhalation of volatiles pathway using the simple site-specific approach. (A detailed site-specific modeling approach to this pathway is discussed in Appendix E).

EPA recommends evaluating this pathway at sites where volatile contaminants have been detected in subsurface source areas and where the surface soils covering those sources are undisturbed (e.g. a covered lagoon). Equations 4-6 and 4-7 calculate the SSLs for the inhalation of carcinogenic and non-carcinogenic volatile compounds, respectively. Each of these equations incorporates a soil-to-air volatilization factor (VF) that relates the concentration of a contaminant in soil to the concentration of the contaminant in air resulting from volatilization. Equation 4-8 is appropriate for calculating the VF. Finally, to ensure that the VF model is applicable to soil contaminant conditions at a site, a soil saturation limit (C_{sat}) must be calculated for each volatile compound. Equation 4-9 is appropriate for calculating this value.

Relative to the inhalation modeling for the residential exposure scenario, the only differences for commercial/industrial soil screening evaluations are the default values for exposure frequency, exposure duration, and averaging time (for non-carcinogenic exposures) in Equations 4-6 and 4-7. The toxicity values used in these equations (inhalation unit risk factors for cancer and reference concentrations for non-cancer effects) are based on an adult inhalation rate of 20 m^3/day, the same rate used to evaluate the migration of volatiles into indoor air. As discussed in the previous section, use of this value for outdoor workers is supported by data on the activity levels and associated inhalation rates for different classes of workers (U.S. Department of Commerce, 1985; US EPA, 1989a; US EPA, 1997a) and is protective of workers engaged in strenuous activities.

Equation 4-6
Screening Level Equation for Inhalation of Carcinogenic Volatile Contaminants in Soil - Commercial/Industrial Scenario

$$\text{Screening Level (mg/kg)} = \frac{TR \times AT \times 365 d/yr}{URF \times 1{,}000 \mu g/mg \times EF \times ED \times \frac{1}{VF}}$$

Parameter/Definition (units)	Default
TR/target cancer risk (unitless)	10^{-6}
AT/averaging time (yr)	70
URF/inhalation unit risk factor $(\mu g/m^3)^{-1}$	chemical-specific (Appendix C)
EF/exposure frequency (d/yr)	
Outdoor Worker	**225**
ED/exposure duration (yr)	
Outdoor Worker	**25**
VF/soil-to-air volatilization factor (m^3/kg)	**chemical-specific (Equation 4-8)**

Equation 4-7
Screening Level Equation for Inhalation of Non-carcinogenic Volatile Contaminants in Soil - Commercial/Industrial Scenario

$$\text{Screening Level (mg/kg)} = \frac{THQ \times AT \times 365 d/yr}{EF \times ED \times [\frac{1}{RfC} \times \frac{1}{VF}]}$$

Parameter/Definition (units)	Default
THQ/target hazard quotient (unitless)	1
AT/averaging time (yr) **Outdoor Worker**	**25[a]**
EF/exposure frequency (d/yr) **Outdoor Worker**	**225**
ED/exposure duration (yr) **Outdoor Worker**	**25**
RfC/inhalation reference concentration (mg/m^3)	chemical-specific (Appendix C)
VF/soil-to-air volatilization factor (m^3/kg)	**chemical-specific (Equation 4-8)**

[a] For non-carcinogens, averaging time equals exposure duration.

The VF equation for the commercial/industrial scenario (Equation 4-8) is identical to the one included in the 1996 *SSG* for screening sites with future residential land use and is based on the model developed by Jury et al. (1984). However, the dispersion factor (Q/C_{vol}) can now be derived for any source size between 0.5 and 500 acres using the equation and look-up table in Appendix D, Exhibit D-3. (The default Q/C_{vol} factor assumes a 0.5 acre source size. As reported in Appendix A to the 1996 *SSG*, SSLs for a 0.5 acre source calculated under the infinite source assumption are protective of uniformly contaminated 30-acre source areas of significant depth — up to 21 meters depending on contaminant and pathway, approximately 10 meters on average.) The look-up table in Exhibit D-3 provides the three constants for the Q/C_{vol} equation (A, B, and C) for each of 29 cities selected to be representative of a range of meteorologic conditions across the country. The Q/C_{vol} constants for each city were derived from the results of modeling runs of EPA's ISC3 dispersion model run in short-term mode using five years of hourly meteorological data.

Equation 4-8
Derivation of the Volatilization Factor
- Commercial/Industrial Scenario

$$VF = \frac{Q/C_{vol} \times (3.14 \times D_A \times T)^{1/2} \times 10^{-4} (m^2/cm^2)}{(2 \times \rho_b \times D_A)}$$

where:

$$D_A = \frac{[(\theta_a^{10/3} D_i H') + \theta_w^{10/3} D_w) / n^2]}{\rho_b K_d + \theta_w + \theta_a H')}$$

Parameter/Definition (units)	Default
VF/volatilization factor (m^3/kg)	chemical-specific
D_A/apparent diffusivity (cm^2/s)	chemical-specific
Q/C_{vol} /inverse of the ratio of the geometric mean air concentration to the volatilization flux at center of a square source (g/m^2-s per kg/m^3)	**68.18[a]**
T/exposure interval (s)	9.5×10^8
ρ_b/dry soil bulk density (g/cm^3)	**1.5**
θ_a/air-filled soil porosity (L_{air}/L_{soil})	n-θ_w
n/total soil porosity (L_{pore}/L_{soil})	1-(ρ_b/ρ_s)
θ_w/water-filled soil porosity (L_{water}/L_{soil})	**0.15**
ρ_s/soil particle density (g/cm^3)	2.65
D_i/diffusivity in air (cm^2/s)	chemical-specific[b]
H´/dimensionless Henry's law constant	chemical-specific[b]
D_w/diffusivity in water (cm^2/s)	chemical-specific[b]
K_d/soil-water partition coefficient (cm^3/g)	for organics: $K_d = K_{oc} \times f_{oc}$ for inorganics: see Appendix C[c]
K_{oc}/soil organic carbon partition coefficient (cm^3/g)	chemical-specific[b]
f_{oc}/fraction organic carbon in soil (g/g)	**0.006 (0.6%)**

[a] Assumes a 0.5 acre emission source; for site-specific values, consult Appendix D.
[b] See Appendix C.
[c] Assume a pH of 6.8 when selecting default K_d values for metals.

To calculate a site-specific Q/C_{vol} factor, site managers must first identify the climatic zone and city most representative of meteorological conditions at the site. Appendix D includes a map of climatic zones to help site managers select the appropriate Q/C_{vol} equation constants for the site. The site manager should also consult with the site hydrogeologist to determine Q/C_{vol} inputs. Once the Q/C_{vol} equation constants have been identified, a dispersion factor can be calculated for any source size between 0.5 and 500 acres and input into Equation 4-8 to derive a site-specific VF.

The C_{sat} equation (Equation 4-9) is also unchanged from the residential guidance; it measures the contaminant concentration at which all soil pore space (both air- and water-filled) is saturated with the compound and the adsorptive limits of the soil particles have been reached.

Equation 4-9
Derivation of the Soil Saturation Limit

$$C_{sat} = \frac{S}{\rho_b}(K_d \rho_b + \theta_w + H \cdot \theta_a)$$

Parameter/Definition (units)	Default
C_{sat}/soil saturation concentration (mg/kg)	chemical-specific[a]
S/solubility in water (mg/L-water)	chemical-specific[a]
ρ_b/dry soil bulk density (kg/L)	**1.5**
K_d/soil-water partition coefficient (L/kg)	organics = $K_{oc} \times f_{oc}$ inorganics = see Appendix C[b]
K_{oc}/organic carbon partition coefficient (L/kg)	chemical-specific[a]
f_{oc}/fraction organic carbon in soil (g/g)	**0.006 (0.6%)**
θ_w/water-filled soil porosity (L_{water}/L_{soil})	**0.15**
H/dimensionless Henry's law constant	chemical-specific[a]
θ_a/air-filled soil porosity (L_{air}/L_{soil})	$n - \theta_w$
n/total soil porosity (L_{pore}/L_{soil})	$1 - (\rho_b/\rho_s)$
ρ_s/soil particle density (kg/L)	2.65

[a] See Appendix C.
[b] Assume a pH of 6.8 when selecting default K_d values for metals.

C_{sat} represents an upper bound on the applicability of the VF model, because compounds exceeding C_{sat} may be present in free phase, which would violate a key principle of the model (i.e., that Henry's Law applies). C_{sat} values should be calculated using the same site-specific soil characteristics used to calculate SSLs. Because VF-based inhalation SSLs are reliable only if they are less than or equal to C_{sat}, these SSLs should be compared to C_{sat} concentrations before they are used in a soil screening evaluation. If the calculated SSL exceeds C_{sat} and the contaminant is liquid at typical soil temperatures (see Appendix C, Exhibit C-3), the SSL is set at C_{sat}. If an organic compound is liquid at soil temperature, concentrations exceeding C_{sat} indicate the potential for nonaqueous phase liquid (NAPL) to be present in soil. This poses a possible risk to ground water, and more investigation may be warranted. For organic compounds that are solid at soil temperatures, concentrations above C_{sat} do not pose a significant inhalation risk nor are they indicative of NAPL contamination. Soil screening decisions for these compounds should be based on SSLs for other exposure pathways. For more information on C_{sat} and the proper selection of SSLs, please refer to the 1996 *SSG*.

Migration to Ground Water.

This guidance calculates commercial/industrial SSLs for the ingestion of leachate-contaminated ground water using the same set of equations and default input values presented in the 1996 *SSG*. Thus, the generic SSLs for this pathway are the same under commercial/industrial and residential land use scenarios.

EPA has adopted this approach for two reasons. First, it protects off-site receptors, including residents, who may ingest contaminated ground water that migrates from the site. Second, it protects potentially potable ground water aquifers that may exist beneath commercial/ industrial properties. (See text box for EPA's policy on ground water classification). Thus, this approach is appropriate for protecting ground water resources and human health; however, it may necessitate that sites meet stringent SSLs if the migration to ground water pathway applies, regardless of future land use.

Ground Water Classification

In order to demonstrate that the ingestion of ground water exposure pathway is not applicable for a site, site managers may either perform a detailed fate and transport analysis (as discussed in the *TBD* to the 1996 *SSG*), or may show that the underlying ground water has been classified as non-potable. EPA's current policy regarding ground water classification for Superfund sites is outlined in an OSWER directive (U.S. EPA, 1997e). EPA evaluates ground water at a site according to the federal ground water classification system, which includes four classes:

1 - sole source aquifers;
2A - currently used for drinking water;
2B - potentially usable for drinking water; and
3 - not usable for drinking water.

Generally, this pathway applies to all potentially potable water (i.e., classes 1, 2A, and 2B), unless the state has made a different determination through a process analogous to the Comprehensive State Ground Water Protection Plan (CSGWPP). Through this process, ground water classification is based on an aquifer or watershed analysis of relevant hydrogeological information, with public participation, in consultation with water suppliers, and using a methodology that is consistently applied throughout the state. If a state has no CSGWPP or similar plan, EPA will defer to the state's ground water classification only if it is more protective than EPA's. As of February 2001, 11 states (AL, CT, DE, GA, IL, MA, NH, NV, OK, VT, and WI) have approved CSGWPP plans.

The simple site-specific ground water approach consists of two steps. First, it employs a simple linear equilibrium soil/water partition equation to estimate the contaminant concentration in soil leachate. Alternatively, the synthetic precipitation leachate procedure (SPLP) can be used to estimate this concentration. Next, a simple water balance equation is used to calculate a dilution factor to account for reduction of soil leachate concentration from mixing in an aquifer. This calculation is based on conservative, simplified assumptions about the release and transport of contaminants in the subsurface (see Exhibit 4-3). These assumptions should be reviewed for consistency with the CSM to determine the applicability of SSLs to the migration to ground water pathway.

Equation 4-10 is the soil/water partition equation; it is appropriate for calculating SSLs corresponding to target leachate contaminant concentrations in the zone of contamination. Equations 4-11 and 4-12 are appropriate for determining the dilution attenuation factor (DAF) by which concentrations are reduced when leachate mixes with a clean aquifer. Because of the wide variability in subsurface conditions that affect contaminant migration in ground water, default values are not provided for input parameters for these dilution equations. Instead, EPA has

developed two possible default DAFs (DAF=20 and DAF=1) that are appropriate for deriving generic SSLs for this pathway. The selection of a default DAF is discussed in Appendix A, and the derivation of these defaults is described in the *TBD* to the 1996 *SSG*. The default DAFs also can be used for calculating simple site-specific SSLs, or the site manager can develop a site-specific DAF using equations 4-11 and 4-12.

To calculate SSLs for the migration to ground water pathway, the acceptable ground water concentration is multiplied by the DAF to obtain a target soil leachate concentration (C_w).[12] For example, if the DAF is 20 and the acceptable ground water concentration is 0.05 mg/L, the target soil leachate concentration would be 1.0 mg/L. Next, the partition equation is used to calculate the total soil concentration (i.e., SSL) corresponding to this soil leachate concentration. Alternatively, if a leach test is used, the target soil leachate concentration is compared directly to extract concentrations from the leach tests.

Exhibit 4-3

Simplifying Assumptions for the SSL Migration to Ground Water Pathway

- Infinite source (i.e., steady-state concentrations are maintained over the exposure period)
- Uniformly distributed contamination from the surface to the top of the aquifer
- No contaminant attenuation (i.e., adsorption, biodegradation, chemical degradation) in soil
- Instantaneous and linear equilibrium soil/water partitioning
- Unconfined, unconsolidated aquifer with homogeneous and isotropic hydrologic properties
- Receptor well at the downgradient edge of the source and screened within the plume
- No contaminant attenuation in the aquifer
- No NAPLs present (if NAPLs are present, the SSLs do not apply)

For more information on the development of SSLs for this pathway, please consult the 1996 *SSG*.

Mass-Limit SSLs. Equations 4-13 and 4-14 present models for calculating mass-limit SSLs for the outdoor inhalation of volatiles and migration to ground water pathways, respectively. These models can be used only if the depth and area of contamination are known or can be estimated with confidence. These equations are identical to those in the 1996 *SSG*. Please consult that guidance for information on using mass-limit SSL models.

[12] The acceptable ground water concentration is, in order of preference: a non-zero Maximum Contaminant Level Goal (MCLG), a Maximum Contaminant Level (MCL), or a health-based level (HBL) calculated based on an ingestion rate of 2L/day and a target cancer risk of $1x10^{-6}$ or an HQ of 1. These values are presented in Appendix C.

Equation 4-10
Soil Screening Level Partitioning Equation for Migration to Ground Water

$$\text{Screening Level in Soil (mg/kg)} = C_w \left[K_D + \frac{(\theta_w + \theta_a H')}{\rho_b} \right]$$

Parameter/Definition (units)	Default
C_w/target soil leachate concentration (mg/L)	(nonzero MCLG, MCL, or HBL)[a] × dilution factor
K_d/soil-water partition coefficient (L/kg)	for organics: $K_d = K_{oc} \times f_{oc}$ for inorganics: see Appendix C[b]
K_{oc}/soil organic carbon/water partition coefficient (L/kg)	chemical-specific[c]
f_{oc}/fraction organic carbon in soil (g/g)	**0.002 (0.2%)**
θ_w/water-filled soil porosity (L_{water}/L_{soil})	**0.3**
θ_a/air-filled soil porosity (L_{air}/L_{soil})	$n - \theta_w$
ρ_b/dry soil bulk density (kg/L)	**1.5**
n/soil porosity (L_{pore}/L_{soil})	$1 - (\rho_b/\rho_s)$
ρ_s/soil particle density (kg/L)	2.65
H′/dimensionless Henry's law constant	chemical-specific[c] (assume to be zero for inorganic contaminants except mercury)

[a] Chemical-specific (see Appendix C).
[b] Assume a pH of 6.8 when selecting default K_d values for metals.
[c] See Appendix C.

Equation 4-11
Derivation of Dilution Attenuation Factor

$$\text{Dilution Attenuation Factor (DAF)} = 1 + \frac{K \times i \times d}{I \times L}$$

Parameter/Definition (units)	Default
DAF/dilution attenuation factor (unitless)	**20 or 1 (0.5-acre source)**
K/aquifer hydraulic conductivity (m/yr)	**Site-specific**
i/hydraulic gradient (m/m)	**Site-specific**
I/infiltration rate (m/yr)	**Site-specific**
d/mixing zone depth (m)	**Site-specific**
L/source length parallel to ground water flow (m)	**Site-specific**

Equation 4-12
Estimation of Mixing Zone Depth

$$d = (0.0112 L^2)^{0.5} + d_a(1 - \exp[(-L \times I)/(K \times i \times d_a)])$$

Parameter/Definition (units)	Default
d/mixing zone depth (m)	**Site-specific**
L/source length parallel to ground water flow (m)	**Site-specific**
I/infiltration rate (m/yr)	**Site-specific**
K/aquifer hydraulic conductivity (m/yr)	**Site-specific**
i/hydraulic gradient (m/m)	**Site-specific**
d_a/aquifer thickness (m)	**Site-specific**

Equation 4-13
Mass-Limit Volatilization Factor
- Commercial/Industrial Scenario

$$VF = Q/C_{vol} \times \frac{[T \times (3.15 \times 10^7 s/yr)]}{(\rho_b \times d_s \times 10^6 g/Mg)}$$

Parameter/Definition (units)	Default
d_s/average source depth (m)	**site-specific**
T/exposure interval (yr)	**30**
Q/C_{vol} /inverse of the ratio of the geometric mean air concentration to the volatilization flux at the center of a square source (g/m^2-s per kg/m^3)	**68.18[a]**
ρ_b/dry soil bulk density (kg/L or Mg/m^3)	**1.5**

[a] Assumes a 0.5 acre emission source

Equation 4-14
Mass-Limit Soil Screening Level for Migration to Ground Water

$$\text{Screening Level in Soil (mg/kg)} = \frac{(C_w \times I \times ED)}{\rho_b \times d_s}$$

Parameter/Definition (units)	Default
C_w/target soil leachate concentration (mg/L)	(nonzero MCLG, MCL, or HBL)[a] × dilution factor
d_s/depth of source (m)	**site-specific**
I/infiltration rate (m/yr)	**0.18**
ED/exposure duration (yr)	70
ρ_b/dry soil bulk density (kg/L)	**1.5**

[a] Chemical-specific, see Appendix C.

4.3 Additional Considerations for the Evaluation of Non-Residential Exposure Scenarios

As described in this guidance document, conducting soil screening evaluations for non-residential land use scenarios involves making well-reasoned assumptions about site use, potential exposure pathways, and potential receptors. These decisions raise the following issues about the derivation and application of non-residential SSLs:

- The importance of involving community representatives in identifying the likely future land use (and associated activities) at sites;
- The selection and implementation of institutional controls to ensure that future site uses and activities will be consistent with the non-residential land use assumptions used to derive SSLs; and
- The relative roles of SSLs and OSHA standards in protecting future workers from exposure to residual contamination at non-residential sites.

This section provides guidance on these issues, outlining EPA policy and highlighting useful resources.

4.3.1 Involving the Public in Identifying Future Land Use at Sites

The potential for site managers to apply non-residential land use assumptions in developing SSLs is most useful when the likely future land use for a site can be identified early in the Superfund process. As discussed in Section 3.1, community representatives (including local land use planners, local officials and members of the general public) can provide a great deal of insight about the reasonably anticipated future land use of sites. This can be one of the most important aspects of overall community involvement, especially for sites that have been abandoned by previous owners or sites where land use is likely to change. Site managers should look to the community as a source of information about both current and reasonably anticipated future site activities, which can help identify relevant exposure pathways that should be reflected in the CSM.

Early interaction with community representatives and local government officials can help to ensure that the assumptions used in the soil screening evaluation will be supported by the community. This also may lead to greater community support of subsequent Superfund activities at a site, such as the baseline risk assessment and selection of remedies, which may be based, in part, on these assumptions. EPA has developed guidance, *Community Involvement in Superfund Risk Assessments, A Supplement to RAGS Part A*, to assist site managers in working with communities and soliciting their input (U.S. EPA, 1999b). Site managers also can consult the

OSWER directive, *Land Use in the CERCLA Remedy Selection Process* (U.S. EPA, 1995a) for information on community involvement in the identification of future land use.[13]

4.3.2 Institutional Controls

Non-residential SSLs are based on specific assumptions about land use and access. These assumptions are typically less conservative than those used to develop residential SSLs; thus, non-residential SSLs may be less stringent than the corresponding residential values. These non-residential SSLs can be protective of the key receptors associated with reasonably anticipated future non-residential land uses, but they may not be universally protective of all receptors and activities. Therefore, ensuring that contaminant levels are protective of exposures at sites or areas of sites that are screened out under these less stringent SSLs depends on site use, activities, and accessibility remaining consistent with the conceptual site model upon which screening decisions are based. Effective, enforceable institutional controls (ICs) may be a very important tool for preventing inappropriate land uses and activities that may result in unacceptable exposures. EPA defines ICs as "non-engineered instruments such as administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use" (U.S. EPA, 2000b).[14]

A non-residential screening assessment should include an evaluation of the implementability and potential effectiveness of ICs for areas that are screened out. This evaluation, which may consider multiple IC options, allows the site manager to identify the best available means (if any) to ensure long-term protectiveness at areas of sites screened out under less stringent, non-residential SSLs. It should provide sufficient evidence to conclude that effective implementation of ICs is feasible and can serve to "prevent an unanticipated change in land use that could result in unacceptable exposures to residual contamination or, at a minimum, alert future users to residual risks and monitor for any changes in use" (U.S. EPA, 1995a). If it does not appear likely that such ICs can be established in the future, then it is inappropriate to screen out a site or area of a site under non-residential SSLs. Instead, site managers may compare soil contaminant concentrations to residential SSLs that would be protective given unrestricted land use.

A variety of ICs exist that can be used to prevent or limit exposure at a site. In general, these fall into the four major categories summarized below (U.S. EPA, 2000b).

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[13] See http://www.epa.gov/oerrpage/superfund/resources/landuse.htm.

[14] EPA also stresses that ICs are generally to be used in conjunction with engineering measures; that they can be used during all stages of the cleanup process; and that they should ideally be "layered" (i.e. the simultaneous application of multiple ICs) or implemented in series to provide overlapping assurances of protection from contamination (U.S. EPA, 2000b).

- **State and Local Government Controls**. Government controls are usually implemented and enforced by a state or local government and can include zoning restrictions, ordinances, statutes, building permits, or other provisions that restrict land or resource use at a site. Since this category of ICs is put in place under local jurisdiction, they may be changed or terminated with little notice to EPA, and EPA generally has no authority to enforce such controls.

- **Proprietary Controls**. These controls have their basis in property law and are unique in that they generally create legal property interests. In other words, proprietary controls involve legal instruments placed in the chain of title of the site or property. Common examples include covenants or easements restricting future land use or prohibiting activities that may compromise specific engineering remedies. The benefit of proprietary controls is that they can be binding on subsequent purchasers of the property (successors in title) and transferable, which may make them more reliable in the long term than other types of ICs. However, property law is complex, and variations in property laws across states can make it difficult to establish and enforce appropriate proprietary controls.

- **Enforcement Tools with IC Components**. Under section 106(a) of CERCLA, EPA has the authority to issue administrative orders to compel land owners to limit certain site activities at both Federal and private sites. Although this tool is frequently used by site managers, it may have significant shortcomings that should be thoroughly evaluated. For example, property restrictions that are part of an enforcement action are binding only on the signatories and are not transferred through a property transaction, which limits their long-term protectiveness.

- **Informational Devices**. Informational tools provide information or notification that residual or capped contamination may remain on site. Common examples include state registries of contaminated properties, deed notices, and advisories. Because such devices are not legally enforceable, it is important to carefully consider the objective of this category of IC. Informational devices are most likely to be used as a secondary "layer" to help ensure the overall reliability of other ICs.

Early and careful consideration of ICs can be valuable for soil screening evaluations because it focuses attention on land use assumptions that can be maintained over time. In the context of soil screening analyses, the IC evaluation should identify the types of ICs available, the existence of the authority necessary to implement an IC, the willingness and ability of the appropriate entity to effectively implement and enforce the IC in both the short and long term, and the relative cost associated with the implementation and maintenance of any IC. Incorporating such considerations as a part of the screening assessment allows site managers to anticipate and consider potential barriers to the implementation of ICs.

In addition, early consideration of IC options assists site managers in identifying those parties (e.g., local government agencies) who would be instrumental in ensuring the effective implementation and management of any IC selected. For example, a local government's ability to effectively maintain or enforce an IC may affect not only the type of IC selected, but also the decision of whether it is appropriate to utilize ICs to help achieve protection of human health. Consideration of IC options is thus a valuable tool for increasing the overall reliability of screening decisions and should not be viewed as an afterthought to the soil screening process.

For more detailed information on how to evaluate and implement ICs, please consult the following publications:

> *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups.* Office of Solid Waste and Emergency Response. EPA 540-F-00. OSWER 9355-0-24-FS-P. September 2000.
>
> *Land Use in the Remedy Selection Process*. OSWER Directive No. 9355.7-04. May 1995.

4.3.3 Applicability of OSHA Standards at NPL Sites

Conducting soil screening evaluations at sites where workers are the primary receptors of concern raises questions about the roles of commercial/industrial SSLs and OSHA standards in protecting these receptors. Although both OSHA standards and SSLs protect the health of workers exposed to toxic substances, the conditions of exposure implicit in each set of values differ. As a result, OSHA standards are not suitable substitutes for SSLs.

The key distinctions between OSHA standards and commercial/industrial SSLs include the underlying assumptions about the context of workplace exposures, the characteristics of the workers being protected, and the level of protection afforded to workers (U.S. EPA, 1995b).

- **Context of Workplace Exposure.** OSHA standards assume that workers are exposed to hazardous chemicals used in or generated as a result of routine work activities. These workers are assumed to be aware of the chemicals to which they are exposed and can obtain information on them through Right-to-Know laws. Further, they tacitly accept certain risks associated with exposure because they receive a benefit (i.e., higher wages) to compensate them for additional hazard. On the other hand, commercial/industrial SSLs address worker exposures to general environmental pollution — contaminants whose presence at a site may be independent of any current or future work activity (though work activities, such as excavation, may lead to exposure).

- **Characteristics of Worker Receptors.** OSHA standards protect workers who are likely, through self-selection, to be less sensitive to the chemicals to which they are exposed; a worker who finds that he or she is highly sensitive to a compound that is used during daily work activities would be able to proactively seek other jobs or alternative job responsibilities that do not involve exposure to that compound. Thus, unlike SSLs, which are based on an RME scenario, OSHA standards are not designed to protect against exposures to sensitive sub-populations.

- **Level of Protection Afforded to Workers.** OSHA standards assume not only that workers are knowingly exposed to specific chemicals in the workplace, but also that they receive additional protection and training to mitigate exposures. OSHA requires workers to be trained to control or prevent exceedances of its exposure standards (including the use of personal protective clothing and gear to help prevent excessive exposures). OSHA also requires periodic worker health monitoring to ensure that excessive exposures are not occurring. In contrast, *RAGS Part A* (U.S. EPA, 1989b) indicates that a Superfund risk assessment is an analysis of potential adverse health effects (current or future) caused by hazardous substances released from a site *in the absence of any actions or controls to mitigate exposures*.

5.0 CALCULATION OF SSLS FOR A CONSTRUCTION SCENARIO

Construction is likely to occur as part of the redevelopment process at many NPL sites, regardless of the anticipated future land use. Although construction is typically of relatively short duration (a year or less), it may lead to significant exposures to construction workers and off-site residents as a result of soil-disturbing activities that include excavation and vehicle traffic on unpaved roads. To help address this potential concern, EPA has developed a construction soil screening scenario that site managers can use to develop construction SSLs.

EPA designed the construction scenario to supplement the residential and non-residential screening scenarios. When appropriate, site managers should calculate construction SSLs *in addition to* the SSLs for the appropriate land use scenario. This chapter of the guidance explains when construction SSLs should be calculated, presents the exposure framework for the construction scenario, and provides equations for calculating simple site-specific SSLs that reflect potential exposure during construction activities. Information on using more detailed site-specific modeling to develop construction SSLs is presented in Appendix E.

5.1 Applicability of the Construction Scenario

The construction scenario assumes that one or more residential or commercial buildings will be erected on a site and that construction will occur within areas of residual soil contamination. Because the activities associated with such a project are likely to result in significant direct contact soil exposures (i.e., ingestion and dermal absorption) to construction workers and are likely to increase emissions of both volatiles and particulate matter from contaminated soils during the construction period, EPA recommends that site managers evaluate the construction exposure scenario whenever major construction is anticipated at a site. However, EPA realizes that developing SSLs based on a construction scenario may be difficult, especially if there is considerable uncertainty surrounding the details of future construction. In such cases, site managers can evaluate several plausible construction scenarios representing a range of activities, areal extents, and durations. The results of these evaluations can provide valuable information to help guide and focus future construction activities.

EPA anticipates that the potential for increased exposure during construction will be a concern at many sites. While we recognize that the construction scenario may produce SSLs that are more stringent than those for the other scenarios, we emphasize that SSLs are not cleanup levels; rather they are used to assist site managers in scoping the analyses that comprise the Superfund process. In addition, construction SSLs can be used to inform future construction plans, highlighting areas and construction activities that may pose significant risks to construction workers or other receptors in the absence of mitigating measures.

There are conditions under which site managers may choose not to evaluate the construction scenario. These include:

- **No Redevelopment Currently Anticipated.** If there are no existing plans for redeveloping a site, the site manager may opt not to evaluate the construction scenario at the time of the initial soil screening evaluation. However, in this case, the soil screening evaluation should be accompanied by an analysis that demonstrates the feasibility of implementing institutional controls in the future to restrict activities that would disturb residual site contamination, such as excavation or digging a well, unless screened out site areas are re-evaluated.

- **Construction Will Not Disturb Contamination.** If a site manager can demonstrate that the proposed excavation does not include any areas of soil contamination and that any unpaved roads created on-site for construction vehicle traffic will not cross areas of surficial soil contamination, the construction scenario need not be evaluated. Again, the soil screening evaluation should identify effective institutional controls that can be implemented in the future to restrict activities in the event that subsequent construction would disturb residual soil contamination.

5.2 Soil Screening Exposure Framework for Construction Scenario

The construction soil screening scenario evaluates exposures to construction workers present throughout a construction project, as well as exposures to nearby off-site residents. These receptors are potentially subject to higher contaminant exposures via increased volatile and fugitive dust emissions during construction activities.

Exhibit 5-1 summarizes the exposure framework for construction workers and off-site residents.

- **Construction Worker.** This is a short-term adult receptor who is exposed to soil contaminants during the work day for the duration of a single construction project (typically a year or less). If multiple non-concurrent construction projects are anticipated, it is assumed that different workers will be employed for each project. The activities for this receptor typically involve substantial on-site exposures to surface and subsurface soils. The construction worker is expected to have a very high soil ingestion rate and is assumed to be exposed to contaminants via the following direct and indirect pathways: incidental soil ingestion, dermal absorption, inhalation of volatiles outdoors, and inhalation of fugitive dust.

Exhibit 5-1

SUMMARY OF THE CONSTRUCTION SCENARIO EXPOSURE FRAMEWORK FOR SOIL SCREENING

	Receptors	
	Construction Worker	**Off-site Resident**
Exposure Characteristics	C Exposed during construction activities only C Potentially high ingestion and inhalation exposures to surface and subsurface soil contaminants C Short-term (subchronic) exposure	C Resides at the site boundary C Exposed both during and post-construction C Potentially high inhalation exposures to contaminants in fugitive dust C Long-term (chronic) exposure
Pathways of Concern[1]	C Ingestion (surface and subsurface soil) C Dermal contact (surface and subsurface soil) C Inhalation of volatiles outdoors (subsurface soil) C Inhalation of fugitive dust due to traffic on unpaved roads (surface soil)[2]	C Inhalation of fugitive dust due to traffic on unpaved roads and wind erosion (surface soil)
Default Exposure Factors		
Exposure Frequency (d/yr)	250	350
Exposure Duration (yr)	1	30
Soil Ingestion Rate[3] (mg/d)	330	NA
Inhalation Rate (m^3/d)	20	20[4]
Body Weight (kg)	70	70
Lifetime (yr)	70	70

[1] The inhalation of volatiles is not included as a pathway of concern for off-site residents because SSLs developed for this pathway for the construction worker (short-term) and for the on-site worker receptor under the commercial/industrial scenario (long-term) were shown to be protective for this receptor.

[2] Analyses of the inhalation of fugitive dust pathway suggest that the most significant contribution to exposure comes from disturbance of surface soil by traffic on unpaved roads. Therefore, the framework for simple site-specific soil screening evaluation for this pathway focuses on surface soil. If a site manager determines that excavation of subsurface soil or other earth-moving activities may lead to significant exposure to fugitive dust, it may be appropriate to use a more detailed site-specific modeling approach to develop a construction SSL for this pathway. Appendix E provides guidance on conducting such modeling.

[3] The soil ingestion rate is revised from the previous default ingestion rate of 480 mg/d. See the discussion of ingestion rate in section 5.3.2.

[4] Residential inhalation exposure to children and adults is evaluated using the RfC toxicity criterion, which is based on an inhalation rate of 20 m^3/day. No comparable toxicity criterion specific to childhood exposures is currently available. EPA has convened a workgroup to identify suitable default values for modeling childhood inhalation exposures, as well as possible approaches for adjusting toxicity values for application to such exposures.

- **Off-site Resident.** This receptor is similar to the one evaluated in the residential soil screening scenario but is located at the site boundary.[21] The off-site resident is exposed to contaminants both during and after construction, for a total of 30 years. This receptor has no direct contact with on-site soils. Under this framework, the only exposure pathway evaluated for this receptor is the inhalation of fugitive dust, which is likely to be exacerbated during construction as a result of dust generated by truck traffic on unpaved roads.

EPA's recommendations for focusing on specific exposure pathways and receptors are based on analyses of the potential exposure levels resulting from different activities. EPA's analysis of the impacts of different construction activities on fugitive dust emissions demonstrated that vehicle traffic on contaminated unpaved roads typically accounts for the majority of emissions, with wind erosion, excavation soil dumping, dozing, grading, and filling operations contributing lesser emissions. Based on this analysis, EPA has focused the simple site-specific construction scenario on fugitive dust emissions from traffic on contaminated unpaved roads. Information on evaluating fugitive dust emissions resulting from other construction activities as part of a detailed site-specific approach can be found in Appendix E.

In the case of volatile contaminants, excavation during construction can increase volatile emissions by unearthing soil contamination and bringing it into direct contact with the air; this increases the flux of volatile contaminants from the soil into the air. The equations for developing simple site-specific SSLs for both the commercial/industrial and construction scenarios are based on the assumption that contaminants are present at the soil surface. The complexity of modeling the volatilization of contaminants from buried waste precludes the development of SSLs for this situation under the simple site-specific approach. SSLs that reflect buried contamination can be calculated for any scenario using the detailed site-specific approach (see Appendix E). Under the conservative assumptions of the simple site-specific approach, SSLs for volatiles developed for the outdoor worker receptor under the commercial/industrial scenario (or for a resident) should be protective of the off-site resident under the construction scenario. (See discussion of the relative exposures for on- and off-site receptors in Section 4.2.2).

EPA also conducted an analysis comparing the subchronic exposure levels to volatile contaminants for on-site construction workers with those for off-site residents and found little difference between the resulting SSLs for the two receptors. The difference in SSLs for these receptors is less than 20 percent, well within the uncertainty associated with emissions modeling.[22]

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[21] This is a conservative assumption, since the highest exposure concentrations for off-site residents occur at the site boundary.

[22] Modeling results indicate that a construction worker, who is located on-site, is exposed to higher concentrations of volatiles than an off-site resident. However, an off-site resident is assumed to have a higher exposure frequency than a construction worker during the construction period (i.e., seven days per week versus five days per week). The net result is a slightly lower SSL for an off-site resident, approximately 18 percent lower than the SSL for a construction worker. This difference is small relative to the uncertainty in the emission, dispersion, and exposure modeling; thus, EPA believes that the construction worker SSL is sufficiently protective of subchronic exposures to off-site residents.

Therefore, EPA recommends that only construction workers be evaluated for subchronic exposure to volatiles during construction activities.

In some cases, site managers also may wish to evaluate direct ingestion and dermal contact exposures of off-site residents to contaminated dust that is deposited on an off-site property during construction activities. For sites where contaminant concentrations meet residential SSLs, this pathway is unlikely to result in significant risks, due to the reduction of contaminant concentrations expected to occur as deposited dust mixes with uncontaminated soils. For sites meeting commercial/industrial SSLs, this may be a pathway of concern for some contaminants, especially metals, for which the commercial/industrial SSL for ingestion/dermal contact exposure is significantly higher than the corresponding residential SSL that would apply to the off-site exposure. For these contaminants, off-site deposition could potentially lead to concentrations that exceed residential direct contact SSLs. However, the complexity of modeling off-site deposition of contaminated dusts precludes EPA from developing an average default factor for estimating the off-site concentration resulting from deposition, relative to on-site contamination levels. Therefore, this pathway should be addressed on a site-specific basis.

5.3 Calculating SSLs for the Construction Scenario

This section presents EPA's recommended approach to calculating SSLs for construction-related exposures. First, it describes key differences between the calculation of construction SSLs and the calculation of residential or commercial/industrial SSLs. Then, it presents the equations used to calculate construction SSLs using the simple site-specific soil screening approach.

5.3.1 Calculation of Construction SSLs - Key Differences

Besides differences in receptors and exposure factors, there are three key differences between construction SSLs and residential or commercial/industrial SSLs:

- **Absence of Generic SSLs.** EPA does not present generic SSLs for the construction scenario. This decision reflects the difficulty of developing standardized default exposure assumptions and other model input parameters for a construction scenario. Construction-related exposures depend on many parameters including, but not limited to: the size of the site; the size of the contaminated source area; the dimensions of the building(s) being constructed and its location relative to the source area and to the site boundary; the type of building being constructed (e.g., a slab-on-grade structure versus a building with a basement); and the overall duration of the construction project. These parameters can vary considerably from project to project, and current data do not allow EPA to identify a reasonable set of generic default values (either central tendency or high end) for all of them.

Therefore, EPA has not established generic SSLs for construction activities, and the equations presented below do not include suggested default values for all model input parameters. Site managers having difficulty determining a site-specific value may wish to calculate SSLs using a range of plausible values.

- **Subchronic Exposures.** Under the guidelines established by the Superfund program, exposures to construction workers of one year or less are classified as subchronic exposures.[23] This short exposure duration affects how site managers use toxicity values in calculating SSLs for non-carcinogenic effects. Specifically, calculations of SSLs based on non-carcinogenic effects associated with *subchronic* exposures should incorporate toxicity values for subchronic, not chronic, effects.[24] Subchronic toxicity values are not as widely available as chronic values, and unlike chronic RfDs and RfCs, no EPA work group exists to review and verify subchronic RfDs or RfCs. Subchronic toxicity values for a limited number of compounds are available from EPA's *Health Effects Assessment Summary Tables* (HEAST).[25] We recommend that site managers seek assistance from EPA's regional risk assessors and from EPA's Superfund Technical Support Center when researching appropriate subchronic toxicity values. In addition, the Agency for Toxic Substances and Disease Registry (ATSDR) publishes Minimal Risk Levels (MRLs) that may be suitable for use as subchronic toxicity values.[26] The SSL equations for the construction worker use the generic term "Health Based Level" (HBL) to refer to these subchronic toxicity values. When calculating SSLs for this receptor, site managers can use a subchronic RfD or RfC from HEAST, a value recommended by the Superfund Technical Support Center, an MRL, or another suitable subchronic value (accompanied by appropriate documentation) as the HBL, as opposed to chronic or acute toxicity values.

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[23] EPA defines subchronic exposures for Superfund purposes as exposures lasting between two weeks and seven years. See U.S. EPA., 1989b, Chapters 6, 7, and 8.

[24] There is no change with respect to SSLs based on carcinogenic effects, because the methodology averages exposures over a lifetime.

[25] HEAST presents tables of chemical-specific toxicity information and values based on data from Health Effects Assessments, Health and Environmental Effects Documents, Health and Environmental Effects Profiles, Health Assessment Documents, or Ambient Air Quality Criteria Documents. HEAST summarizes interim (and some verified) RfDs and RfCs, as well as other toxicity information for specific chemicals. Although the HEAST data do not have the agency-wide consensus of the IRIS data, the information contained in HEAST represents current toxicity data generated by EPA. The most recent printed version of HEAST was printed in 1997.

[26] ATSDR MRLs were developed in response to a CERCLA mandate and represent the highest exposure levels that would not lead to the development of non-cancer health effects in humans based on acute (1-14 days), subchronic (15-364 days), and chronic (365 days and longer) exposures via oral and inhalation pathways. MRLs are based on non-cancer health effects only. MRLs are available from ATSDR'S website, http://atsdr1.atsdr.cdc.gov:8080/mrls.html.

- **Focus on Subsurface Soil.** Construction SSLs for the combined direct ingestion/dermal absorption exposure pathway should be used to evaluate contaminant concentrations in both surface and subsurface soils. The focus on subsurface soils is appropriate because excavation and other earth-moving activities could result in substantial exposures to soils at depths greater than two centimeters (the 1996 *SSG* definition of surface soils).

5.3.2 SSL Equations for the Construction Scenario

This section presents the equations used to calculate construction SSLs for surface and subsurface soils using the simple site-specific soil screening approach. As noted above, a generic approach is not appropriate for evaluating the construction scenario. As an alternative to the simple site-specific approach, site managers can perform detailed site-specific modeling to evaluate this scenario; Appendix E presents suggestions for modeling inhalation pathways under construction conditions using the detailed site-specific approach.

For each equation, site-specific input parameters are indicated in bold. Where possible, default values for these parameters are provided for use when site-specific data are not available. As in the other exposure scenarios, all site-specific inputs describing soil, aquifer, and meteorologic characteristics should represent average or typical site conditions in order to produce risk-based SSLs that reflect reasonable maximum exposure (RME).

Chemical-specific data, including chronic toxicity criteria, for use in developing simple site-specific SSLs are provided in Appendix C. Prior to calculating SSLs, each relevant chemical-specific value in Appendix C should be checked against the most recent version of its source and updated, if necessary.

In general, the basic forms of the SSL equations for the construction scenario are similar to those used for the other scenarios. Changes to default exposure parameters that apply to individual pathways are discussed below, along with their respective SSL equations.

SSL Equations for Surface Soils

The relevant pathways for exposure to surface soils under the construction scenario include direct ingestion and dermal absorption for construction workers, and inhalation of fugitive dusts by both construction workers and off-site residents.

Direct Ingestion and Dermal Absorption. Equations 5-1 and 5-2 are appropriate for addressing subchronic ingestion and dermal absorption exposure of construction workers to carcinogens and non-carcinogens, respectively. These equations produce SSLs for combined exposure of construction workers via these pathways.

Equation 5-1
Screening Level Equation for Combined Subchronic Ingestion and Dermal Absorption Exposure to Carcinogenic Contaminants in Soil
Construction Scenario - Construction Worker

$$\text{Screening Level (mg/kg)} = \frac{TR \times BW \times AT \times 365\,d/yr}{(EF \times ED \times 10^{-6}\,kg/mg)\,[(SF_o \times IR) + (SF_{ABS} \times AF \times ABS_d \times SA \times EV)]}$$

Parameter/Definition (units)	Default
TR/target cancer risk (unitless)	10^{-6}
BW/body weight (kg)	70
AT/averaging time (years)	70
EF/exposure frequency (days/year)	**site-specific**
ED/exposure duration (years)	**site-specific**
SF_o/oral cancer slope factor $(mg/kg\text{-}d)^{-1}$	chemical-specific (Appendix C)
IR/soil ingestion rate (mg/d)	330
SF_{ABS}/dermally adjusted cancer slope factor $(mg/kg\text{-}d)^{-1}$	chemical-specific (Equation 3-3)
AF/skin-soil adherence factor (mg/cm^2-event)	**0.3**
ABS_d/dermal absorption fraction (unitless)	chemical-specific (Exhibit 3-3 and Appendix C)
SA/skin surface area exposed (cm^2)	**3,300**
EV/event frequency (events/day)	**1**

Equation 5-2
Screening Level Equation for Combined Subchronic Ingestion and Dermal Absorption Exposure to Non-Carcinogenic Contaminants in Soil
Construction Scenario - Construction Worker

$$\text{Screening Level (mg/kg)} = \frac{THQ \times BW \times AT \times 365\,d/yr}{(EF \times ED \times 10^{-6}\,kg/mg)\left[\left(\frac{1}{HBL_{sc}} \times IR\right) + \left(\frac{1}{HBL_{ABS}} \times AF \times ABS_d \times SA \times EV\right)\right]}$$

Parameter/Definition (units)	Default
THQ/target hazard quotient (unitless)	1
BW/body weight (kg)	70
AT/averaging time (years)	**site specific[a]**
EF/exposure frequency (days/year)	**site specific**
ED/exposure duration (years)	**site specific**
HBL_{sc}/subchronic health-based limit (mg/kg-d)	chemical-specific
IR/soil ingestion rate (mg/d)	330
HBL_{ABS}/dermally-adjusted subchronic health-based limit (mg/kg-d)	chemical-specific (Equation 3-4)
AF/skin-soil adherence factor (mg/cm^2-event)	**0.3**
ABS_d/dermal absorption fraction (unitless)	chemical-specific (Exhibit 3-3 and Appendix C)
SA/skin surface exposed (cm^2)	**3,300**
EV/event frequency (events/day)	**1**

[a] For non-carcinogens, averaging time equals to exposure duration.

Data on soil ingestion rates for adults engaged in outdoor work are not currently available. However, EPA believes construction workers are likely to experience substantial exposures to soils during excavation and other work activities; therefore, a high-end soil ingestion rate has been selected to estimate exposures under this scenario. The default value of 330 mg/day (Stanek et al., 1997) listed in Equations 5-1 and 5-2 replaces the previous default ingestion rate of 480 mg/day (Hawley, 1985). While the Hawley value was based on a theoretical calculation for adults engaged in outdoor physical activity, the revised default ingestion rate is based on the 95th percentile value for adult soil intake rates reported in a soil ingestion mass-balance study.[27]

[27]Research is on-going to refine our knowledge about adult soil ingestion and to produce better ingestion rate estimates for individuals engaged in strenuous activities. This default is therefore subject to change as better data become available.

The dermal absorption components of Equations 5-1 and 5-2 are based on the same methodology discussed in Section 3.2.1, and they can be used to calculate SSLs for the same seven compounds and two compound classes discussed in that section. The suggested default input values for the dermal exposure equations are consistent with those recommended in EPA's interim dermal guidance (U.S. EPA, 2001). Event frequency (EV, the number of events per day) is assumed to be one. Construction workers are assumed to have their face, forearms, and hands exposed. Therefore, this guidance recommends that a value of 3,300 cm^2 be used as an estimate of the skin surface area exposed (SA). We also assume a default adherence factor (AF) of 0.3 mg soil per square centimeter of exposed skin. The SA default value is the same as that used for commercial/industrial outdoor worker receptors; the AF value represents the 95th percentile value for construction workers. The chemical-specific dermal absorption fractions (ABS_d) are presented in Appendix C. For those compounds that are classified as both semi-volatiles and as PAHs, the ABS_d default for PAHs should be applied. Subchronic oral toxicity values used to calculate this SSL should be adjusted in the same manner as chronic oral RfDs (see Equation 3-4).

Inhalation of Fugitive Dusts. Under a construction scenario, fugitive dusts may be generated from surface soils by wind erosion, construction vehicle traffic on temporary unpaved roads and other construction activities. Inhalation of these dusts containing semi-volatile organic compounds and metals may be of concern to construction workers and off-site residents. As described in Section 4.2.3, site managers need only evaluate the fugitive dust pathway for a single contaminant, hexavalent chromium (Cr^{+6}) under the residential and commercial/industrial scenarios; however, due to the potential for increased dust exposure from truck traffic on unpaved roads during construction, EPA recommends that SSLs for the construction scenario be calculated for semi-volatile compounds and for all metals.[28]

Equations 5-3 and 5-4 are appropriate for calculating fugitive dust SSLs for carcinogens and non-carcinogens for subchronic construction worker exposure. These equations are similar to the fugitive dust SSL equations for other scenarios, with the exception of the health based limit subchronic toxicity value term (HBL_{sc}). In addition, the equation to calculate the subchronic particulate emission factor (PEF_{sc}, Equation 5-5) is significantly different from the residential and non-residential PEF equations. The PEF_{sc} in Equation 5-5 focuses exclusively on emissions from truck traffic on unpaved roads, which typically contribute the majority of dust emissions during construction. This equation requires estimates of parameters such as the number of days with at least 0.01 inches of rainfall, the mean vehicle weight, and the sum of fleet vehicle distance traveled during construction.

[28] For purposes of this guidance, semi-volatile compounds are defined as those listed on EPA's Contract Laboratory Program list of target semi-volatile compounds (see http://www.epa.gov/superfund/programs/clp/target.htm). These compounds are identified on the exhibits in Appendix A. In addition, metals are listed at the bottom of each exhibit in Appendix A.

Equation 5-3
Screening Level Equation for Subchronic Inhalation of Carcinogenic Fugitive Dusts
Construction Scenario - Construction Worker

$$\text{Screening Level (mg/kg)} = \frac{TR \times AT \times 365 d/yr}{URF \times 1{,}000 \mu g/mg \times EF \times ED \times \frac{1}{PEF_{sc}}}$$

Parameter/Definition (units)	Default
TR/target cancer risk (unitless)	10^{-6}
AT/averaging time (years)	70
URF/inhalation unit risk factor $(\mu g/m^3)^{-1}$	chemical -specific (Appendix C)
EF/exposure frequency (days/year)	**site-specific**
ED/exposure duration (years)	**site-specific**
PEF_{sc}/subchronic road particulate emission factor (m^3/kg)	**site-specific (Equation 5-5)**

Equation 5-4
Screening Level Equation for Subchronic Inhalation of Non-carcinogenic Fugitive Dusts
Construction Scenario - Construction Worker

$$\text{Screening Level (mg/kg)} = \frac{THQ \times AT \times 365 d/yr}{EF \times ED \times \left(\frac{1}{HBL_{sc}} \times \frac{1}{PEF_{sc}} \right)}$$

Parameter/Definition (units)	Default
THQ/target hazard quotient (unitless)	1
AT/averaging time (years)	**site-specific[a]**
EF/exposure frequency (days/year)	**site-specific**
ED/exposure duration (years)	**site-specific**
HBL_{sc}/subchronic health-based limit (mg/m^3)	chemical-specific
PEF_{sc}/subchronic road particulate emission factor (m^3/kg)	**site-specific (Equation 5-5)**

[a] For non-carcinogens, averaging time equals exposure duration.

Equation 5-5
Derivation of the Particulate Emission Factor
Construction Scenario - Construction Worker

$$PEF_{sc} \text{ ' } Q/C_{sr} \times \frac{1}{F_D} \times \left[\frac{T \times A_R}{556 \times (W/3)^{0.4} \times \frac{(365d/yr\&p)}{365d/yr} \times \Sigma VKT} \right]$$

Parameter/Definition (units)	Default
PEF_{sc}/subchronic road particulate emission factor (m^3/kg)	**site-specific**
Q/C_{sr}/ inverse of the ratio of the 1-h geometric mean air concentration to the emission flux along a straight road segment bisecting a square site (g/m^2-s per kg/m^3)	**23.02[a] (Equation 5-6)**
F_D/dispersion correction factor (unitless)	0.185 (Appendix E)
T/total time over which construction occurs (s)	**site-specific**
A_R/surface area of contaminated road segment (m^2) **L_R/length of road segment (ft)** **W_R/width of road segment (ft)**	**274.213** **($A_R = L_R \times W_R \times 0.092903 m^2/ft^2$)**
W/mean vehicle weight (tons)	**site-specific**
p/number of days with at least 0.01 inches of precipitation (days/year)	**site-specific (Exhibit 5-2)**
' VKT/sum of fleet vehicle kilometers traveled during the exposure duration (km)	**site-specific**

[a] Assumes a 0.5 acre site

The number of days with at least 0.01 inches of rainfall can be estimated using Exhibit 5-2. Mean vehicle weight (W) can be estimated by assuming the numbers and weights of different types of vehicles. For example, assuming that the daily unpaved road traffic consists of 20 two-ton cars and 10 twenty-ton trucks, the mean vehicle weight would be:

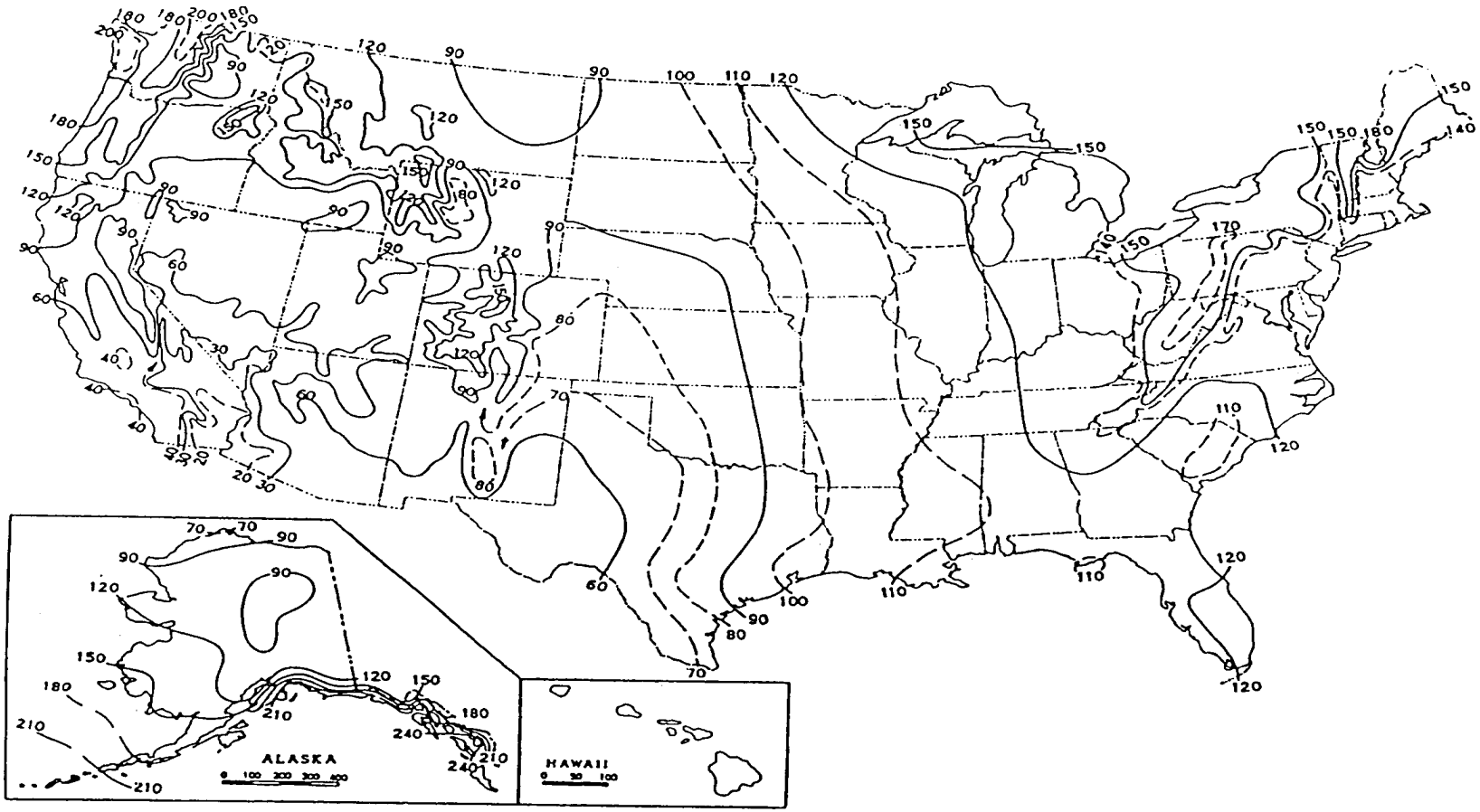
$$W = [(20 \text{ cars x } 2 \text{ tons/car}) + (10 \text{ trucks x } 20 \text{ tons/truck})]/30 \text{ vehicles} = 8 \text{ tons}$$

The sum of the fleet vehicle kilometers traveled during construction (ΣVKT) can be estimated based on the size of the area of surface soil contamination, assuming the configuration of the unpaved road, and the amount of vehicle traffic on the road. For example, if the area of surface soil contamination is 0.5 acres (or 2,024 m^2), and one assumes that this area is configured as a square with the unpaved road segment dividing the square evenly, the road length would be equal to the square root of 2,024 m^2, 45 m (or 0.045 km). Assuming that each vehicle travels the length of the road once per day, 5 days per week for a total of 6 months, the total fleet vehicle kilometers traveled would be:

$$\Sigma VKT = 30 \text{ vehicles x } 0.045 \text{ km/day x } (52 \text{ wks/yr} \div 2) \text{ x } 5 \text{ days/wk} = 175.5 \text{ km}$$

Exhibit 5-2

MEAN NUMBER OF DAYS WITH 0.01 INCH OR MORE OF ANNUAL PRECIPITATION



The equation for the subchronic dispersion factor for dust generated by unpaved road traffic, Q/C_{sr}, is presented in Equation 5-6. Q/C_{sr} was derived using EPA's ISC3 dispersion model for a hypothetical site under a wide range of meteorological conditions. Unlike the Q/C values for the other scenarios, the Q/C_{sr} for the construction scenario's simple site-specific approach can be modified only to reflect different site sizes between 0.5 and 500 acres; it cannot be modified for climatic zone. Users conducting a detailed site-specific analysis for the construction scenario can develop a site-specific Q/C_{sr} value by running the ISC3 model. Further details on the derivation of Q/C_{sr} can be found in Appendix E.

Equation 5-6
Derivation of the Dispersion Factor for Particulate Emissions from Unpaved Roads - Construction Scenario

$$Q/C_{sr} \text{ ' } A \times \exp\left[\frac{(\ln A_s \& B)^2}{C}\right]$$

Parameter/Definition (units)	Default
Q/C_{sr}/inverse of the ratio of the 1-h geometric mean air concentration to the emission flux along a straight road segment bisecting a square site (g/m^2-s per kg/m^3)	23.02[a]
A/constant (unitless)	12.9351
A_s/areal extent of site surface soil contamination (acres)	0.5
B/constant (unitless)	5.7383
C/constant (unitless)	71.7711

[a] Assumes a 0.5 acre site

Equations 5-7 and 5-8 are appropriate for calculating fugitive dust SSLs for carcinogens and non-carcinogens based on chronic exposure to off-site residents. The fugitive dust SSL is calculated for off-site residents who are exposed both during construction and after construction is complete. During site construction, off-site residents are assumed to be exposed to fugitive dust emissions from site traffic on temporary unpaved roads. After construction, receptors are assumed to be exposed to emissions from wind erosion. Although the construction exposure duration is considerably shorter than the post-construction exposure duration, the magnitude of emissions due to unpaved road traffic may be substantially higher than that due to wind erosion. For this reason, we evaluate chronic exposure to off-site residents by combining the total mass emitted from both unpaved road traffic during construction and wind erosion post-construction, normalizing this value over the total exposure duration.

Equation 5-7
Screening Level Equation for Chronic Inhalation of Carcinogenic Fugitive Dust Construction Scenario - Off-Site Resident

$$\text{Screening Level (mg/kg)} = \frac{TR \times AT \times 365d/yr}{URF \times 1{,}000\mu g/mg \times EF \times ED \times \frac{1}{PEF_{off}}}$$

Parameter/Definition (units)	Default
TR/target cancer risk (unitless)	10^{-6}
AT/averaging time (years)	70
URF/inhalation unit risk factor $(\mu g/m^3)^{-1}$	chemical-specific (Appendix C)
EF/exposure frequency (days/year)	**350**
ED/exposure duration (years)	**30**
PEF_{off}/off-site particulate emission factor (m^3/kg)	**4.40×10^8 (Equation 5-9)**

Equation 5-8
Screening Level Equation for Chronic Inhalation of Non-carcinogenic Fugitive Dust Construction Scenario - Off-Site Resident

$$\text{Screening Level (mg/kg)} = \frac{THQ \times AT \times 365d/yr}{EF \times ED \times \left[\frac{1}{RfC} \times \frac{1}{PEF_{off}}\right]}$$

Parameter/Definition (units)	Default
THQ/target hazard quotient (unitless)	1
AT/averaging time (years)	**30[a]**
EF/exposure frequency (days/year)	**350**
ED/exposure duration (years)	**30**
RfC/inhalation reference concentration (mg/m^3)	chemical-specific (Appendix C)
PEF_{off}/off-site particulate emission factor (m^3/kg)	**4.40×10^8 (Equation 5-9)**

[a] For non-carcinogens, averaging time equals exposure duration.

Equation 5-9 calculates the particulate emission factor for off-site residents (PEF_{off}). Because it normalizes the mass of fugitive dust emitted over 30 years, this equation requires separate estimates of the mass of dust emitted by traffic on unpaved roads during construction and the mass of dust emitted by wind erosion. These are calculated using Equation 5-10 (based on U.S. EPA, 1985) and Equation 5-11 (based on Cowherd et al., 1985), respectively.

Q/C_{off} can be derived for any source size between 0.5 and 500 acres using the equation and look-up table in Appendix D, Exhibit D-4. (The default Q/C_{off} factor assumes a 0.5 acre source size.) The look-up table in Exhibit D-4 provides the three coefficients for the Q/C_{off} equation (A, B, and C) for each of 29 cities selected to be representative of the range of meteorologic conditions across the country. The Q/C_{off} equation for each city was derived from the results of modeling runs of EPA's ISC3 dispersion model using five years of meteorological data. To calculate a site-specific Q/C_{off} factor, the site manager must first identify the climatic zone and city most representative of meteorological conditions at the site. Appendix D includes a map of climatic zones to help site managers select the appropriate Q/C_{off} coefficients. Once the coefficients have been identified, Q/C_{off} can be calculated for any source size between 0.5 and 500 acres and input into Equation 5-9 to derive a site-specific PEF_{off}.

Equation 5-9
Derivation of the Particulate Emission Factor
Construction Scenario - Off-Site Resident

$$PEF_{off} = Q/C_{off} \times \frac{1}{J_T}$$

where:

$$J_T = \frac{M_{road} + M_{wind}}{A_{site} \times ED \times (3.1536 \times 10^7 s/yr)}$$

Parameter/Definition (units)	Default
PEF_{off}/off-site particulate emission factor (m^3/kg)	4.40×10^8
Q/C_{off}/inverse of ratio of the geometric mean air concentration to the emission flux at the boundary of a square source (g/m^2-s per kg/m^3)	**89.03[a] (Appendix D, Appendix E)**
J_T/total time-averaged emission flux (g/m^2-s)	**site-specific**
M_{road}/unit mass emitted from unpaved road traffic (g)	**site-specific (Equation 5-10)**
M_{wind}/unit mass emitted from wind erosion (g)	**site-specific (Equation 5-11)**
A_{site}/areal extent of site (m^2)	**2,024**
ED/exposure duration (year)	**30**

[a] Assumes a 0.5 acre emission source

Equation 5-10
Mass of Dust Emitted by Road Traffic
Construction Scenario - Off-Site Resident

$$M_{road} \text{ ' } 556(W/3)^{0.4} \times \left[\frac{(365d/yr \,\&\, p)}{365d/yr}\right] \times \Sigma VKT$$

Parameter/Definition (units)	Default
M_{road}/unit mass emitted from unpaved road traffic (g)	**site-specific**
W/mean vehicle weight (tons)	**site-specific**
p/number of days per year with at least 0.01 inches of precipitation (days/year)	**site-specific (Exhibit 5-2)**
' VKT/sum of fleet vehicle kilometers traveled during construction (km)	**site-specific**

Equation 5-11
Mass of Dust Emitted by Wind Erosion
Construction Scenario - Off-Site Resident

$$M_{wind} \text{ ' } 0.036 \times (1 \,\&\, V) \times \left(\frac{U_m}{U_t}\right)^3 \times F(x) \times A_{surf} \times ED \times 8{,}760 hr/yr$$

Parameter/Definition (units)	Default
M_{wind}/unit mass emitted from wind erosion (g)	1.32E+05
V/fraction of vegetative cover (unitless)	**0.5**
U_m/mean annual windspeed (m/s)	**4.69**
U_t/equivalent threshold value of windspeed at 7m (m/s)	**11.32**
F(x)/function dependent on U_m/U_t derived from Cowherd, et al., 1985 (unitless)	**0.194**
A_{surf}/areal extent of site with undisturbed surface soil contamination (m^2)	**2,024**
ED/exposure duration (years)	**30**

SSL Equations for Subsurface Soils

The relevant pathways for exposure to subsurface soils for the construction scenario include direct ingestion, dermal absorption, and inhalation of volatiles outdoors. As noted above, these pathways are evaluated for construction workers only. SSLs for ingestion and dermal absorption exposure to subsurface soils are calculated in the same way as those for surface soils and as described in the previous section.

Inhalation of Volatiles. Equations 5-12 through 5-15 are appropriate for calculating SSLs for subchronic outdoor inhalation of volatiles by construction workers. These equations are appropriate for the simple site-specific approach; the detailed site-specific modeling approach to this pathway is discussed in Appendix E. Equations 5-12 and 5-13 calculate the SSLs for the subchronic inhalation of carcinogenic and non-carcinogenic volatile compounds, respectively. Equation 5-14 is appropriate for calculating the soil-to-air volatilization factor (VF_{sc}) that relates the concentration of a contaminant in soil to the concentration in air resulting from volatilization. The equation for the subchronic dispersion factor for volatiles, Q/C_{sa}, is presented in Equation 5-15. Q/C_{sa} was derived using EPA's SCREEN3 dispersion model for a hypothetical site under a wide range of meteorological conditions. Unlike the Q/C values for the other scenarios, the Q/C_{sa} for the construction scenario's simple site-specific approach can be modified only to reflect different site sizes between 0.5 and 500 acres; it cannot be modified for climatic zone. Site managers conducting a detailed site-specific analysis for the construction scenario can develop a site-specific Q/C value by running the SCREEN3 model. Further details on the derivation of Q/C_{sa} can be found in Appendix E.

Equation 5-12
Screening Level Equation for Subchronic Inhalation of Carcinogenic Volatile Contaminants in Soil
Construction Scenario - Construction Worker

$$\text{Screening Level (mg/kg)} = \frac{TR \times AT \times 365\,d/yr}{URF \times 1{,}000\,\mu g/mg \times EF \times ED \times \frac{1}{VF_{sc}}}$$

Parameter/Definition (units)	Default
TR/target cancer risk (unitless)	10^{-6}
AT/averaging time (years)	70
URF/inhalation unit risk factor $(\mu g/m^3)^{-1}$	chemical-specific (Appendix C)
EF/exposure frequency (days/year)	**site-specific**
ED/exposure duration (years)	**site-specific**
VF_{sc}/subchronic soil-to-air volatilization factor (m^3/kg)	**chemical-specific (Equation 5-14)**

Equation 5-13
Screening Level Equation for Subchronic Inhalation of Non-Carcinogenic Volatile Contaminants in Soil Construction Scenario - Construction Worker

$$\text{Screening Level (mg/kg)} = \frac{THQ \times AT \times 365 d/yr}{EF \times ED \times \left(\frac{1}{HBL_{sc}} \times \frac{1}{VF_{sc}} \right)}$$

Parameter/Definition (units)	Default
THQ/target hazard quotient (unitless)	1
AT/averaging time (years)	**site-specific[a]**
EF/exposure frequency (days/year)	**site-specific**
ED/exposure duration (years)	**site-specific**
HBL_{sc} /subchronic health-based limit (mg/m^3)	chemical-specific
VF_{sc} /subchronic soil-to-air volatilization factor (m^3/kg)	**chemical-specific (Equation 5-14)**

[a] For non-carcinogens, averaging time equals exposure duration.

Equation 5-16 is appropriate for calculating the soil saturation limit (C_{sat}) for each volatile compound. As discussed in Section 4.2.3, C_{sat} represents an upper bound on SSLs calculated using the VF model. If the calculated SSL exceeds C_{sat} and the contaminant is liquid at soil temperatures (see Appendix C, Exhibit C-3), the SSL should be set at C_{sat}. Soil screening decisions for organic compounds that are solid at soil temperatures should be based on SSLs for other exposure pathways.

Because the equations developed to calculate SSLs for the inhalation of volatiles outdoors assume an infinite source, they can violate mass-balance considerations, especially for small sources. To address this concern, a mass-limit SSL equation for this pathway may be used (Equation 5-17). This equation can be used only when the volume (i.e., area and depth) of the contaminated soil source is known or can be estimated with confidence.

As discussed above, the simple site-specific approach for calculating construction scenario SSLs uses the same emission model for volatiles as that used in the residential and non-residential scenarios. However, the conservative nature of this model (i.e., it assumes all contamination is at the surface) makes it sufficiently protective of construction worker exposures to volatiles. The toxicity values used in these equations (inhalation unit risk factors for cancer and subchronic reference concentrations for non-cancer effects) are based on an adult inhalation rate of 20 m^3/day. This is consistent with the rate used for residential and commercial/industrial SSLs. Although construction worker receptors are exposed for shorter periods each day than residents (generally eight to 10 hours versus 24 hours), data on worker-related activity levels and associated inhalation rates suggest that the 20 m^3/day rate is a reasonable estimate of RME for these workers (see Section 4.2.3 for a more complete discussion of these data).

Equation 5-14
Derivation of the Subchronic Volatilization Factor
Construction Scenario - Construction Worker

$$VF_{sc} = \left[\frac{(3.14 \times D_A \times T)^{1/2}}{2 \times \rho_b \times D_A}\right] \times 10^{-4} m^2/cm^2 \times Q/C_{sa} \times \frac{1}{F_D}$$

where:

$$D_A = \frac{[(\theta_a^{10/3} D_i H') + \theta_w^{10/3} D_w)/n^2]}{\rho_b K_d + \theta_w + \theta_a H'}$$

Parameter/Definition (units)	Default
VF_{sc}/subchronic volatilization factor (m^3/kg)	chemical-specific[a]
D_A/apparent diffusivity (cm^2/s)	chemical-specific[a]
T/total time over which construction occurs (s)	**site-specific**
ρ_b/dry soil bulk density (g/cm^3)	1.5
Q/C_{sa} /inverse of the ratio of the 1-h geometric mean air concentration to the volatilization flux at the center of a square site (g/m^2-s per kg/m^3)	**14.31[b] (Equation 5-15)**
F_D/dispersion correction factor (unitless)	0.185
θ_a/air-filled soil porosity (L_{air}/L_{soil})	$n-\theta_w$
n/total soil porosity (L_{pore}/L_{soil})	$1-(\rho_b/\rho_s)$
θ_w/water-filled soil porosity (L_{water}/L_{soil})	**0.15**
ρ_s/soil particle density (g/cm^3)	2.65
D_i/diffusivity in air (cm^2/s)	chemical-specific[a]
H´/dimensionless Henry's law constant	chemical-specific[a]
D_w/diffusivity in water (cm^2/s)	chemical-specific[a]
K_d/soil-water partition coefficient (cm^3/g)	for organics: $K_d = K_{oc} \times f_{oc}$ for inorganics: see Appendix C[c]
K_{oc}/soil organic carbon partition coefficient (cm^3/g)	chemical-specific[a]
f_{oc}/fraction organic carbon in soil (g/g)	**0.006 (0.6%)**

[a] See Appendix C
[b] Assumes a 0.5 acre site
[c] Assume a pH of 6.8 when selecting default K_d values

Equation 5-15
Derivation of the Dispersion Factor for Subchronic Volatile Contaminant Emissions Construction Scenario - Construction Worker

$$Q/C_{sa} = A \times \exp\left[\frac{(\ln A_c \& B)^2}{C}\right]$$

Parameter/Definition (units)	Default
Q/C_{sa}/inverse of the ratio of the 1-h geometric mean air concentration to the volatilization flux at the center of the square source (g/m^2-s per kg/m^3)	**14.31[a]**
A/constant (unitless)	**2.4538**
A_C/areal extent of site soil contamination (acres)	**0.5**
B/constant (unitless)	**17.5660**
C/constant (unitless)	**189.0426**

[a] Assumes a 0.5 acre emission source

Equation 5-16
Derivation of the Soil Saturation Limit

$$C_{sat} = \frac{S}{\rho_b}(K_d \rho_b + \theta_w + H \theta_a)$$

Parameter/Definition (units)	Default
C_{sat}/soil saturation concentration (mg/kg)	chemical-specific
S/solubility in water (mg/L-water)	chemical-specific (Appendix C)
ρ_b/dry soil bulk density (kg/L)	**1.5**
K_d/soil-water partition coefficient (L/kg)	organic = K_{oc} x f_{oc} inorganic = see Appendix C[a]
K_{oc}/organic carbon partition coefficient (L/kg)	chemical-specific (Appendix C)
f_{oc}/fraction organic carbon in soil (g/g)	**0.006 (0.6%)**
θ_w/water-filled soil porosity (L_{water}/L_{soil})	**0.15**
H/dimensionless Henry's law constant	chemical-specific (Appendix C)
θ_a/air-filled soil porosity (L_{air}/L_{soil})	n - θ_w
n/total soil porosity (L_{pore}/L_{soil})	1 - (ρ_b/ρ_s)
ρ_s/soil particle density (kg/L)	2.65

[a] Assume a pH of 6.8 when selecting default K_d values

Equation 5-17
Mass-Limit Volatilization Factor
Construction Scenario - Construction Worker

$$VF_{sc} \text{ ' } Q/C_{sa} \times \frac{1}{F_D} \times \frac{T \times (3.15 \times 10^7 s/yr)}{\rho_b \times d_s \times 10^6 g/Mg}$$

Parameter/Definition (units)	Default
VF_{sc}/volatilization factor (m^3/kg)	--
Q/C_{sa}/inverse of the ratio of the 1-h geometric mean air concentration to the volatilization flux at the center of a square source (g/m^2-s per kg/m^3)	**14.31[a] (Equation 5-15)**
F_D/dispersion correction factor (unitless)	0.185 (Appendix E)
T/exposure interval (year)	**site-specific (=ED)**
ρ_b/dry soil bulk density (kg/L or Mg/m^3)	**1.5**
d_s/average source depth (m)	**site-specific**

[a] Assumes a 0.5 acre emission source

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Charleston, SC 29418

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prepared by:
Cape Environmental Management Inc
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Waukegan, IL 60085

Contact: Kurt Gates, CIH, CSP
Vice President

847/336-4341

November 1998

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1.0 INTRODUCTION

This introductory section briefly describes the project, outlines the format of the survey report, presents our technical approach to the project, and the sample analysis methodology. The survey results and recommendations are provided in Section 2.0 and a preliminary cost estimate is presented in Section 3.0 (under separate cover).

1.1 Overview

Southern Division's Naval Facility Engineering Command (South Div) retained CAPE Environmental Management Inc (CAPE) to conduct a Pre-demolition asbestos-containing material (ACM), lead-based paint (LBP), lead dust contamination and polychlorinated biphenyl (PCB) survey of Building 910 located at the Great Lakes Naval Training Center, Great Lakes, Illinois. The asbestos, lead and PCB survey report, as well as the abatement design, are to be issued as part of a design-build solicitation for price and technical proposals to perform the work. CAPE's understanding of the intent of this military construction project is the entire Building 910 will be demolished.

The field investigation for this project was conducted between November 9 and November 12, 1998 by CAPE's survey team. The survey team included Kurt Gates and Nick Briglio. Both Mr. Gates and Mr. Briglio are accredited and State licensed lead inspectors, lead risk assessor, asbestos building inspectors and management planners. Personnel certifications are in included in Appendix F.

1.2 Technical Approach

The surveys consisted of investigating the interiors and exteriors of Buildings 910 for asbestos, lead-based paint, lead dust contamination and PCB light fixture ballasts.

1.2.1 Lead–Containing Paint Survey

CAPE conducted a lead-containing paint (LCP) survey to determine representative location and quantity of the LCP with the potential to be impacted during building demolition. The survey consisted of an inspection of all accessible areas of the building.

Currently, there are no regulations that include a protocol for completing lead surveys of Federal buildings (with no day-care services). The U.S. Department of Housing and Urban Development (HUD) Regulations does have survey guidelines which apply to Public and Indian housing. There are various Federal regulations that will apply to the actual building demolition. These regulations include but are not limited to 29 CFR 1926.62, 20 CFR 1910.1025 and 40 CFR 260-265. The Illinois Department of Public Health also has a Lead Poisoning Prevention Code, Title 77, Chapter I, Subchapter p, Part 845. This code primarily pertains to residential and child care facilities.

HUD defines Lead-Based Paint (LBP) as any paint with over 5,000 parts per million (ppm) or 0.5% of lead, when analyzed using atomic absorption. OSHA, however, does not recognize a threshold value for lead concentration in paint to determine potential lead exposures. According to OSHA, any amount of detectable lead in paint constitutes a potential lead exposure. When lead is detected in paint, the paint is considered lead-containing paint (LCP), as defined by OSHA.

The number of representative rooms surveyed was based on visual inspection of components. Rooms that were not sampled were assumed to have similar lead concentrations as the tested rooms. Painted components tested included the following: ceilings, stairs, floors, walls, door components, ballards and metal bullet back stop. CAPE's investigation concentrated on the most prevalent components as they are most likely to impact the demolition.

Furniture and equipment that were not an integral part of the building (such as free standing tables, chairs, desks and equipment), were not tested. Other items not tested included: factory coated vinyl products, such as basecoving, factory anodized metal components, such as air conditioners, and items that had no evidence of being painted.

A summary of the components sampled and the Atmoic Absorption Spectroscopy (AAS) results are included in Appendix A. Location of bulk paint chip samples are included in Appendix D.

The collected bulk paint chip samples were sent to STAT Analysis Corporation in Chicago, Illinois. The paint chip samples were analyzed for lead content using Atomic Absorption Spectrophotometry (AAS), modified EPA SW846 Method 3050. STAT is accredited by the American Industrial Hygiene Association and participates successfully in the Environmental Lead Proficiency Analytical Testing (ELPAT) Program. The lead paint sample results are included as Appendix B. STAT's certifications are included in Appendix F.

1.2.2 Land Dust, Sand, Soil and Demolition Waste Survey

CAPE surveyed the settled dust in the building for lead contamination associated with the firing range, the sand in the bullet traps for lead contamination, the soil on the exterior of the building for lead contamination and assessed the building to make an initial determination of the waste stream following demolition for lead waste characterization.

Settled dust was observed throughout the building. The settled dust samples were collected using wipe sample techniques, in accordance with Housing and Urban Development (HUD's) wipe sample collection protocol. The samples were analyzed using AAS, NIOSH Method 7082. Currently the prominent criteria to evaluate lead dust levels is HUD's criteria for clearance of residential units following a lead abatement project. HUD's clearance criteria, based on wipe sampling is:

100 ug/ft^2 for floors
500 ug/ft^2 for interior window sills
800 ug/ft^2 for window troughs and other rough surfaces

Although useful for point of reference, this criteria would not apply to demolition of this building.

Sand was observed in two bullet traps. Samples of the sand were collected an analyzed for total lead, using AAS. Additionally, a composite sample of the traps were collected and analyzed using toxicity characteristic leaching procedures (TCLP) to characterize the sand for waste disposal purposes as defined by EPA 40 CFR 260-265 (RCRA).

The firing range was equipped with an extensive exhaust system to provide make-up air to the shooters and pull the potentially contaminated air past the targets and exhausted to the exterior of the building. The current exhaust system was equipped with HEPA filters to remove the lead prior to exhaust, however the previous exhaust system may not have had HEPA filters (per Kurt Gates conversation with Building Representative, Chief Rickey). Therefore, two soil samples were collected from the exterior of the building and analyzed using TCLP method.

The actual building itself was assessed to determine if the waste stream created by the demolition process would be characterized by hazardous waste. In addition to the lead contamination previously discussed in this section, lead shot was observed to have adhered to the back stop framing. The other source of lead in the waste stream would be from the lead-based paint. However, this paint was observed to be generally in good condition, and adhered to the substrate. In Illinois, the Illinois EPA considers LBP still adhered to the substrate that is generated from a non-residential structure being demolished or renovated as general refuse, and not special waste in regards to lead.

1.2.3 Asbestos-Containing Material Survey

As part of a separate contract, CAPE conducted an initial asbestos-containing material (ACM) survey of Building 910 for management purposes to determine and quantify ACM present. The initial survey was conducted in 1993 and consisted of the following:

a) Conducting an inspection of all accessible areas to identify suspect ACMs;
b) Development of an asbestos sampling plan based on AHERA protocols;
c) Collection of bulk asbestos samples for analysis by polarized light microscopy in accordance with the sampling plan;
d) Quantification of materials determined to be asbestos-containing; and
e) Development of hazard assessments, asbestos removal costs and operations and maintenance procedures.

CAPE's current scope of work including updating the initial survey based on changes to the building over the four-year period since our initial survey was completed and to complete a demolition survey based on the proposed scope of work. Additionally, ACMs have been categorized by Federal regulatory definitions for renovation/demolition purposes.

The following definitions explain the general categorization of ACM relative to potential disturbance and requirement for removal prior to building demolition in accordance with the U.S. EPA, 40 CFR part 61, National Emissions Standards for Hazardous Air Pollutants (NESHAP) Asbestos Revision; Final Rule and OSHA 29 CFR 1926.1101, Asbestos Construction Standard.

- **Asbestos-Containing Material (ACM):** Any material containing more than 1% (one percent) of asbestos of any type or mixture as determined using the method specified in Appendix A, Subpart F, 40 CFR Part 763, Section 1, Polarized Light Microscopy.

- **Friable ACM:** Any ACM that when dry can be crumbled, pulverized or reduced to a powder by applying hand pressure.

- **Non-Friable ACM:** Any ACM that when dry can <u>not</u> be crumbled, pulverized or reduced to a powder by hand pressure.

- **Category I Non-Friable ACM:** Packing, gaskets, resilient floor covering, and asphalt roofing products containing more than one- percent asbestos.

- **Category II Non-Friable ACM:** Any material, excluding Category I Non-Friable ACM, containing more than one percent asbestos that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.

- **Regulated Asbestos Containing Material (RACM):** Any material that meets one or more of the following conditions:

  a) Friable ACM;
  b) Category I Non-Friable ACM that has become friable;
  c) Category I Non-Friable ACM that will be or has been subject to sanding, grinding, cutting, or abrading; or
  d) Category II Non-Friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation.

- **Non-Regulated Asbestos Containing Materials (Non-RACM):** Means Category I ACM or Category II ACM which does not meet the definition stated in RACM condition B, C, or D.

- **Class I Asbestos Work:** Means activities involving the removal of asbestos-containing or presumed asbestos-containing thermal system insulation and surfacing material.

- **Class II Asbestos Work:** Means activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.

- **Class III Asbestos Work:** Means repair and maintenance operations, where "ACM", including thermal system insulation and surfacing material is likely to be disturbed.

- **Class IV Asbestos Work:** Means maintenance and custodial activities during which employees contact ACM and Presumed ACM and activities to clean up waste and debris containing ACM and Presumed ACM.

Materials were categorized as RACM or Non-RACM and classified based on an interpretation of NESHAP and OSHA regulations for friable and non-friable ACM and the conditions anticipated during demolition. A summary of asbestos-containing materials present in each building is included in Appendix C and drawings showing locations of ACM and asbestos and lead bulk samples are included in Appendix D.

Collected bulk samples from the initial survey were sent to Analytical Environmental Services (AES) located in Atlanta, Georgia. Confirmation bulk samples were sent to Cape Environmental Management's lab in Atlanta, GA. Both Cape and AES are accredited by the American Industrial Hygiene Association and participates successfully in the National Voluntary Laboratory Accreditation Program administered by the National Institute of Standards and Technology.

1.2.4 PCB Survey

The Polychlorinated Biphenyl (PCB) investigation was conducted on November 12th, 1998 and included the identification of PCB containing light fixture ballasts.

Fluorescent light fixtures ballasts identified in the investigation were suspected of containing PCB's. Representative fluorescent light fixtures were opened so ballasts could be visually examined to determine the manufacturer and model number. Based on the manufacturer and model number, it could then be determined if the oil in the ballast does or does not contain PCB's. Similar fixtures in the same room or adjacent areas were judged as PCB or non-PCB based upon the inspection of the representative fixture(s).

2.0 SURVEY RESULTS AND RECOMMENDATIONS

2.1 Lead-Based Paint

Based on the Atomic Absorption Spectroscopy (AAS) results to determine total lead concentration in paint it was determined that all of the major painted components in the building contain lead. Although each major component sampled contained lead, components did not exceed HUD's definition of lead-based paint (5000 ppm), with the exception of certain walls, and the yellow bollards which did exceed HUD's definition of LBP. Table 1 presents the lead paint chip bulk sample results.

Table 1
Paint Chip Samples – Total Lead

Sample Number	Substrate	Color	Results (ppm)
Pb910-01	Ceiling (wood)	White	1,930
Pb910-02	Wall (wood)	White	3,660
Pb910-03	Wall (wood)	White	14,200
Pb910-04	Floor (concrete)	Gray	4,960
Pb910-05	Bollard (metal)	Yellow	7,660
Pb910-06	Roof truss (wood)	Black	1,110
Pb910-07	Bullet back stop (metal)	Black	3,150

As previously stated, OSHA does not recognize a threshold value for lead concentration in paint relative to potential exposures. According to OSHA, any amount of detectable lead in paint constitutes a potential lead exposure. The AAS results did indicate that detectable levels of lead are present in each component sampled, and therefore OSHA requirements as stated in 20 CFR 1926.62 shall be complied with during any activities impacting lead surfaces as part of this demolition project.

Based on the sampling results and CAPE's understanding of this project, LBP Abatement is not anticipated to be required. Because OSHA considers any quantity of lead in paint as a potential hazard, limited lead controls would still be required during demolition. These controls would include a work plan to control exposures and air monitoring to document actual exposures. Depending on the contractor's selected means and methods for demolition and the actual air monitoring results, the proposed lead controls should be adjusted accordingly, and shall always be in full compliance with OSHA.

Based on the TCLP results, this waste would not be expected to be characterized as lead waste, as defined by EPA 40 CFR 260-265. Because this is a design-build project, and the demolition contractor may segregate the waste, the exact waste stream cannot be determined and therefore this determination will be the responsibility of the contractor. Although not expected, if lead-contaminated waste (as defined by RCRA) is generated, the waste shall be placed in labeled containers (in accordance with 29 CFR 1926.62 and 40 CFR 260-265) and transported (in accordance with 49 CFR 171) off-site to an EPA-approved hazardous waste treatment or disposal facility.

2.2 Lead Dust, Sand, Soil and Demolition Waste

Lead dust was found throughout the building, with the highest concentrations identified in the back stop/range area. The results identified are presented in Table 2.

Table 2
Lead Dust Wipe Results

Sample Number	Substrate	Location	Result (ug/ft²)
WP-910-01	Floor	Armory	1,270
WP-910-02	Floor	Crews lounge	1,030
WP-910-03	Floor	Shower area	5,080
WP-910-04	Floor	South open area	8,400
WP-910-05	Floor	South open area	6,140
WP-910-06	Floor	Firing range	6,820
WP-910-07	Floor	Firing range	7,420
WP-910-08	Floor	Behind backstop	744,000
WP-910-09	Floor	Middle firing range	33,600
WP-910-10	Backstop	Backstop	D
WP-910-11	Floor	Firing range	21,400
WP-910-12	Floor	Work out room	13,500
WP-910-13	Floor	Work out room	21,700
WP-910-14	Floor	Work out room	22,000
WP-910-15	Pipe 9' above floor	Gun & repair shop	2,420
WP-910-16	Ceiling 8' above floor, slanted ceiling	Firing range (center)	477
WP-910-17	Dust 12' above floor	Work out room	3,160
WP-910-18	Locker 7' above floor	S. office	743

Note: Actual lab results are presented in Appendix A.

Although there is not a threshold in which lead dust is required to be decontaminated prior to demolition, CAPE feels that the levels in this building would justify a decontamination. This recommendation is primarily based on the concern for protecting both the demolition workers and the surrounding environment if this decontamination is not completed.

The soil surrounding the building was also determined to be contaminated with lead. Two soil samples were collected and analyzed using TCLP method. The results of these samples are 6 and 18 mg/L. The TCLP lab results are included in Appendix B. Soil with greater than 5 mg/L of lead analyzed by TCLP is considered hazardous. The soil would not be expected to be directly impacted by the demolition, therefore soil cleanup would not be required to be associated with the demolition. However, if the contractor is required to excavate the surrounding soil and transport off-site, this soil should be treated as hazardous waste. Additionally, South Div should be aware that this contamination is present and may select to remediate the soil as part of this or an independent project to limit the dispersion of the contamination.

The lead-based paint was observed to be in generally good condition and therefore, based on IEPA regulations, the demolition waste can be treated as general refuse and would not have to be

treated as hazardous or special waste. One exception was the backstop framing was observed to have lead shot adhered to the framing. CAPE recommends that his framing be disposed of as hazardous waste, or the lead removed prior to disposal.

2.3 Asbestos-Containing Materials

In accordance with the NESHAP regulations, it is recommended that all Regulated Asbestos Containing Material (reference Section 1.2.2 for definition of regulated material) be removed. Certain Category I and Category II non-friable ACMs not expected to become friable or will not be subjected to sanding, cutting, grinding or abrading during demolition activities could remain in the building. Additionally, all work involving ACM shall be completed in accordance with the appropriate OSHA classification.

Appendix C presents the ACM identified in each building, as well as the NESHAP and OSHA classifications. The contractor's industrial hygienist shall review the contractor's work plan to ensure each ACM is appropriately classified. Specific contractor proposed means and methods of demolition could result in a material being classified differently. Appendix D presents drawings showing sample locations and locations of ACM identified.

RACMs will become friable during demolition, and therefore, should be removed prior to demolition activities.

2.4 PCBs

Representative light fixture ballasts were inspected for PCB content. If the manufacturer's label on the ballast indicated "NO PCB" of "NON PCB", the ballast was assumed to be non-PCB-containing. If the label did not indicate "NO PCB", the ballast were assumed to contain PCBs. Approximately 10% of the light fixtures were checked for PCBs. Of the light fixtures checked, they all displayed labels stating that they were "Non-PCB-containing". Therefore, the number of assumed PCB-containing ballasts is estimated to be less than 10%.

Based on this representative inspection, CAPE estimated that there are a total of 70 light fixtures in Building 910. Because each representative light fixture ballast inspected did not contain PCB's, it is possible that all PCB ballasts have been removed from the building. However, for estimating purposes, CAPE is using 7 ballasts (10% of 70) in case unrepresentative ballasts contain PCB's.

Additionally, fluorescent lamps were assumed to contain mercury and should be disposed or recycled in accordance with Federal, State, local and Navy regulations.

Appendix A

STAT Analysis Corporation:
2201 West Campbell Park Drive, Chicago, Illinois 60612-3501
Tel. 312.733.0551; Fax: 312.733.2386; e-mail address: StatLabs@AOL.Com

NVLAP & AIHA Environmental Lead and Industrial Hygiene ACCREDITED LABORATORY

LEAD DUST ANALYSIS BY FLAME ATOMIC ABSORBTION SPECTROSCOPY

Niosh 7082/AOAC 5.001-3: OSHA reg. 29 CFR 1910.1450

Cape Environmental Management, Inc.

91 Noll Street
Waukegan, IL 60085
Phone: 847-336-4341
Fax: 847-336-4971

STAT Batch: 99319
Client Ref: BLD 910 Great Lakes
Stat Client:
Site Location:

Date Received: 11/13/98
Date Analyzed: 11/13/98
Date Reported: 11/13/98
Turnaround time: 4 hours

Laboratory Number	Client Number	Area Wiped (ft^2)	Pb (µg)	Pb (µg/ft^2)	Comments
19319001	WP-910-01	1.00	1270	1,270	
19319002	WP-910-02	1.00	1030	1,030	
19319003	WP-910-03	1.00	5080	5,080	
19319004	WP-910-04	1.00	8400	8,400	
19319005	WP-910-05	1.00	6140	6,140	
19319006	WP-910-06	1.00	6820	6,820	
19319007	WP-910-07	1.00	7420	7,420	
19319008	WP-910-08	1.00	744000	744,000	
19319009	WP-910-09	1.00	33600	33,600	
19319010	WP-910-10	1.00	D	D	
19319011	WP-910-11	1.00	21400	21,400	
19319012	WP-910-12	1.00	13500	13,500	
19319013	WP-910-13	1.00	21700	21,700	
19319014	WP-910-14	1.00	22000	22,000	
19319015	WP-910-15	1.00	2420	2,420	
19319016	WP-910-16	1.00	477	477	
19319017	WP-910-17	1.00	3160	3,160	
19319018	WP-910-18	1.00	743	743	

Note: Samples no.s 8 & 10 are so high in lead content that readings are close to, or greater than, unity. The dilutions needed to read the analyte concentration are greater than 10000 fold.

OPH clearance limit for all horizontal surfaces:
HUD Guidelines (1996 Revision): Floors = 200µg/ft2; Walls = 500µg/ft2; Sills = 500µg/ft2

(µg/ft^2= micrograms per foot squared)

Instrument: PE3300
Corr. Coeff.: 0.99997
Ref. Abs. (20ppm Pb): 0.159
Analyzed by: Ron Rudy
Date: 11/13/98

STAT Analysis Corporation:
2201 West Campbell Park Drive, Chicago, Illinois 60612-3501
Tel. 312.733.0551; Fax: 312.733.2386; e-mail address: StatLabs@AOL.Com

NVLAP & AIHA Environmental Lead and Industrial Hygiene ACCREDITED LABORATORY

LEAD BASED PAINT ANALYSIS BY FLAME ATOMIC ABSORBTION SPECTROSCOPY

Niosh 7082/AOAC 5.001-3
OSHA reg. 29 CFR 1910.1450

CAPE ENVIRONMENTAL MANAGEMENT INC

Kurt Gates
91 Noll Street
Waukegan, Illinois 60085
Phone: (847) 336-4341
Fax: (847) 336-4971

STAT Batch: 99318
Client Ref: Bld 910 Great Lakes
Stat Client: 843
Job Site:

Date Received: 11/13/98
Date Analyzed: 11/16/98
Date Reported: 11/16/98
Turnaround time: 24 hours

Laboratory Number	Client Number	Sample Wt. (g)	Pb (µg)	Pb (ppm)	Comments
19318001	Pb-910-01	0.050		1,930	
19318002	Pb-910-02	0.064		3,660	
19318003	Pb-910-03	0.050		14,200	
19318004	Pb-910-04	0.050		4,960	
19318005	Pb-910-05	0.050		7,660	
19318006	Pb-910-06	0.050		1,110	
19318007	Pb-910-07	0.050		3,150	
19318008	TPb-910-01	0.050		13,600	
19318009	TPb-910-02	0.050		18,700	

HUD Guidelines (1997) = 5000ppm

CPSC (1978) consumer lead based paint = 600ppm

Analyzed by: Angela M. Jackson
Date: 11/12/98

Appendix B

STAT Analysis Corporation:
2201 West Campbell Park Drive, Chicago, Illinois 60612-3501
Tel. 312.733.0551; Fax: 312.733.2386; e-mail address: StatLabs@AOL.Com

NVLAP & AIHA Environmental Lead and Industrial Hygiene ACCREDITED LABORATORY

TCLP LEAD ANALYSIS BY FLAME ATOMIC ABSORBTION SPECTROSCOPY

EPA 1311/Niosh 7082/AOAC 5.001-3: OSHA reg. 29 CFR 1910.1450

Cape Environmental Management, Inc.
Doug Paris
91 Noll Street
Waukegan, IL 60085
Phone: 847-336-4341
Fax: 847-336-4971

STAT Batch: 99317
Client Ref:
Stat Client: 843
Job Name: Bld. 910 Great Lakes

Date Received: 11/13/98
Date Analyzed: 11/18/98
Date Reported: 11/18/98
Turnaround time: 72 hours

Laboratory Number	Client Number	Sample Vol. (ml)	Pb (mg/L)	Comments
19317001	TCLP-01	10.00	1160	
19317002	Soil - 910-01	10.00	18.3	
19317003	Soil - 910-02	10.00	6.16	0.05

RCRA Disposal Code D008 = 5.00 mg/L

Instrument: PE3300
Corr. Coeff.: 0.99882
Ref. Abs. (20.0ppm Pb): 0.142

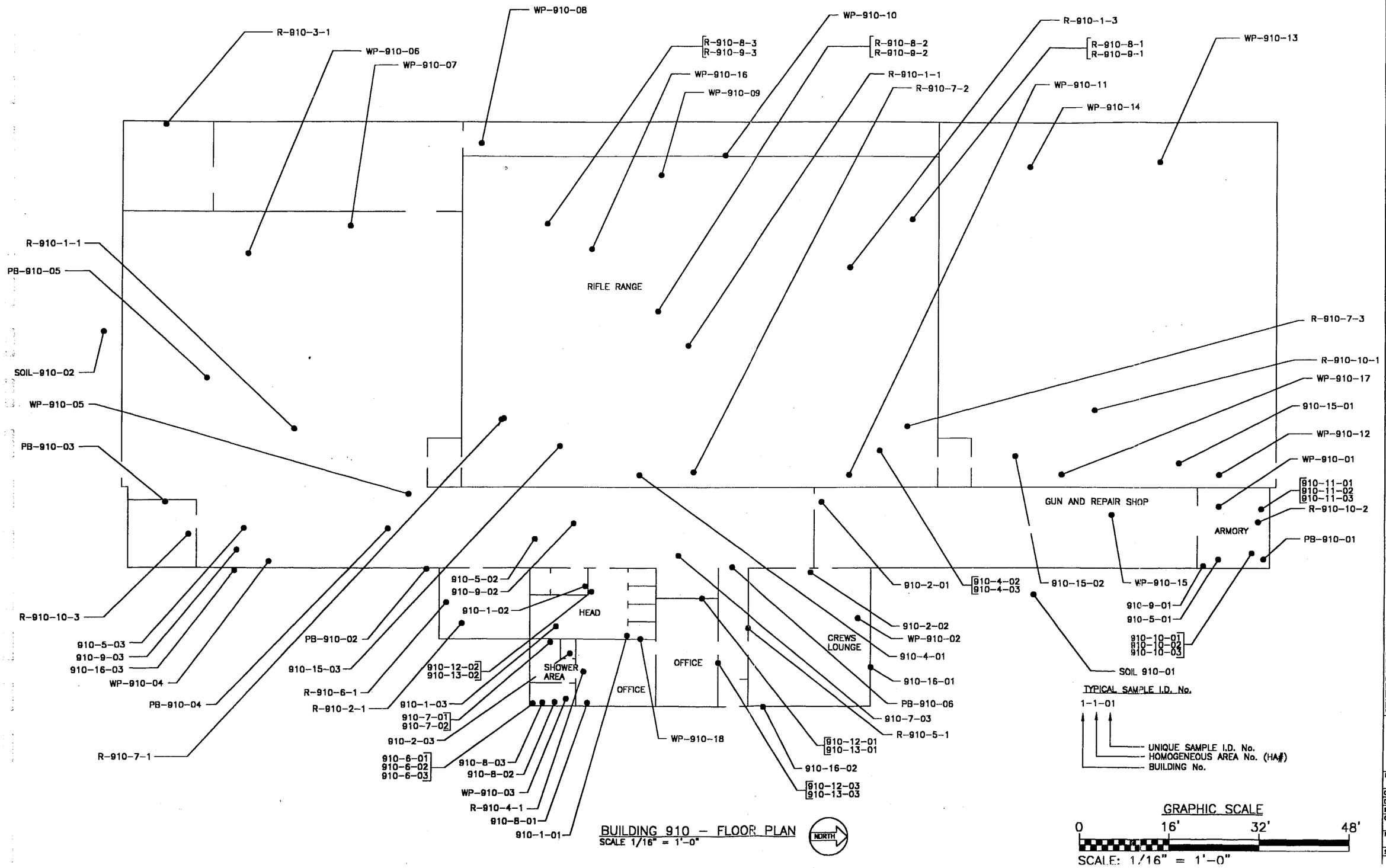
Analyzed by: _____
Date: 11/18/98

Appendix C

Asbestos Material Summary

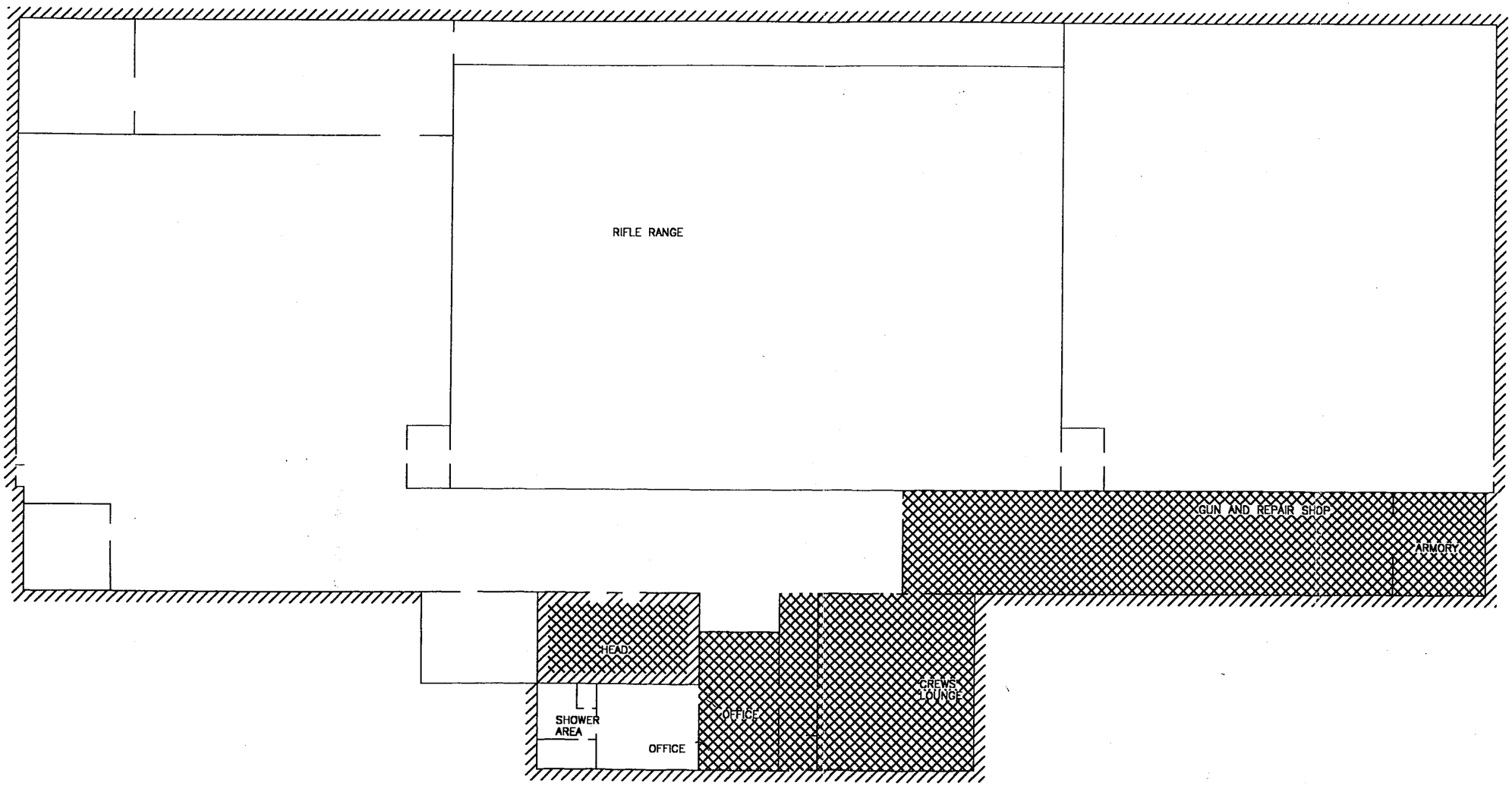
Material Description	Location	Sample Numbers (910)	Asbestos
Floor tile 12"x12" black/white streaks w/mastic	Head	1-01, 1-02, 1-03	Yes
Floor tile 12"x12", grey/streaks w/mastic	Armory, gun and repair shop, crews lounge, entrance, offices and shower area	2-01, 2-02, 2-03, R-4-01	No
Floor tile 9"x9", w/mastic	Under 12"x12" floor tile	R-5-01	Yes
Duct joint sealer	Rifle range	4-01, 4-02, 4-03	No
Pipe fitting insulation, on non-ACM insulated (fiberglass) runs	Throughout	5-01, 5-02, 5-03, R-10-1, R-10-2, R-10-3	No
Pipe fitting insulation, on cardboard-type runs	Rifle range and shower area	6-01, 6-02, 6-03	Yes
Pipe insulation, cardboard-type runs	Rifle range and shower area	7-01, 7-02, 7-03	Yes
Pipe insulation, magnesia-type runs	Shower area	8-01, 8-02, 8-03	Yes
Pipe insulation, canvas wrap (fiberglass)	Throughout	9-01, 9-02, 9-03	No
Tank insulation	Armory	10-01, 10-02, 10-03	Yes
Capping insulation	Armory	11-01, 11-02, 11-03	No
Gypsum board	Entrance, offices, head and rifle range	12-01, 12-02, 12-03	No
Joint compound on gypsum board	Entrance, offices, rifle range, and head	13-01, 13-02, 13-03	No
Flexible duct connector	Rifle range	15-01, 15-02, 15-03	No
Window putty	Interior and exterior windows	16-01, 16-02, 16-03	No (<1%)
Foam roofing	Roof	R-1-1, R-1-2, R-1-3	No
Rolled roofing	Women's head roof	R-2-1	No
Transite-type siding	Exterior walls	R-3-1	Yes
Floor tile 12"x12" white w/mastic	Women's head	R-6-1	No
2'x4' ceiling tile	Range	R-7-1, R-7-2, R-7-3	No
1'x1' acoustical tile	Range	R-8-1, R-8-2, R-8-3	No
1'x1' acoustical tile mastic	Range	R-9-1, R-9-2, R-9-3	No

Appendix D



BUILDING 910 – FLOOR PLAN
SCALE 1/16" = 1'-0"

CAPE ENVIRONMENTAL MANAGEMENT INC.
WAUKESHA (847) 336-4341
DESIGN D.TUMANTIL CHK K.GATES
DRFT K.GATES CH ENGR
SUBMITTED BY (FIRM MEMBER-TITLE) DATE
EIC BR HD
PREP BY DATE APPRVD
DATE OFFICER IN CHARGE FPE
REV. DESCRIPTION APPROVED
DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
CHARLESTON, S.C.
NAVAL FACILITIES ENGINEERING COMMAND
HAZARDOUS MATERIAL–PRE–DEMOLITION SURVEY
AT NTC GREAT LAKES
BUILDING 910 – FLOOR PLAN
SAMPLE LOCATIONS
DATE
ETD FOR COMMANDER, NAVFAC
APPROVED
PROJECT No: 1501A.099.000
RECORD DRAWING DATE
CODE I.D. NO. 80091
DRAWING SIZE: D
SPEC. NO. N/A
CONSTRN. CNTR. NO. N/A
NAVFAC DRAWING NO. N/A
SHEET 1 OF 3



LEGEND

ASBESTOS–CONTAINING MATERIALS (ACM) IDENTIFIED ON FLOORS AND WALLS INCLUDING TOTAL QUANTITIES THIS SHEET:

FLOOR COVERING/MASTIC (3 LAYERS) (2300 SF.)

TRANSITE TYPE WALLS (9000 SF.)

BUILDING 910 – FLOOR PLAN
SCALE 1/16" = 1'–0"

NORTH

GRAPHIC SCALE

0 16' 32' 48'

SCALE: 1/16" = 1'–0"

CMPE ENVIRONMENTAL MANAGEMENT INC.
WAUKEGAN (847) 336-4341

DESIGN D.TAMANTIA CHK K.GATES
CH ENGR
SUPV K.GATES
SUBMITTED BY (FIRM MEMBER–TITLE) DATE
EE BR HD
DR OFFICER IN CHARGE PPE
DATE

PREP BY DATE APPRV'D
REV. DESCRIPTION

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
CHARLESTON, S.C.
NAVAL FACILITIES ENGINEERING COMMAND

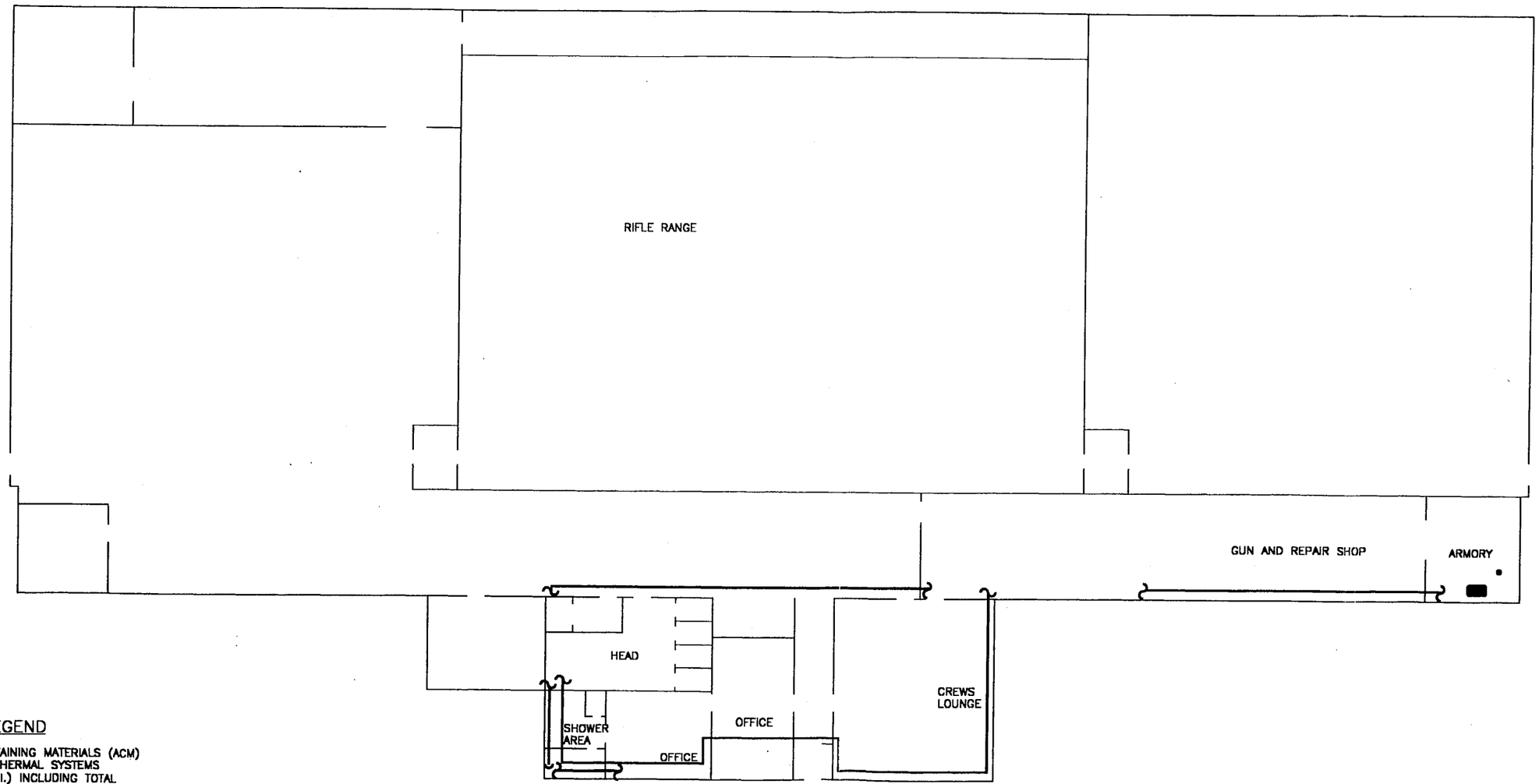
HAZARDOUS MATERIAL–PRE–DEMOLITION SURVEY
AT NTC GREAT LAKES
BUILDING 910 – FLOOR PLAN
FLOOR AND WALLS

APPROVED DATE
ETD FOR COMMANDER, NAVFAC
APPROVED

PROJECT No: 1501A.099.000

RECORD DRAWING DATE

CODE I.D. NO. 80091
DRAWING SIZE: D
SPEC. NO. N/A
CONSTRN. CNTR. NO. N/A
NAVFAC DRAWING NO. N/A
SHEET 2 OF 3
910ASB–2



LEGEND

ASBESTOS-CONTAINING MATERIALS (ACM) IDENTIFIED ON THERMAL SYSTEMS INSULATION (T.S.I.) INCLUDING TOTAL QUANTITIES THIS SHEET:

- PIPING INSULATION (250 LF)
- PIPE TURNS DOWN
- PIPING INSULATION ENDS, PIPE CONTINUES
- PIPING INSULATION ON RISER (5LF)
- TANK INSULATION (15 SF)

BUILDING 910 – FLOOR PLAN
SCALE 1/16" = 1'-0"

NORTH

GRAPHIC SCALE

0 16' 32' 48'

SCALE: 1/16" = 1'-0"

REV.	DESCRIPTION	PREP BY	DATE APPRVD

CAPE ENVIRONMENTAL MANAGEMENT INC.
WAUCHAW (847) 336-4341

DESIGN D.TURNAMTUL CHK K.GATES
SURV K.GATES CH ENGR
SUBMITTED BY (FIRM MEMBER-TITLE) DATE
EE DR HD
DATE OFFICER IN CHARGE PRE
DR

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHERN DIVISION
CHARLESTON, S.C.

HAZARDOUS MATERIAL-PRE-DEMOLITION SURVEY
AT NTC GREAT LAKES
BUILDING 910 – FLOOR PLAN
THERMAL SYSTEM INSULATION

APPROVED DATE
ED'D FOR COMMANDER, NAVFAC
DATE APPROVED

PROJECT No:
1501A.099.000

RECORD DRAWING DATE

CODE I.D. NO. 80081
DRAWING SIZE: D
SPEC. NO. N/A
CONSTRN. CNTR. NO. N/A
NAVFAC DRAWING NO. N/A
SHEET 3 OF 3

910ASB-3

Appendix E

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

ENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

JECT NAME: GREAT LAKES SURVEY / 1303A.04

AMPLE ID : 910-1-01 AES LAB NO : 20515 AES JOB NO : B1114

PLE LOCATION :

AMPLE - CRIPTION BLACK HARD COMPACT PARTLY GRANULAR WITH FIBERS, GLUE AND BLACK MASTIC.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)			
ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
HRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
ROCIDOLITE		MICA	
NTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	45
CTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		OTHER COMPONENTS	
YNTHETICS	1	ALUMINUM	
INERAL WOOL		BITUMEN	2
IBERGLASS		RESILIENT MATERIAL	
ELLULOSE	3	GLUE	3
ANIMAL HAIR		BINDERS	46
NTIGORITE			

MMENTS :

is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the nalysis of asbestos in building materials by polarized light microscopy. LAP Laboratory Code: 2033.

CROANALYST : RB

RESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

.IENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-1-02 AES LAB NO : 20516 AES JOB NO : B1114

MPLE LOCATION :

SAMPLE - SCRIPTION BLACK HARD COMPACT PARTLY GRANULAR WITH FIBERS, GLUE AND BLACK MASTIC.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	< 1	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	45
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS	1	ALUMINUM	
MINERAL WOOL		BITUMEN	3
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	2	GLUE	3
ANIMAL HAIR		BINDERS	46
ANTIGORITE			

COMMENTS : BITUMEN CONTAINS 3% CHRYSOTILE.

: is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. VLAP Laboratory Code: 2033.

ICROANALYST : RB

ORESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

.IENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

.AMPLE ID : 910-1-03 AES LAB NO : 20517 AES JOB NO : B1114

MPLE LOCATION :

SAMPLE - SCRIPTION BLACK HARD COMPACT PARTLY GRANULAR WITH FIBERS, GLUE AND BLACK MASTIC.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)			
ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	40
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		OTHER COMPONENTS	
SYNTHETICS	1	ALUMINUM	
MINERAL WOOL		BITUMEN	3
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	3	GLUE	5
ANIMAL HAIR		BINDERS	48
ANTIGORITE			

COMMENTS :

: is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

CROANALYST : RB

DRESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

..IENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-2-01 AES LAB NO : 20518 AES JOB NO : B1114

MPLE LOCATION :

SAMPLE - SCRIPTION LIGHT BLUE HARD COMPACT PARTLY GRANULAR WITH FIBERS, GLUE AND BLACK MASTIC.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)			
ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	45
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		OTHER COMPONENTS	
SYNTHETICS	1	ALUMINUM	
MINERAL WOOL		BITUMEN	5
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	2	GLUE	2
ANIMAL HAIR		BINDERS	45
ANTIGORITE			

COMMENTS :

: is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : R B

..DRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-2-02 AES LAB NO : 20519 AES JOB NO : B1114

MPLE LOCATION :

SAMPLE - LIGHT BLUE HARD COMPACT PARTLY GRANULAR WITH FIBERS, GLUE AND
SCRIPTION BLACK MASTIC.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)			
ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	45
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		OTHER COMPONENTS	
SYNTHETICS	1	ALUMINUM	
MINERAL WOOL		BITUMEN	4
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	3	GLUE	2
ANIMAL HAIR		BINDERS	45
ANTIGORITE			

MMENTS :

is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. VLAP Laboratory Code: 2033.

MICROANALYST : R B

ODRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-2-03 AES LAB NO : 20520 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LIGHT BLUE HARD COMPACT PARTLY GRANULAR WITH FIBERS, GLUE AND BLACK MASTIC.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	45
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS	1	ALUMINUM	
MINERAL WOOL		BITUMEN	5
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	2	GLUE	2
ANIMAL HAIR		BINDERS	45
ANTIGORITE			

COMMENTS :

It is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : R B
RODRESH BIHALLI

QUALITY CONTROL BY : L Kuznetsov
LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

:IENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

AMPLE ID : 910-4-01 AES LAB NO : 20521 AES JOB NO : B1114

IPLE LOCATION :

AMPLE - BLACK SOFT BITUMENOUS TO VACUOUS WITH FIBERS AND PAINT.
CRIPTION

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
HRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
ROCIDOLITE		MICA	
NTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
CTINOLITE		STYROFOAM	25
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
YNTHETICS		ALUMINUM	
INERAL WOOL		BITUMEN	60
IBERGLASS	1	RESILIENT MATERIAL	
ELLULOSE	2	GLUE	
ANIMAL HAIR		BINDERS	12
NTIGORITE			

OMMENTS : PAINT INCLUDED AS BINDER.

is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. LAP Laboratory Code: 2033.

ICROANALYST : RB

RESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

AMPLE ID : 910-4-02 AES LAB NO : 20522 AES JOB NO : B1114

MPLE LOCATION :

AMPLE - BLACK SOFT BITUMENOUS TO VACUOUS WITH FIBERS AND PAINT.
SCRIPTION

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
HRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
ROCIDOLITE		MICA	
NTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
CTINOLITE		STYROFOAM	25
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
YNTHETICS		ALUMINUM	
INERAL WOOL		BITUMEN	60
FIBERGLASS	2	RESILIENT MATERIAL	
ELLULOSE	2	GLUE	
ANIMAL HAIR		BINDERS	11
NTIGORITE			

MMENTS : PAINT INCLUDED AS BINDER.

is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. LAP Laboratory Code: 2033.

ICROANALYST : R B

RESH BIHALLI

QUALITY CONTROL BY : L Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-4-03 AES LAB NO : 20523 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - BLACK SOFT BITUMENOUS TO VACUOUS WITH FIBERS AND PAINT.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	20
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	60
FIBERGLASS	2	RESILIENT MATERIAL	
CELLULOSE	2	GLUE	
ANIMAL HAIR		BINDERS	16
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

This is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : R B

SURESH BIHALLI

QUALITY CONTROL BY : L Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-5-01 AES LAB NO : 20524 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LAYERED: 1) GRAY SOFT WOVEN WITH PAINT;
2) GRAY SOFT POWDERY TO FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL	45	BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	15	GLUE	
ANIMAL HAIR		BINDERS	40
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

This is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : RB
DORESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov
LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

AMPLE ID : 910-5-02 AES LAB NO : 20525 AES JOB NO : B1114

PLE LOCATION :

AMPLE - LAYERED: 1) GRAY SOFT WOVEN WITH PAINT;
CRIPTION 2) GRAY SOFT POWDERY TO FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
HRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
ROCIDOLITE		MICA	
NTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
CTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
YNTHETICS		ALUMINUM	
MINERAL WOOL	25	BITUMEN	
IBERGLASS	5	RESILIENT MATERIAL	
ELLULOSE	25	GLUE	
ANIMAL HAIR		BINDERS	45
NTIGORITE			

OMMENTS : PAINT INCLUDED AS BINDER.

is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the nalysis of asbestos in building materials by polarized light microscopy. VLAP Laboratory Code: 2033.

CROANALYST : R B

RESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

ROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-5-03 AES LAB NO : 20526 AES JOB NO : B1114

AMPLE LOCATION :

SAMPLE - ESCRIPTION LAYERED: 1) GRAY SOFT WOVEN WITH PAINT;
2) GRAY SOFT POWDERY TO FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL	30	BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	30	GLUE	
ANIMAL HAIR		BINDERS	40
ANTIGORITE			

OMMENTS : PAINT INCLUDED AS BINDER.

It is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : RB

UDRESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

:LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

' OJECT NAME: GREAT LAKES SURVEY / 1303A.04

;AMPLE ID : 910-6-01 AES LAB NO : 20527 AES JOB NO : B1114

; MPLE LOCATION :

;AMPLE - LAYERED: 1) LIGHT BROWN SOFT WOVEN WITH PAINT;
) SCRIPTION 2) GRAY SOFT FIBROUS TO POWDERY.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	45	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	15	GLUE	
ANIMAL HAIR		BINDERS	40
ANTIGORITE			

'OMMENTS : PAINT INCLUDED AS BINDER.

t is certified by the signatures below that this laboratory is accredited y the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. VLAP Laboratory Code: 2033.

MICROANALYST : RB

..DRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-6-02 AES LAB NO : 20528 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LAYERED: 1) LIGHT BROWN SOFT WOVEN WITH PAINT;
2) GRAY SOFT WOVEN;
3) GRAY SOFT FIBROUS TO POWDERY.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	40	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS	15	RESILIENT MATERIAL	
CELLULOSE	10	GLUE	
ANIMAL HAIR		BINDERS	35
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

It is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : R B

DRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

IENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

ROJECT NAME: GREAT LAKES SURVEY / 1303A.04

MPLE ID : 910-6-03 AES LAB NO : 20529 AES JOB NO : B1114

MPLE LOCATION :

AMPLE - LAYERED: 1) LIGHT BROWN SOFT WOVEN WITH PAINT;
FSCRIPTION 2) GRAY SOFT FIBROUS TO POWDERY;
3) LIGHT BROWN SOFT FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
HRYSOTILE	35	VERMICULITE	
AMOSITE		BIOTITE	
ROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
REMOLITE		AGGREGATE/SAND	
CTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
NTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
BERGLASS		RESILIENT MATERIAL	
ELLULOSE	35	GLUE	
NIMAL HAIR		BINDERS	30
TIGORITE			

MMENTS : PAINT INCLUDED AS BINDER.

t is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the lysis of asbestos in building materials by polarized light microscopy. VLAP Laboratory Code: 2033.

OANALYST : RB

ESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

AMPLE ID : 910-7-01 AES LAB NO : 20530 AES JOB NO : B1114

IPLE LOCATION :

AMPLE - LAYERED: 1) BROWN SOFT WOVEN WITH PAINT;
SCRIPTION 2) LIGHT BROWN SOFT FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	1 - 2	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	85	GLUE	
ANIMAL HAIR		BINDERS	13 - 14
ANTIGORITE			

OMMENTS : PAINT INCLUDED AS BINDER.
LAYER #2 CONTAINS 3% CHRYSOTILE.

is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

ICROANALYST : RB

SURESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-7-02 AES LAB NO : 20531 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LAYERED: 1) BROWN SOFT WOVEN WITH PAINT;
2) LIGHT BROWN SOFT FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	1 - 2	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	85	GLUE	
ANIMAL HAIR		BINDERS	13 - 14
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.
LAYER #2 CONTAINS 3% CHRYSOTILE.

It is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : R B
ADRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov
LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

:LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-7-03 AES LAB NO : 20532 AES JOB NO : B1114

MPLE LOCATION :

MPLE - SCRIPTION LAYERED: 1) BROWN SOFT WOVEN WITH PAINT;
2) LIGHT BROWN SOFT FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	< 1	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	90	GLUE	
ANIMAL HAIR		BINDERS	10
ANTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.
LAYER #2 CONTAINS <1% CHRYSOTILE.

is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. VLAP Laboratory Code: 2033.

MICROANALYST : RB

UDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-8-01 AES LAB NO : 20533 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LAYERED: 1) GRAY SEMI-HARD WOVEN WITH PAINT;
2) LIGHT GRAY SOFT POWDERY TO FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	1 - 2	VERMICULITE	
AMOSITE	45	BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	10	GLUE	
ANIMAL HAIR		BINDERS	43 - 44
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : R B

ADRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-8-02 AES LAB NO : 20534 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LIGHT GRAY SOFT POWDERY TO FIBROUS WITH PAINT.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	5	VERMICULITE	
AMOSITE	45	BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE		GLUE	
ANIMAL HAIR		BINDERS	50
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : R B
ODRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov
LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

)JECT NAME: GREAT LAKES SURVEY / 1303A.04

AMPLE ID : 910-8-03 AES LAB NO : 20535 AES JOB NO : B1114

IPLE LOCATION :

'IPLE - LAYERED: 1) LIGHT BROWN SOFT FIBROUS WITH PAINT;
SCRIPTION 2) LIGHT GRAY SOFT POWDERY TO FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
HRYSOTILE	5	VERMICULITE	
MOSITE	45	BIOTITE	
ROCIDOLITE		MICA	
NTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
CTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
YNTHETICS		ALUMINUM	
INERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
ELLULOSE	10	GLUE	
ANIMAL HAIR		BINDERS	40
NTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.

is certified by the signatures below that this laboratory is accredited y the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. LAP Laboratory Code: 2033.

ICROANALYST : RB

DRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-9-01 AES LAB NO : 20536 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LAYERED: 1) LIGHT BROWN SEMI-HARD WOVEN WITH PAINT;
2) GRAY SOFT FIBROUS TO WOVEN WITH GLUE AND ALUMINUM.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	3
MINERAL WOOL		BITUMEN	
FIBERGLASS	5	RESILIENT MATERIAL	
CELLULOSE	70	GLUE	2
ANIMAL HAIR		BINDERS	20
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : RB

ABHIJEET BIHALLI

QUALITY CONTROL BY : LEV KUZNETSOV

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-9-02 AES LAB NO : 20537 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LIGHT GRAY SOFT WOVEN WITH GLUE AND PAINT.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)			
ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		OTHER COMPONENTS	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	85	GLUE	5
ANIMAL HAIR		BINDERS	10
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : RB

KUDRESH BIHALLI

QUALITY CONTROL BY : LEV KUZNETSOV

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

JECT NAME: GREAT LAKES SURVEY / 1303A.04

AMPLE ID : 910-9-03 AES LAB NO : 20538 AES JOB NO : B1114

PLE LOCATION :

PLE - CRIPTION LAYERED: 1) LIGHT BROWN SEMI-HARD WOVEN WITH PAINT; 2) GRAY SOFT FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
HRYSOTILE		VERMICULITE	
MOSITE		BIOTITE	
CROCIDOLITE		MICA	
NTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
CTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
INERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
ELLULOSE	80	GLUE	
ANIMAL HAIR		BINDERS	20
ANTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.

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ICROANALYST : R B

UDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-10-01 AES LAB NO : 20539 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LAYERED: 1) LIGHT BROWN SEMI-HARD WOVEN WITH PAINT;
2) GRAY SOFT FIBROUS TO POWDERY.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	70	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	10	GLUE	
ANIMAL HAIR		BINDERS	20
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : R B

RUDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-10-02 AES LAB NO : 20540 AES JOB NO : B1114

MPLE LOCATION :

MPLE - LAYERED: 1) LIGHT BROWN SEMI-HARD WOVEN WITH PAINT;
SCRIPTION 2) GRAY SOFT FIBROUS TO POWDERY.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)			
ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	70	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		OTHER COMPONENTS	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	10	GLUE	
ANIMAL HAIR		BINDERS	20
ANTIGORITE			

MMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : R B

UDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-10-03 AES LAB NO : 20541 AES JOB NO : B1114

MPLE LOCATION :

MPLE - LAYERED: 1) LIGHT BROWN SEMI-HARD WOVEN WITH PAINT;
SCRIPTION 2) GRAY SOFT FIBROUS TO POWDERY.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	70	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	10	GLUE	
ANIMAL HAIR		BINDERS	20
ANTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.

is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy.
LAP Laboratory Code: 2033.

ICROANALYST : R B

UDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-11-01 AES LAB NO : 20542 AES JOB NO : B1114

MPLE LOCATION :

MPLE - SCRIPTION LAYERED: 1) LIGHT GRAY SOFT WOVEN;
2) GRAY SOFT FIBROUS TO POWDERY.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL	35	BITUMEN	
FIBERGLASS	20	RESILIENT MATERIAL	
CELLULOSE	3	GLUE	
ANIMAL HAIR		BINDERS	42
ANTIGORITE			

MMENTS :

: is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. VLAP Laboratory Code: 2033.

MICROANALYST : R B

RUDRESH BIHALLI

QUALITY CONTROL BY : L Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

:LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

')JECT NAME: GREAT LAKES SURVEY / 1303A.04

;AMPLE ID : 910-11-02 AES LAB NO : 20543 AES JOB NO : B1114

; .IPLE LOCATION :

;' IPLE - LAYERED: 1) GRAY SOFT POWDERY TO FIBROUS WITH PAINT;
) ;CRIPTION 2) LIGHT GRAY SOFT WOVEN.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
:HRYSOTILE		VERMICULITE	
]MOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL	25	BITUMEN	
FIBERGLASS	50	RESILIENT MATERIAL	
CELLULOSE		GLUE	
ANIMAL HAIR		BINDERS	25
ANTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.

is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. LAP Laboratory Code: 2033.

ICROANALYST : R B

UDRESH BIHALLI

QUALITY CONTROL BY : L Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

:LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

:AMPLE ID : 910-11-03 AES LAB NO : 20544 AES JOB NO : B1114

:MPLE LOCATION :

:MPLE - LAYERED: 1) LIGHT GRAY SOFT WOVEN;
SCRIPTION 2) GRAY SOFT FIBROUS TO POWDERY.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL	35	BITUMEN	
FIBERGLASS	20	RESILIENT MATERIAL	
CELLULOSE	5	GLUE	
ANIMAL HAIR		BINDERS	40
ANTIGORITE			

:MMENTS :

:t is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : RB

RUDRESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

JECT NAME: GREAT LAKES SURVEY / 1303A.04

AMPLE ID : 910-12-01 AES LAB NO : 20545 AES JOB NO : B1114

PLE LOCATION :

AMPLE - LAYERED: 1) BROWN SOFT FIBROUS WITH PAINT;
CRIPTION 2) GRAY SEMI-HARD SILTY TO FIBROUS WITH MICA.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
HRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
ROCIDOLITE		MICA	3
NTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
CTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
YNTHETICS		ALUMINUM	
INERAL WOOL		BITUMEN	
FIBERGLASS	10	RESILIENT MATERIAL	
ELLULOSE	25	GLUE	
ANIMAL HAIR		BINDERS	62
NTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.

is certified by the signatures below that this laboratory is accredited the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy.
LAP Laboratory Code: 2033.

ICROANALYST : RB

DRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

:LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

)JECT NAME: GREAT LAKES SURVEY / 1303A.04

AMPLE ID : 910-12-02 AES LAB NO : 20546 AES JOB NO : B1114

IPLE LOCATION :

IPLE - LAYERED: 1) BROWN SOFT FIBROUS WITH PAINT;
CRIPTION 2) GRAY SEMI-HARD SILTY TO FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
HRYSOTILE		VERMICULITE	
MOSITE		BIOTITE	
CROCIDOLITE		MICA	
NTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
CTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
INERAL WOOL		BITUMEN	
FIBERGLASS	10	RESILIENT MATERIAL	
ELLULOSE	25	GLUE	
ANIMAL HAIR		BINDERS	65
ANTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.

: is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy.
VLAP Laboratory Code: 2033.

MICROANALYST : R B

UDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-12-03 AES LAB NO : 20547 AES JOB NO : B1114

MPLE LOCATION :

SAMPLE - LAYERED: 1) BROWN SOFT FIBROUS WITH PAINT;
SCRIPTION 2) GRAY SEMI-HARD SILTY TO FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)			
ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		OTHER COMPONENTS	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS	10	RESILIENT MATERIAL	
CELLULOSE	20	GLUE	
ANIMAL HAIR		BINDERS	70
ANTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.

is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : R B

RADHESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

:LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

: OJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-13-01 AES LAB NO : 20548 AES JOB NO : B1114

: IPLE LOCATION :

SAMPLE - LAYERED: 1) LIGHT GRAY SEMI-HARD SILTY WITH FIBERS AND PAINT;
: SCRIPTION 2) BROWN SOFT FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	40	GLUE	
ANIMAL HAIR		BINDERS	60
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

: is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : R B
ROORESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov
LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

OJECT NAME: GREAT LAKES SURVEY / 1303A.04

MPLE ID : 910-13-02 AES LAB NO : 20549 AES JOB NO : B1114

AMPLE LOCATION :

IPLE - LAYERED: 1) LIGHT GRAY SEMI-HARD SILTY WITH FIBERS AND PAINT;
CRIPTION 2) LIGHT BROWN SEMI-HARD FIBROUS WITH PAINT.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	80	GLUE	
ANIMAL HAIR		BINDERS	20
ANTIGORITE			

MMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : R B

RUDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

:LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

))JECT NAME: GREAT LAKES SURVEY / 1303A.04

:AMPLE ID : 910-13-03 AES LAB NO : 20550 AES JOB NO : B1114

:.MPLE LOCATION :

; IPLE - LAYERED: 1) LIGHT GRAY SEMI-HARD SILTY WITH FIBERS AND PAINT;
) ;CRIPTION 2) BROWN SOFT FIBROUS.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	30	GLUE	
ANIMAL HAIR		BINDERS	70
ANTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.

: is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. VLAP Laboratory Code: 2033.

MICROANALYST : RB

UDRESH BIHALLI

QUALITY CONTROL BY : LV Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

:LIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

))JECT NAME: GREAT LAKES SURVEY / 1303A.04

;AMPLE ID : 910-15-01 AES LAB NO : 20551 AES JOB NO : B1114

; IPLE LOCATION :

;-IPLE - DARK GRAY SOFT WOVEN WITH PAINT.
) ;CRIPTION

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
:HRYSOTILE		VERMICULITE	
]MOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	90	GLUE	
ANIMAL HAIR		BINDERS	10
ANTIGORITE			

MENTS : PAINT INCLUDED AS BINDER.

is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy.
LAP Laboratory Code: 2033.

ICROANALYST : R B
UDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov
LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-15-02 AES LAB NO : 20552 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - DARK GRAY SOFT WOVEN WITH PAINT.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)			
ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		OTHER COMPONENTS	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	90	GLUE	
ANIMAL HAIR		BINDERS	10
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : RB
SURESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov
LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-15-03 AES LAB NO : 20553 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - DARK GRAY SOFT WOVEN WITH PAINT.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE		VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	90	GLUE	
ANIMAL HAIR		BINDERS	10
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : R B

SANJEEVRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-16-01 AES LAB NO : 20554 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LIGHT BROWN SEMI-HARD SILTY WITH FIBERS AND PAINT.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	< 1	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	1	GLUE	
ANIMAL HAIR		BINDERS	99
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : R B

RUDRESH BIHALLI

QUALITY CONTROL BY : L. Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-16-02 AES LAB NO : 20555 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LIGHT BROWN SEMI-HARD SILTY WITH FIBERS AND PAINT.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)

ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	< 1	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		**OTHER COMPONENTS**	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	1	GLUE	
ANIMAL HAIR		BINDERS	99
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.
PICROLITE INCLUDED AS CHRYSOTILE.

It is certified by the signatures below that this laboratory is accredited by the National Institute of Standards and Technology under NVLAP for the analysis of asbestos in building materials by polarized light microscopy. NVLAP Laboratory Code: 2033.

MICROANALYST : RB

AJDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

Analytical Environmental Services, Inc.
3781 Presidential Parkway, Suite 111, Atlanta, GA 30340
TEL: (404)457-8177 FAX: (404)457-8188

CLIENT NAME : CAPE ENVIRONMENTAL MANAGEMENT, INC. DATE : 12-21-93

PROJECT NAME: GREAT LAKES SURVEY / 1303A.04

SAMPLE ID : 910-16-03 AES LAB NO : 20556 AES JOB NO : B1114

SAMPLE LOCATION :

SAMPLE DESCRIPTION - LIGHT BROWN SEMI-HARD SILTY WITH FIBERS AND PAINT.

RESULT OF BULK SAMPLE ANALYSIS (BY VISUAL VOLUMETRIC PERCENTAGE)			
ASBESTOS FIBERS		NONFIBROUS COMPONENTS	
CHRYSOTILE	< 1	VERMICULITE	
AMOSITE		BIOTITE	
CROCIDOLITE		MICA	
ANTHOPHYLLITE		PERLITE	
TREMOLITE		AGGREGATE/SAND	
ACTINOLITE		STYROFOAM	
NONASBESTOS FIBERS		OTHER COMPONENTS	
SYNTHETICS		ALUMINUM	
MINERAL WOOL		BITUMEN	
FIBERGLASS		RESILIENT MATERIAL	
CELLULOSE	2	GLUE	
ANIMAL HAIR		BINDERS	98
ANTIGORITE			

COMMENTS : PAINT INCLUDED AS BINDER.

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MICROANALYST : RB

RUDRESH BIHALLI

QUALITY CONTROL BY : Lev Kuznetsov

LEV KUZNETSOV

CAPE ENVIRONMENTAL MANAGEMENT INC
91 Noll Street, Waukegan, Illinois 60085
847/336-4341 FAX: 847/336-4971

LABORATORY NAME:	
CAPE PROJECT MANAGER: Kurt Gates	
CAPE JOB NAME: Bld 910 Great Lakes	CAPE JOB NUMBER: 150/A.099.000
ANALYSIS REQUESTED: PLM	CLIENT NAME:
TURNAROUND TIME REQUESTED: RUSH	
SPECIAL INSTRUCTIONS: Results to kurt	

SAMPLE ID	SAMPLE DESCRIPTION/LOCATION
1. R 910-1-1	
2. R 910-1-2	
3. R 910-1-3	
4. R 910-2-1	
5. R 910-3-1	
6. R 910-4-1	
7. R 910-5-1	
8. R 910-6-1	
9. R 910-7-1	
10. R 910 7-2	
11. R 910 7-3	
12. R 910-8-1	
13. R 910-8-2	
14. R 910-8-3	
15. R 910-9-1	
16. R 910-9-2	
17. R 910-9-3	
18. R 910-10-1	
19. R 910-10-2	
20. R 910-10-3	
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36.	
37.	

RELINQUISHED BY: [signature]		RECEIVED BY: [signature]		
DATE: 11/12/98	TIME: 4:00	DATE: 11/13/98	TIME: 10:30	
RELINQUISHED BY:		RECEIVED BY:		
DATE:	TIME:	DATE:	TIME:	

CAPE ENVIRONMENTAL MANAGEMENT INC

TEL: (770) 908-7200 FAX: (770) 908-7219

PLM ANALYSIS SUMMARY

for quick reference on asbestos content

CLIENT NAME: NAVY SOUTH DIVISION

PROJECT NAME: GREAT LAKES BLDG. 910

PROJECT NO: 1501A.099.000

LAB JOB NO: B8277

DATE RCVD: 11/13/98

	SAMPLE LAB ID	SAMPLE FIELD ID	LAYER NUMBER	APPEARANCE	LOCATION / DESCIRPTION	% ASBESTOS (COMMENTS)
1	814738	R910-1-1		YELLOW SOFT VACUOUS WITH RESILIENT PAINT		-
2	814739	R910-1-2		YELLOW SOFT VACUOUS WITH RESILIENT PAINT		-
3	814740	R910-1-3		YELLOW SOFT VACUOUS WITH RESILIENT PAINT		-
4	814741	R910-2-1		BLACK SEMI-HARD BITUMINOUS TO FIBROUS WITH AGGREGATES		-
5	814742	R910-3-1		GRAY HARD CEMENTITIOUS TO FIBROUS WITH PAINT		30%CHR
6	814743-1	R910-4-1	1 (of 2)	BLUE HARD RESILIENT TO GRANULAR WITH FIBERS		-
7	814743-2	R910-4-1	2 (of 2)	BLACK SOFT BITUMINOUS WITH FIBERS		-
8	814744-1	R910-5-1	1 (of 3)	BLACK SOFT BITUMINOUS WITH FIBERS		<1%CHR
9	814744-2	R910-5-1	2 (of 3)	GREEN HARD RESILIENT TO GRANULAR WITH FIBERS		3%CHR
10	814744-3	R910-5-1	3 (of 3)	BLACK SOFT BITUMINOUS WITH FIBERS		3%CHR
11	814745	R910-6-1	1+2 (of 2)	1. GRAY HARD RESILIENT TO GRANULAR; 2. BLACK SOFT BITUMINOUS WITH FIBERS		-
12	814746	R910-7-1		GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT		-
13	814747	R910-7-2		GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT		-
14	814748	R910-7-3		GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT		-

"-" = NO ASBESTOS DETECTED

These results are provided before full QC is completed and therefore could be changed. Use signed copies of anlayses reports as final results

ENVIRONMENTAL MANAGEMENT INC

TEL: (770) 908-7200 FAX: (770) 908-7219

PLM ANALYSIS SUMMARY

for quick reference on asbestos content

CLIENT NAME: NAVY SOUTH DIVISION

PROJECT NAME: GREAT LAKES BLDG. 910

PROJECT NO: 1501A.099.000

LAB JOB NO: B8277

DATE RCVD: 11/13/98

	SAMPLE LAB ID	SAMPLE FIELD ID	LAYER NUMBER	APPEARANCE	LOCATION / DESCIRPTION	% ASBESTOS (COMMENTS)
15	814749	R910-8-1		GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT		-
16	814750	R910-8-2		GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT		-
17	814751	R910-8-3		GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT		-
18	814752-1	R910-9-1	1 (of 2)	YELLOW HARD SILTY		-
19	814752-2	R910-9-1	2 (of 2)	GRAY SOFT FIBROUS TO GRANULAR TO POWDERY ~~WITH PAINT~~		-
20	814753-1	R910-9-2	1 (of 2)	YELLOW HARD SILTY		-
21	814753-2	R910-9-2	2 (of 2)	GRAY SOFT FIBROUS TO GRANULAR TO POWDERY ~~WITH PAINT~~		-
22	814754-1	R910-9-3	1 (of 2)	YELLOW HARD SILTY		-
23	814754-2	R910-9-3	2 (of 2)	GRAY SOFT FIBROUS TO GRANULAR TO POWDERY ~~WITH PAINT~~		-
24	814755	R910-10-1		GRAY SOFT POWDERY TO FIBROUS WITH CANVAS AND PAINT		-
25	814756	R910-10-2		GRAY SOFT POWDERY TO FIBROUS WITH CANVAS AND PAINT		-
26	814757	R910-10-3		GRAY SOFT POWDERY TO FIBROUS WITH CANVAS AND PAINT		-

"-" = NO ASBESTOS DETECTED

'hese results are provided before full QC is completed and therefore could be changed. Use signed copies of anlayses reports as final results

C A P E
ENVIRONMENTAL
MANAGEMENT
I N C

2302 PARKLAKE DRIVE, SUITE 200, ATLANTA, GA 30345
TEL: (770) 908-7200 FAX: (770) 908-7219

NVLAP®
ACCREDITED
LAB CODE - 102111

POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME: NAVY SOUTH DIVISION
PROJECT NAME: GREAT LAKES BLDG. 910
PROJECT NO: 1501A.099.000

LAB JOB NO: B8277
DATE RECEIVED: 11/13/98
REPORT ISSUED: 11/13/98

SAMPLE FIELD ID: R910-1-1
SAMPLE INFO:

LAB ID: 814738
DATE ANALYZED: 11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: YELLOW SOFT VACUOUS WITH RESILIENT PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM	90	VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
FOR ALL HETEROGENEOUS AND LAYERED SAMPLES EASILY SEPARATED INTO SUBLAYERS, EACH LAYER IS ANALYZED SEPARATELY.

ANALYST
ALEKSEY REZNIK

QUALITY CONTROL
MICHAEL BLACK

PLM IS NOT CONSISTENTLY RELIABLE IN DETECTING SMALL CONCENTRATION OF ASBESTOS IN FLOOR TILES AND SIMILAR NONFRIABLE MATERIALS, QUANTITATIVE TEM IS CURRENTLY THE ONLY METHOD THAT CAN BE USED TO GET THE CONCLUSIVE ASBESTOS CONTENT. THIS REPORT RELATES ONLY TO THE ITEMS TESTED. THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, AND NOT WITHOUT WRITTEN APPROVAL OF THE LABORATORY. THIS REPORT SHALL NOT BE USED TO CLAIM ENDORSEMENT BY NVLAP OR ANY AGENCY OF U.S. GOVERMENT.

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LAB CODE - 102111

POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME: NAVY SOUTH DIVISION
PROJECT NAME: GREAT LAKES BLDG. 910
PROJECT NO: 1501A.099.000

LAB JOB NO: B8277
DATE RECEIVED: 11/13/98
REPORT ISSUED: 11/13/98

SAMPLE FIELD ID: R910-1-2
SAMPLE INFO:

LAB ID: 814739
DATE ANALYZED: 11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: YELLOW SOFT VACUOUS WITH RESILIENT PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM	90	VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
FOR ALL HETEROGENEOUS AND LAYERED SAMPLES EASILY SEPARATED INTO SUBLAYERS, EACH LAYER IS ANALYZED SEPARATELY.

ANALYST

ALEKSEY REZNIK

QUALITY CONTROL

MICHAEL BLACK

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME: NAVY SOUTH DIVISION
PROJECT NAME: GREAT LAKES BLDG. 910
PROJECT NO: 1501A.099.000

LAB JOB NO: B8277
DATE RECEIVED: 11/13/98
REPORT ISSUED: 11/13/98

SAMPLE FIELD ID: R910-1-3
SAMPLE INFO:

LAB ID: 814740
DATE ANALYZED: 11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: YELLOW SOFT VACUOUS WITH RESILIENT PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM	90	VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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ANALYST
ALEKSEY REZNIK

QUALITY CONTROL
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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-2-1	LAB ID:	814741
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: BLACK SEMI-HARD BITUMINOUS TO FIBROUS WITH AGGREGATES

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	60
AMOSITE		GLASS FIBERS	3	PERLITE		SAND/AGGR.	20
CROCIDOLITE		SYNTHETICS	7	EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-3-1	LAB ID:	814742
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED:	NO
APPEARANCE:	GRAY HARD CEMENTITIOUS TO FIBROUS WITH PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE	30	CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	5
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	65

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-4-1	LAB ID:	814743-1
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES	LAYER NO: 1	NO. OF LAYERS: * 2
APPEARANCE: BLUE HARD RESILIENT TO GRANULAR WITH FIBERS		

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	5	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	30
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	65

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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ANALYST

ALEKSEY REZNIK

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-4-1	LAB ID:	814743-2
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES LAYER NO: 2 NO. OF LAYERS: * 2

APPEARANCE: BLACK SOFT BITUMINOUS WITH FIBERS

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	5	VERMICULITE/MICA		BITUMEN/TAR	90
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	5

COMMENTS:

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-5-1	LAB ID:	814744-1
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES LAYER NO: 1 NO. OF LAYERS: * 3

APPEARANCE: BLACK SOFT BITUMINOUS WITH FIBERS

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE	<1	CELLULOSE	5	VERMICULITE/MICA		BITUMEN/TAR	90
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	5

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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ANALYST

ALEKSEY REZNIK

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-5-1	LAB ID:	814744-2
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES LAYER NO: 2 NO. OF LAYERS: * 3

APPEARANCE: GREEN HARD RESILIENT TO GRANULAR WITH FIBERS

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE	3	CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	30
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	67

COMMENTS:

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-5-1	LAB ID:	814744-3
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES	LAYER NO: 3	NO. OF LAYERS: * 3
APPEARANCE: BLACK SOFT BITUMINOUS WITH FIBERS		

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE	3	CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	90
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	7

COMMENTS:

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-6-1	LAB ID:	814745
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES	LAYER NO: 1+2	NO. OF LAYERS: * 2	
APPEARANCE:	1. GRAY HARD RESILIENT TO GRANULAR; 2. BLACK SOFT BITUMINOUS WITH FIBERS		

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	1	VERMICULITE/MICA		BITUMEN/TAR	3
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	35
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	61

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
FOR ALL HETEROGENEOUS AND LAYERED SAMPLES EASILY SEPARATED INTO SUBLAYERS, EACH LAYER IS ANALYZED SEPARATELY.
* NO OF LAYERS - INDICATES NUMBER OF SUBSAMPLES ANALYZED AND REPORTS ISSUED (UNLESS COMPOSITED).

ANALYST

ALEKSEY REZNIK

QUALITY CONTROL

MICHAEL BLACK

PLM IS NOT CONSISTENTLY RELIABLE IN DETECTING SMALL CONCENTRATION OF ASBESTOS IN FLOOR TILES AND SIMILAR NONFRIABLE MATERIALS, QUANTITATIVE TEM IS CURRENTLY THE ONLY METHOD THAT CAN BE USED TO GET THE CONCLUSIVE ASBESTOS CONTENT. THIS REPORT RELATES ONLY TO THE ITEMS TESTED. THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, AND NOT WITHOUT WRITTEN APPROVAL OF THE LABORATORY. THIS REPORT SHALL NOT BE USED TO CLAIM ENDORSEMENT BY NVLAP OR ANY AGENCY OF U.S. GOVERMENT.

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-7-1	LAB ID:	814746
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	30	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	30	PERLITE	30	SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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ANALYST

ALEKSEY REZNIK

QUALITY CONTROL

MICHAEL BLACK

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME: NAVY SOUTH DIVISION
PROJECT NAME: GREAT LAKES BLDG. 910
PROJECT NO: 1501A.099.000

LAB JOB NO: B8277
DATE RECEIVED: 11/13/98
REPORT ISSUED: 11/13/98

SAMPLE FIELD ID: R910-7-2
SAMPLE INFO:

LAB ID: 814747
DATE ANALYZED: 11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	30	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	30	PERLITE	30	SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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ANALYST
ALEKSEY REZNIK

QUALITY CONTROL
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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-7-3	LAB ID:	814748
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	30	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	30	PERLITE	30	SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-8-1	LAB ID:	814749
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED:	NO
APPEARANCE:	GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	30	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	30	PERLITE	30	SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-8-2	LAB ID:	814750
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	30	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	30	PERLITE	30	SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-8-3	LAB ID:	814751
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: GRAY SOFT FIBROUS TO GRANULAR TO POWDERY WITH PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	30	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	30	PERLITE	30	SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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ANALYST

ALEKSEY REZNIK

QUALITY CONTROL:

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-9-1	LAB ID:	814752-1
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES	LAYER NO: 1	NO. OF LAYERS: * 2
APPEARANCE: YELLOW HARD SILTY		

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	900
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	-800

COMMENTS:

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ANALYST

ALEKSEY REZNIK

QUALITY CONTROL

MICHAEL BLACK

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-9-1	LAB ID:	814752-2
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES LAYER NO: 2 NO. OF LAYERS: * 2

APPEARANCE: GRAY SOFT FIBROUS TO GRANULAR TO POWDERY

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	30	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	30	PERLITE	30	SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

SAMPLE WAS ANALYZED BY PLM USING DISPERSION STAINING TECHNIQUES IN ACCORDANCE WITH U.S. EPA METHOD 40CFR Ch. I (7-1-92) PT. 763, SUBPT. F, APP. A. LAST CALIBRATION OF EQUIPMENT WAS PERFORMED ON: 11/13/98
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ANALYST

ALEKSEY REZNIK

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-9-2	LAB ID:	814753-1
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES	LAYER NO: 1	NO. OF LAYERS: * 2
APPEARANCE: YELLOW HARD SILTY		

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	90
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

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ANALYST

ALEKSEY REZNIK

QUALITY CONTROL

MICHAEL BLACK

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LAB CODE - 102111

POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-9-2	LAB ID:	814753-2
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES LAYER NO: 2 NO. OF LAYERS: * 2

APPEARANCE: GRAY SOFT FIBROUS TO GRANULAR TO POWDERY

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	30	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	30	PERLITE	30	SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-9-3	LAB ID:	814754-1
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES	LAYER NO: 1	NO. OF LAYERS: * 2
APPEARANCE: YELLOW HARD SILTY		

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE		VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS		PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	90
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-9-3	LAB ID:	814754-2
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: YES	LAYER NO: 2	NO. OF LAYERS: * 2
APPEARANCE: GRAY SOFT FIBROUS TO GRANULAR TO POWDERY		

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	30	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	30	PERLITE	30	SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	10

COMMENTS:

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POLARIZED LIGHT MICROSCOPY (PLM)
BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-10-2	LAB ID:	814756
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: GRAY SOFT POWDERY TO FIBROUS WITH CANVAS AND PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	10	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	10	PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	80

COMMENTS:

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BULK SAMPLE ANALYSIS REPORT

CLIENT NAME:	NAVY SOUTH DIVISION	LAB JOB NO:	B8277
PROJECT NAME:	GREAT LAKES BLDG. 910	DATE RECEIVED:	11/13/98
PROJECT NO:	1501A.099.000	REPORT ISSUED:	11/13/98
SAMPLE FIELD ID:	R910-10-3	LAB ID:	814757
SAMPLE INFO:		DATE ANALYZED:	11/13/98

SAMPLE DESCRIPTION

LAYERED: NO

APPEARANCE: GRAY SOFT POWDERY TO FIBROUS WITH CANVAS AND PAINT

RESULT OF ANALYSIS IN VOLUME PERCENTAGE (BY VISUAL ESTIMATE)

ASBESTOS FIBERS		NONASBESTOS FIBERS		NONFIBROUS COMPONENTS		OTHER COMPONENTS	
CHRYSOTILE		CELLULOSE	10	VERMICULITE/MICA		BITUMEN/TAR	
AMOSITE		GLASS FIBERS	10	PERLITE		SAND/AGGR.	
CROCIDOLITE		SYNTHETICS		EXPANDED GLASS		GLUE/CAULK	
TREMOLITE		WOLLASTONITE		SYNTHETIC FOAM		VINYL	
ACTINOLITE		TALC		ALUMINUM/METAL		CORK	
ANTHOPHYLLITE				FOAM RUBBER		LATEX/RUBBER	
						BINDERS/PAINT	80

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Appendix F

State of Illinois A 86367
Department of Public Health

LICENSE, PERMIT, CERTIFICATION, REGISTRATION

ASBESTOS PROFESSIONAL LICENSE

EXPIRATION DATE	CATEGORY	I.D. NUMBER
05/15/99	5319	100-3516

NICKOLAS ERIGLIO

MANAGEMENT PLANN
PROJECT MANAGER
INSPECTOR AIR SAMPLING PROFESSION

State of Illinois A 86261
Department of Public Health

LICENSE, PERMIT, CERTIFICATION, REGISTRATION

The person, firm or corporation whose name appears on this certificate has complied with the provisions of the Illinois Statutes and/or rules and regulations and is hereby authorized to engage in the activity as indicated below.

JOHN R. LUMPKIN, M.D.
DIRECTOR

Issued under the authority of
The State of Illinois
Department of Public Health

EXPIRATION DATE	CATEGORY	I.D. NUMBER
05/15/99	5319	100-0269

KURT GATES

MANAGEMENT PLANNER
PROJECT DESIGNER PROJECT MANAGER
INSPECTOR AIR SAMPLING PROFESSIONAL

BUSINESS ADDRESS

ALTERING THIS CERTIFICATE MAY RESULT IN LEGAL ACTION

KURT GATES
6949 MORGAN COURT
GURNEE IL 60031

THIS LICENSE IS NOT VALID IF YOUR IDPH
REFRESHER COURSE CERTIFICATE IS NOT CURRENT

Printed by Authority of the State of Illinois ● 2/91 ●

United States Department of Commerce
National Institute of Standards and Technology

NVLAP

Certificate of Accreditation

ANALYTICAL ENVIRONMENTAL SERVICES, INC.
ATLANTA, GA

is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 7 Code of Federal Regulations. Accreditation is awarded for specific services, listed on the Scope of Accreditation, for:

BULK ASBESTOS FIBER ANALYSIS

October 1, 1994
Effective until

DEPARTMENT OF COMMERCE • UNITED STATES OF AMERICA

For the National Institute of Standards and Technology

NVLAP LAB CODE: 2033

AUG 02 '94 03:17PM ANALYTICAL ENVIRONMENTAL SERVICE P.3/3

United States Department of Commerce
National Institute of Standards and Technology

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ISO/IEC GUIDE 25:1990
ISO 9002:1987

Certificate of Accreditation

DEPARTMENT OF COMMERCE ★ UNITED STATES OF AMERICA ★

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BULK ASBESTOS FIBER ANALYSIS

June 30, 1999

Effective through

For the National Institute of Standards and Technology

NVLAP Lab Code: 102111-0

NVLAP-01C (11-95)

United States
Environmental Protection
Agency

Office of Water
Office of Science and Technology
(4304T)

2009

National Recommended Water Quality Criteria

View this document online at http://water.epa.gov/scitech/swguidance/standards/current/

Priority Pollutants

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
1	Antimony	7440360					5.6 B	640 B	65 FR 66443
2	Arsenic	7440382	340 A,D,K	150 A,D,K	69 A,D,bb	36 A,D,bb	0.018 C,M,S	0.14 C,M,S	65 FR 31682 57 FR 60848
3	Beryllium	7440417					Z		65 FR 31682
4	Cadmium	7440439	2.0 D,E,K,bb	0.25 D,E,K,bb	40 D,bb	8.8 D,bb	Z		EPA 822R-01-001 65 FR 31682
5a	Chromium (III)	16065831	570 D,E,K	74 D,E,K			Z Total		EPA 820B-96-001 65 FR 31682
5b	Chromium (VI)	18540299	16 D,K	11 D,K	1,100 D,bb	50 D,bb	Z Total		65 FR 31682
6	Copper	7440508	Freshwater criteria calculated using the BLM mm - See Document (epa.gov/waterscience/criteria/copper/)		4.8 D,cc,ff	3.1 D,cc,ff	1,300 U		EPA-822-R-07-001 65 FR 31682 72 FR 7983
7	Lead	7439921	65 D,E,bb,gg	2.5 D,E,bb,gg	210 D,bb	8.1 D,bb			65 FR 31682
8a	Mercury	7439976	1.4 D,K,hh	0.77 D,K,hh	1.8 D,ee,hh	0.94 D,ee,hh			62 FR 42160
8b	Methylmercury	22967926						0.3 mg/kg J	EPA 823R-01-001
9	Nickel	7440020	470 D,E,K	52 D,E,K	74 D,bb	8.2 D,bb	610 B	4,600 B	65 FR 31682
10	Selenium	7782492	L,R,T	5.0 T	290 D,bb,dd	71 D,bb,dd	170 Z	4200	62 FR 42160 65 FR 31682 65 FR 66443

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
11	Silver	7440224	3.2 D,E,G		1.9 D,G				65 FR 31682
12	Thallium	7440280					0.24	0.47	68 FR 75510
13	Zinc	7440666	120 D,E,K	120 D,E,K	90 D,bb	81 D,bb	7,400 U	26,000 U	65 FR 31682 65 FR 66443
14	Cyanide	57125	22 K,Q	5.2 K,Q	1 Q,bb	1 Q,bb	140 jj	140 jj	EPA 820B-96001 57 FR 60848 68 FR 75510
15	Asbestos	1332214					7 million fibers/L I		57 FR 60848
16	2,3,7,8-TCDD (Dioxin)	1746016					5.0E-9 C	5.1E-9 C	65 FR 66443
17	Acrolein	107028	3ug/L	3ug/L			6 II	9 II	74 FR 27535 74 FR 46587
18	Acrylonitrile	107131					0.051 B,C	0.25 B,C	65 FR 66443
19	Benzene	71432					2.2 B,C	51 B,C	IRIS 01/19/00 65 FR 66443
20	Bromoform	75252					4.3 B,C	140 B,C	65 FR 66443
21	Carbon Tetrachloride	56235					0.23 B,C	1.6 B,C	65 FR 66443
22	Chlorobenzene	108907					130 Z,U	1,600 U	68 FR 75510
23	Chlorodibromomethane	124481					0.40 B,C	13 B,C	65 FR 66443
24	Chloroethane	75003							
25	2-Chloroethylvinyl Ether	110758							
26	Chloroform	67663					5.7 C,P	470 C,P	62 FR 42160

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
27	Dichlorobromomethane	75274					0.55 B,C	17 B,C	65 FR 66443
28	1,1-Dichloroethane	75343							
29	1,2-Dichloroethane	107062					0.38 B,C	37 B,C	65 FR 66443
30	1,1-Dichloroethylene	75354					330	7,100	68 FR 75510
31	1,2-Dichloropropane	78875					0.50 B,C	15 B,C	65 FR 66443
32	1,3-Dichloropropene	542756					0.34 C	21 C	68 FR 75510
33	Ethylbenzene	100414					530	2,100	68 FR 75510
34	Methyl Bromide	74839					47 B	1,500 B	65 FR 66443
35	Methyl Chloride	74873							65 FR 31682
36	Methylene Chloride	75092					4.6 B,C	590 B,C	65 FR 66443
37	1,1,2,2-Tetrachloroethane	79345					0.17 B,C	4.0 B,C	65 FR 66443
38	Tetrachloroethylene	127184					0.69 C	3.3 C	65 FR 66443
39	Toluene	108883					1,300 Z	15,000	68 FR 75510
40	1,2-Trans-Dichloroethylene	156605					140 Z	10,000	68 FR 75510
41	1,1,1-Trichloroethane	71556					Z		65 FR 31682
42	1,1,2-Trichloroethane	79005					0.59 B,C	16 B,C	65 FR 66443
43	Trichloroethylene	79016					2.5 C	30 C	65 FR 66443
44	Vinyl Chloride	75014					0.025 C,kk	2.4 C,kk	68 FR 75510
45	2-Chlorophenol	95578					81 B,U	150 B,U	65 FR 66443

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
46	2,4-Dichlorophenol	120832					77 B,U	290 B,U	65 FR 66443
47	2,4-Dimethylphenol	105679					380 B	850 B,U	65 FR 66443
48	2-Methyl-4,6Dinitrophenol	534521					13	280	65 FR 66443
49	2,4-Dinitrophenol	51285					69 B	5,300 B	65 FR 66443
50	2-Nitrophenol	88755							
51	4-Nitrophenol	100027							
52	3-Methyl-4-Chlorophenol	59507					U	U	
53	Pentachlorophenol	87865	19 F,K	15 F,K	13 bb	7.9 bb	0.27 B,C	3.0 B,C,H	65 FR 31682
54	Phenol	108952					10,000 ll,U	860,000 ll,U	74 FR 27535
55	2,4,6-Trichlorophenol	88062					1.4 B,C	2.4 B,C,U	65 FR 66443
56	Acenaphthene	83329					670 B,U	990 B,U	65 FR 66443
57	Acenaphthylene	208968							65 FR 66443
58	Anthracene	120127					8,300 B	40,000 B	65 FR 66443
59	Benzidine	92875					0.000086 B,C	0.00020 B,C	65 FR 66443
60	Benzo(a) Anthracene	56553					0.0038 B,C	0.018 B,C	65 FR 66443
61	Benzo(a) Pyrene	50328					0.0038 B,C	0.018 B,C	65 FR 66443
62	Benzo(b) Fluoranthene	205992					0.0038 B,C	0.018 B,C	65 FR 66443
63	Benzo(ghi) Perylene	191242							65 FR 66443
64	Benzo(k) Fluoranthene	207089					0.0038 B,C	0.018 B,C	65 FR 66443

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
65	Bis(2-Chloroethoxy) Methane	111911							
66	Bis(2-Chloroethyl) Ether	111444					0.030 B,C	0.53 B,C	65 FR 66443
67	Bis(2-Chloroisopropyl) Ether	108601					1,400 B	65,000 B	65 FR 66443
68	Bis(2-Ethylhexyl) Phthalatex	117817					1.2 B,C	2.2 B,C	65 FR 66443
69	4-Bromophenyl Phenyl Ether	101553							
70	Butylbenzyl Phthalatew	85687					1,500 B	1,900 B	65 FR 66443
71	2-Chloronaphthalene	91587					1,000 B	1,600 B	65 FR 66443
72	4-Chlorophenyl Phenyl Ether	7005723							
73	Chrysene	218019					0.0038 B,C	0.018 B,C	65 FR 66443
74	Dibenzo(a,h)Anthracene	53703					0.0038 B,C	0.018 B,C	65 FR 66443
75	1,2-Dichlorobenzene	95501					420	1,300	68 FR 75510
76	1,3-Dichlorobenzene	541731					320	960	65 FR 66443
77	1,4-Dichlorobenzene	106467					63	190	68 FR 75510
78	3,3'-Dichlorobenzidine	91941					0.021 B,C	0.028 B,C	65 FR 66443
79	Diethyl Phthalatew	84662					17,000 B	44,000 B	65 FR 66443
80	Dimethyl Phthalatew	131113					270,000	1,100,000	65 FR 66443
81	Di-n-Butyl Phthalatew	84742					2,000 B	4,500 B	65 FR 66443
82	2,4-Dinitrotoluene	121142					0.11 C	3.4 C	65 FR 66443
83	2,6-Dinitrotoluene	606202							

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
84	Di-n-Octyl Phthalate	117840							
85	1,2-Diphenylhydrazine	122667					0.036 B,C	0.20 B,C	65 FR 66443
86	Fluoranthene	206440					130 B	140 B	65 FR 66443
87	Fluorene	86737					1,100 B	5,300 B	65 FR 66443
88	Hexachlorobenzene	118741					0.00028 B,C	0.00029 B,C	65 FR 66443
89	Hexachlorobutadiene	87683					0.44 B,C	18 B,C	65 FR 66443
90	Hexachlorocyclopentadiene	77474					40 U	1,100 U	68 FR 75510
91	Hexachloroethane	67721					1.4 B,C	3.3 B,C	65 FR 66443
92	Ideno(1,2,3-cd)Pyrene	193395					0.0038 B,C	0.018 B,C	65 FR 66443
93	Isophorone	78591					35 B,C	960 B,C	65 FR 66443
94	Naphthalene	91203							
95	Nitrobenzene	98953					17 B	690 B,H,U	65 FR 66443
96	N-Nitrosodimethylamine	62759					0.00069 B,C	3.0 B,C	65 FR 66443
97	N-Nitrosodi-n-Propylamine	621647					0.0050 B,C	0.51 B,C	65 FR 66443
98	N-Nitrosodiphenylamine	86306					3.3 B,C	6.0 B,C	65 FR 66443
99	Phenanthrene	85018							
100	Pyrene	129000					830 B	4,000 B	65 FR 66443
101	1,2,4-Trichlorobenzene	120821					35	70	68 FR 75510

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
102	Aldrin	309002	3.0 G		1.3 G		0.000049 B,C	0.000050 B,C	65 FR 31682 65 FR 66443
103	alpha-BHC	319846					0.0026 B,C	0.0049 B,C	65 FR 66443
104	beta-BHC	319857					0.0091 B,C	0.017 B,C	65 FR 66443
105	gamma-BHC (Lindane)	58899	0.95 K		0.16 G		0.98	1.8	65 FR 31682 68 FR 75510
106	delta-BHC	319868							
107	Chlordane	57749	2.4 G	0.0043 G,aa	0.09 G	0.004 G,aa	0.00080 B,C	0.00081 B,C	65 FR 31682 65 FR 66443
108	4,4'-DDT	50293	1.1 G,ii	0.001 G,aa,ii	0.13 G,ii	0.001 G,aa,ii	0.00022 B,C	0.00022 B,C	65 FR 31682 65 FR 66443
109	4,4'-DDE	72559					0.00022 B,C	0.00022 B,C	65 FR 66443
110	4,4'-DDD	72548					0.00031 B,C	0.00031 B,C	65 FR 66443
111	Dieldrin	60571	0.24 K	0.056 K,O	0.71 G	0.0019 G,aa	0.000052 B,C	0.000054 B,C	65 FR 31682 65 FR 66443
112	alpha-Endosulfan	959988	0.22 G,Y	0.056 G,Y	0.034 G,Y	0.0087 G,Y	62 B	89 B	65 FR 31682 65 FR 66443
113	beta-Endosulfan	33213659	0.22 G,Y	0.056 G,Y	0.034 G,Y	0.0087 G,Y	62 B	89 B	65 FR 31682 65 FR 66443
114	Endosulfan Sulfate	1031078					62 B	89 B	65 FR 66443
115	Endrin	72208	0.086 K	0.036 K,O	0.037 G	0.0023 G,aa	0.059	0.060	65 FR 31682 68 FR 75510
116	Endrin Aldehyde	7421934					0.29 B	0.30 B,H	65 FR 66443
117	Heptachlor	76448	0.52 G	0.0038 G,aa	0.053 G	0.0036 G,aa	0.000079 B,C	0.000079 B,C	65 FR 31682 65 FR 66443

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC 1 (acute) (µg/L)	CCC 1 (chronic) (µg/L)	CMC 1 (acute) (µg/L)	CCC 1 (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
118	Heptachlor Epoxide	1024573	0.52 G,V	0.0038 G,V,aa	0.053 G,V	0.0036 G,V,aa	0.000039 B,C	0.000039 B,C	65 FR 31682 65 FR 66443
119	Polychlorinated Biphenyls (PCBs)			0.014 N,aa		0.03 N,aa	0.000064 B,C,N	0.000064 B,C,N	65 FR 31682 65 FR 66443
120	Toxaphene	8001352	0.73	0.0002 aa	0.21	0.0002 aa	0.00028 B,C	0.00028 B,C	65 FR 31682 65 FR 66443

Footnotes

A This recommended water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic, which might imply that arsenic (III) and arsenic (V) are equally toxic to aquatic life and that their toxicities are additive. In the arsenic criteria document (PDF) (74 pp., 3.2 MB) (EPA 440/5-84-033, January 1985), Species Mean Acute Values are given for both arsenic (III) and arsenic (V) for five species and the ratios of the SMAVs for each species range from 0.6 to
1.7. Chronic values are available for both arsenic (III) and arsenic (V) for one species; for the fathead minnow, the chronic value for arsenic (V) is 0.29 times the chronic value for arsenic (III). No data are known to be available concerning whether the toxicities of the forms of arsenic to aquatic organisms are additive.

B This criterion has been revised to reflect The Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of May 17, 2002. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.

C This criterion is based on carcinogenicity of 10^{-6} risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10^{-5}, move the decimal point in the recommended criterion one place to the right).

D Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. The recommended water quality criteria value was calculated by using the previous 304(a) aquatic life criteria expressed in terms of total recoverable metal, and multiplying it by a conversion factor (CF). The term "Conversion Factor" (CF) represents the recommended conversion factor for converting a metal criterion expressed as the total recoverable fraction in the water column to a criterion expressed as the dissolved fraction in the water column. (Conversion Factors for saltwater CCCs are not currently available. Conversion factors derived for saltwater CMCs have been used for both saltwater CMCs and CCCs). See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria (PDF)," (49 pp., 3MB) October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available from the Water Resource center and 40CFR§131.36(b)(1). Conversion Factors applied in the table can be found in Appendix A to the Preamble-Conversion Factors for Dissolved Metals.

E The freshwater criterion for this metal is expressed as a function of hardness (mg/L) in the water column. The value given here corresponds to a hardness of 100 mg/L. Criteria values for other hardness may be calculated from the following: CMC (dissolved) = $\exp\{m_A [\ln(\text{hardness})] + b_A\}$ (CF), or CCC (dissolved) = $\exp\{m_C [\ln(\text{hardness})] + b_C\}$ (CF)

and the parameters specified in Appendix B-Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent.

F Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH, and are calculated as follows: CMC = exp(1.005(pH)-4.869); CCC = exp(1.005(pH)-5.134). Values displayed in table correspond to a pH of 7.8.

G This Criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (PDF) (153 pp., 7.3 MB) (EPA 440/5-80-019), Chlordane (PDF) (68 pp., 3.1 MB) (EPA 440/5-80-027), DDT (PDF) (175 pp., 8.3 MB) (EPA 440/5-80-038), Endosulfan (PDF) (155 pp., 7.3 MB) (EPA 440/5-80-046), Endrin (PDF) (103 pp., 4.6 MB) (EPA 440/5-80-047), Heptachlor (PDF) (114 pp., 5.4 MB) (EPA 440/5-80-052), Hexachlorocyclohexane (PDF) (109 pp., 4.8 MB) (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines (PDF) (104 pp., 3.3 MB) . For example, a "CMC" derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

H No criterion for protection of human health from consumption of aquatic organisms excluding water was presented in the 1980 criteria document or in the *1986 Quality Criteria for Water*. Nevertheless, sufficient information was presented in the 1980 document to allow the calculation of a criterion, even though the results of such a calculation were not shown in the document.

I This criterion for asbestos is the Maximum Contaminant Level (MCL) developed under the Safe Drinking Water Act (SDWA).

J This fish tissue residue criterion for methylmercury is based on a total fish consumption rate of 0.0175 kg/day.

K This recommended criterion is based on a 304(a) aquatic life criterion that was issued in the 1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water, (EPA 820-B-96-001, September 1996). This value was derived using the GLI Guidelines (60 FR 15393-15399, March 23, 1995; 40CFR132 Appendix A); the difference between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. None of the decisions concerning the derivation of this criterion were affected by any considerations that are specific to the Great Lakes.

L The CMC = 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 g/l and 12.82 g/l, respectively.

M EPA is currently reassessing the criteria for arsenic.

N This criterion applies to total pcbs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses.)

O The derivation of the CCC for this pollutant (Endrin) did not consider exposure through the diet, which is probably important for aquatic life occupying upper trophic levels.

P Although a new RfD is available in IRIS, the surface water criteria will not be revised until the National Primary Drinking Water Regulations: Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) is completed, since public comment on the relative source contribution (RSC) for chloroform is anticipated.

Q This recommended water quality criterion is expressed as g free cyanide (as CN)/L.

R This value for selenium was announced (61 FR 58444-58449, November 14, 1996) as a proposed GLI 303(c) aquatic life criterion. EPA is currently working on this criterion and so this value might change substantially in the near future.

S This recommended water quality criterion for arsenic refers to the inorganic form only.

T This recommended water quality criterion for selenium is expressed in terms of total recoverable metal in the water column. It is scientifically acceptable to use the conversion factor (0.996-CMC or 0.922-CCC) that was used in the GLI to convert this to a value that is expressed in terms of dissolved metal.

U The organoleptic effect criterion is more stringent than the value for priority toxic pollutants.

V This value was derived from data for heptachlor and the criteria document provides insufficient data to estimate the relative toxicities of heptachlor and heptachlor epoxide.

W Although EPA has not published a completed criteria document for butylbenzyl phthalate it is EPA's understanding that sufficient data exist to allow calculation of aquatic criteria. It is anticipated that industry intends to publish in the peer reviewed literature draft aquatic life criteria generated in accordance with EPA Guidelines. EPA will review such criteria for possible issuance as national WQC.

X There is a full set of aquatic life toxicity data that show that DEHP is not toxic to aquatic organisms at or below its solubility limit.

Y This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

Z A more stringent MCL has been issued by EPA. Refer to drinking water regulations (40 CFR 141) or Safe Drinking Water Hotline (1-800-426-4791) for values.

aa This criterion is based on a 304(a) aquatic life criterion issued in 1980 or 1986, and was issued in one of the following documents: Aldrin/Dieldrin (PDF) (153 pp., 7.3 MB) (EPA 440/5-80-019), Chlordane (PDF) (68 pp., 3.1 MB) (EPA 440/5-80027), DDT (PDF) (175 pp., 8.3 MB) (EPA 440/5-80-038), Endrin (PDF) (103 pp., 4.6 MB) (EPA 440/5-80-047), Heptachlor (PDF) (114 pp., 5.4 MB) (EPA 440/5-80-052), Polychlorinated biphenyls (EPA 440/5-80-068), Toxaphene (EPA 440/5-86-006). This CCC is currently based on the Final Residue Value (FRV) procedure. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60 FR 15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria. Therefore, the Agency anticipates that future revisions of this CCC will not be based on the FRV procedure.

bb This water quality criterion is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (PDF) (104 pp., 3.3 MB) (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Arsenic (PDF) (74 pp., 3.2 MB) (EPA 440/5-84-033), Cadmium (EPA 822-R-01-001), Chromium (EPA 440/5-84-029), Copper (PDF) (150 pp., 6.2 MB) (EPA 440/5-84-031), Cyanide (PDF) (67 pp., 2.7 MB) (EPA 440/5-84-028), Lead (EPA 440/5-84-027), Nickel (EPA 440/5-86-004), Pentachlorophenol (EPA 440/5-86-009), Toxaphene, (EPA 440/5-86-006), Zinc (EPA 440/5-87-003).
cc When the concentration of dissolved organic carbon is elevated, copper is substantially less toxic and use of Water-Effect Ratios might be appropriate.

dd The selenium criteria document (EPA 440/5-87-006, September 1987) provides that if selenium is as toxic to saltwater fishes in the field as it is to freshwater fishes in the field, the status of the fish community should be monitored whenever the concentration of selenium exceeds 5.0 g/L in salt water because the saltwater CCC does not take into account uptake via the food chain.

ee This recommended water quality criterion was derived on page 43 of the mercury criteria document (PDF) (144 pp., 6.4 MB) (EPA 440/5-84-026, January 1985). The saltwater CCC of 0.025 ug/L given on page 23 of the criteria document is based on the Final Residue Value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60 FR 15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

ff This recommended water quality criterion was derived in *Ambient Water Quality Criteria Saltwater Copper Addendum* (Draft, April 14, 1995) and was promulgated in the Interim final National Toxics Rule (60 FR 22228-222237, May 4, 1995).

gg EPA is actively working on this criterion and so this recommended water quality criterion may change substantially in the near future.

hh This recommended water quality criterion was derived from data for inorganic mercury (II), but is applied here to total mercury. If a substantial portion of the mercury in the water column is methylmercury, this criterion will probably be under protective. In addition, even though inorganic mercury is converted to methylmercury and methylmercury bioaccumulates to a great extent, this criterion does not account for uptake via the food chain because sufficient data were not available when the criterion was derived.

ii This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).

jj This recommended water quality criterion is expressed as total cyanide, even though the IRIS RFD we used to derive the criterion is based on free cyanide. The multiple forms of cyanide that are present in ambient water have significant differences in toxicity due to their differing abilities to liberate the CN-moiety. Some complex cyanides require even more extreme conditions than refluxing with sulfuric acid to liberate the CN-moiety. Thus, these complex cyanides are expected to have little or no 'bioavailability' to humans. If a substantial fraction of the cyanide present in a water body is present in a complexed form (e.g., $Fe_4[Fe(CN)_6]_3$), this criterion may be over conservative.

kk This recommended water quality criterion was derived using the cancer slope factor of 1.4 (LMS exposure from birth).

ll This criterion has been revised to reflect the Environmental Protection Agency's cancer slope factor (CSF) or reference dose (RfD), as contained in the Integrated Risk Information System (IRIS) as of (Final FR Notice June 10, 2009). The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.

mm The available toxicity data, when evaluated using the procedures described in the “Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses” indicate that freshwater aquatic life should be protected if the 24-hour average and four-day average concentrations do not respectively exceed the acute and chronic criteria concentrations calculated by the Biotic Ligand Model.

Non Priority Pollutants

	Non Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC (acute) (µg/L)	CCC (chronic) (µg/L)	CMC (acute) (µg/L)	CCC (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
1	**Alkalinity**	—		20000 F					Gold Book
2	**Aluminum pH 6.5 – 9.0**	7429905	750 G,I	87 G,I,L					53 FR 33178
3	**Ammonia**	7664417	FRESHWATER CRITERIA ARE pH, Temperature and Life-stage DEPENDENT — SEE DOCUMENT D SALTWATER CRITERIA ARE pH AND TEMPERATURE DEPENDENT						EPA 822-R99-014 EPA 440-588-004
4	**Aesthetic Qualities**	—	NARRATIVE STATEMENT — SEE DOCUMENT						Gold Book
5	**Bacteria**	—	FOR PRIMARY RECREATION AND SHELLFISH USES — SEE DOCUMENT						Gold Book
6	**Barium**	7440393					1,000 A		Gold Book
7	**Boron**	—	NARRATIVE STATEMENT — SEE DOCUMENT						Gold Book
8	**Chloride**	16887006	860000 G	230000 G					53 FR 19028
9	**Chlorine**	7782505	19	11	13	7.5	C		Gold Book
10	**Chlorophenoxy Herbicide (2,4,5,-TP)**	93721					10 A		Gold Book
11	**Chlorophenoxy Herbicide (2,4-D)**	94757					100 A,C		Gold Book
12	**Chloropyrifos**	2921882	0.083 G	0.041 G	0.011 G	0.0056 G			Gold Book
13	**Color**	—	NARRATIVE STATEMENT — SEE DOCUMENT F						Gold Book
14	**Demeton**	8065483		0.1 F		0.1 F			Gold Book
15	**Ether, Bis(Chloromethyl)**	542881					0.00010 E,H	0.00029 E,H	65 FR 66443
16	**Gases, Total Dissolved**	—	NARRATIVE STATEMENT — SEE DOCUMENT F						Gold Book

	Non Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC (acute) (µg/L)	CCC (chronic) (µg/L)	CMC (acute) (µg/L)	CCC (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
17	**Guthion**	86500		0.01 F		0.01 F			Gold Book
18	**Hardness**	—	NARRATIVE STATEMENT — SEE DOCUMENT						Gold Book
19	**Hexachlorocyclo-hexane-Technical**	608731					0.0123 H	0.0414 H	EPA 440/5-80-054
20	**Iron**	7439896		1000 F			300 A		Gold Book
21	**Malathion**	121755		0.1 F		0.1 F			Gold Book
22	**Manganese**	7439965					50 A,O	100 A	Gold Book
23	**Methoxychlor**	72435		0.03 F		0.03 F	100 A,C		Gold Book
24	**Mirex**	2385855		0.001 F		0.001 F			Gold Book
25	**Nitrates**	14797558					10,000 A		Gold Book
26	**Nitrosamines**	—					0.0008	1.24	Gold Book
27	**Dinitrophenols**	25550587					69	5300	65 FR 66443
28	**Nonylphenol**	84852153	28ug/L	28ug/L	7ug/L	7ug/L			71 FR 9337
29	**Nitrosodibutylamine, N**	924163					0.0063 A,H	0.22 A,H	65 FR 66443
30	**Nitrosodiethylamine, N**	55185					0.0008 A,H	1.24 A,H	Gold Book
31	**Nitrosopyrrolidine, N**	930552					0.016 H	34 H	65 FR 66443
32	**Oil and Grease**	—	NARRATIVE STATEMENT — SEE DOCUMENT F						Gold Book
33	**Oxygen, Dissolved Freshwater Oxygen, Dissolved Saltwater**	7782447	WARMWATER AND COLDWATER MATRIX — SEE DOCUMENT N SALTWATER — SEE DOCUMENT						Gold Book EPA 822-R00-012
34	**Diazinon**	333415	0.17ug/L	0.17ug/L	0.82ug/L	0.82ug/L			71 FR 9336

	Non Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC (acute) (µg/L)	CCC (chronic) (µg/L)	CMC (acute) (µg/L)	CCC (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
35	**Parathion**	56382	0.065 J	0.013 J					Gold Book
36	**Pentachlorobenzene**	608935					1.4 E	1.5 E	65 FR 66443
37	**pH**	—		6.5 – 9 F		6.5 – 8.5 F,K	5 – 9		Gold Book
38	**Phosphorus Elemental**	7723140				0.1 F,K			Gold Book
39	**Nutrients**	—	See EPA's Ecoregional criteria for Total Phosphorus, Total Nitrogen, Chlorophyll *a* and Water Clarity (Secchi depth for lakes; turbidity for streams and rivers) (& Level III Ecoregional criteria)						P
40	**Solids Dissolved and Salinity**	—						250,000 A	Gold Book
41	**Solids Suspended and Turbidity**	—	NARRATIVE STATEMENT—SEE DOCUMENT F						Gold Book
42	**Sulfide-Hydrogen Sulfide**	7783064		2.0 F		2.0 F			Gold Book
43	**Tainting Substances**	—	NARRATIVE STATEMENT—SEE DOCUMENT						Gold Book
44	**Temperature**	—	SPECIES DEPENDENT CRITERIA—SEE DOCUMENT M						Gold Book
45	**Tetrachlorobenzene,1,2,4,5**	95943					0.97 E	1.1 E	65 FR 66443
46	**Tributyltin (TBT)**	—	0.46 Q	0.072 Q	0.42 Q	0.0074 Q			69 FR 342
47	**Trichlorophenol,2,4,5**	95954					1,800 B,E	3,600 B,E	65 FR 66443

Footnotes

A This human health criterion is the same as originally published in the Red Book (EPA 440/9-76-023, July, 1976) which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value is now published in the Gold Book (Quality Criteria for Water: 1986. EPA 440/5-86-001).

B The organoleptic effect criterion is more stringent than the value presented in the non priority pollutants table.

C A more stringent Maximum Contaminant Level (MCL) has been issued by EPA under the Safe Drinking Water Act. Refer to drinking water regulations 40CFR141 or Safe Drinking Water Hotline (1-800-426-4791) for values.

D According to the procedures described in the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, except possibly where a very sensitive species is important at a site, freshwater aquatic life should be protected if both conditions specified in Appendix C to the Preamble-Calculation of Freshwater Ammonia Criterion are satisfied.

E This criterion has been revised to reflect EPA's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of May 17, 2002. The fish tissue bioconcentration factor (BCF) used to derive the original criterion was retained in each case.

F The derivation of this value is presented in the Red Book (EPA 440/9-76-023, July, 1976).

G This value is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Aluminum (EPA 440/5-86-008); Chloride (EPA 440/5-88001); Chloropyrifos (EPA 440/5-86-005).

H This criterion is based on carcinogenicity of 10^{-6} risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10^{-5}, move the decimal point in the recommended criterion one place to the right).

I This value for aluminum is expressed in terms of total recoverable metal in the water column.

J This value is based on a 304(a) aquatic life criterion that was issued in the *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water* (EPA 820-B-96-001). This value was derived using the GLI Guidelines (60 FR 15393-15399, March 23, 1995; 40CFR132 Appendix A); the differences between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. No decision concerning this criterion was affected by any considerations that are specific to the Great Lakes.

K According to page 181 of the Red Book (EPA 440/9-76-023, July, 1976): For open ocean waters where the depth is substantially greater than the euphotic zone, the pH should not be changed more than 0.2 units from the naturally occurring variation or any case outside the range of 6.5 to 8.5. For shallow, highly productive coastal and estuarine areas where naturally occurring pH variations approach the lethal limits of some species, changes in pH should be avoided but in any case should not exceed the limits established for fresh water, i.e., 6.5-9.0.

L There are three major reasons why the use of Water-Effect Ratios might be appropriate.

The value of 87 µg/l is based on a toxicity test with the striped bass in water with pH = 6.5–6.6 and hardness <10 mg/L. Data in "Aluminum Water-Effect Ratio for the 3M Plant Effluent Discharge, Middleway, West Virginia" (May 1994) indicate that aluminum is substantially less toxic at higher pH and hardness, but the effects of pH and hardness are not well quantified at this time.

In tests with the brook trout at low pH and hardness, effects increased with increasing concentrations of total aluminum even though the concentration of dissolved aluminum was constant, indicating that total recoverable is a more appropriate measurement than dissolved, at least when particulate aluminum is

primarily aluminum hydroxide particles. In surface waters, however, the total recoverable procedure might measure aluminum associated with clay particles, which might be less toxic than aluminum associated with aluminum hydroxide.

EPA is aware of field data indicating that many high quality waters in the U.S. contain more than 87 g aluminum/L, when either total recoverable or dissolved is measured.

M U.S. EPA. 1973. Water Quality Criteria 1972. EPA-R3-73-033. National Technical Information Service, Springfield, VA.; U.S. EPA. 1977. Temperature Criteria for Freshwater Fish: Protocol and Procedures. EPA 600/3-77-061. National Technical Information Service, Springfield, VA.

N U.S. EPA. 1986. Ambient Water Quality Criteria for Dissolved Oxygen. EPA 440/5-86-003. National Technical Information Service, Springfield, VA.

O This criterion for manganese is not based on toxic effects, but rather is intended to minimize objectionable qualities such as laundry stains and objectionable tastes in beverages.

P Lakes and Reservoirs in Nutrient Ecoregion: II EPA 822-B-00-007, III EPA 822-B-01-008, IV EPA 822-B-01-009, V EPA 822-B-01-010, VI EPA 822-B-00-008 , VII EPA 822-B-00-009, VIII EPA 822-B-01-015, IX EPA 822-B-00-011, XI EPA 822-B-00-012, XII EPA 822-B-00-013, XIII EPA 822-B-00-014, XIV EPA 822-B-01-011; Rivers and Streams in Nutrient Ecoregion: I EPA 822-B-01-012, II EPA 822-B-00-015, III EPA 822-B-00-016, IV EPA 822-B-01-013, V EPA 822-B-01-014, VI EPA 822-B-00-017, VII EPA 822-B-00-018, VIII EPA 822-B-01-015, IX EPA 822-B-00-019, X EPA 822-B-01-016, XI EPA 822-B-00-020, XII EPA 822-B-00-021, XIV EPA 822-B-00-022; and Wetlands in Nutrient Ecoregion (PDF) (77 pp., 257 K) XIII EPA 822-B-00-023.

Q EPA announced the availability of a draft updated tributyltin (TBT) document on August 7, 1997 (62 FR 42554). The Agency has reevaluated this document and anticipates releasing an updated document for public comment in the near future.

Organoleptic Effects (e.g., taste and odor)

	Pollutant	CAS Number	Organoleptic Effect Criteria (µg/L)	FR Cite / Source
1	Acenaphthene	83329	20	Gold Book
2	Monochlorobenzene	108907	20	Gold Book
3	3-Chlorophenol	—	0.1	Gold Book
4	4-Chlorophenol	106489	0.1	Gold Book
5	2,3-Dichlorophenol	—	0.04	Gold Book
6	2,5-Dichlorophenol	—	0.5	Gold Book
7	2,6-Dichlorophenol	—	0.2	Gold Book
8	3,4-Dichlorophenol	—	0.3	Gold Book
9	2,4,5-Trichlorophenol	95954	1	Gold Book
10	2,4,6-Trichlorophenol	88062	2	Gold Book
11	2,3,4,6-Tetrachlorophenol	—	1	Gold Book
12	2-Methyl-4-Chlorophenol	—	1800	Gold Book
13	3-Methyl-4-Chlorophenol	59507	3000	Gold Book
14	3-Methyl-6-Chlorophenol	—	20	Gold Book
15	2-Chlorophenol	95578	0.1	Gold Book
16	Copper	7440508	1000	Gold Book
17	2,4-Dichlorophenol	120832	0.3	Gold Book
18	2,4-Dimethylphenol	105679	400	Gold Book
19	Hexachlorocyclopentadiene	77474	1	Gold Book
20	Nitrobenzene	98953	30	Gold Book
21	Pentachlorophenol	87865	30	Gold Book
22	Phenol	108952	300	Gold Book
23	Zinc	7440666	5000	45 FR79341

Notes

1. These criteria are based on organoleptic (taste and odor) effects. Because of variations in chemical nomenclature systems, this listing of pollutants does not duplicate the listing in Appendix A of 40 CFR Part 423. Also listed are the Chemical Abstracts Service (CAS) registry numbers, which provide a unique identification for each chemical.

Additional Notes

1. Criteria Maximum Concentration and Criterion Continuous Concentration

The Criteria Maximum Concentration (CMC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. The Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The CMC and CCC are just two of the six parts of an aquatic life criterion; the other four parts are the acute averaging period, chronic averaging period, acute frequency of allowed exceedence, and chronic frequency of allowed exceedence. Because 304(a) aquatic life criteria are national guidance, they are intended to be protective of the vast majority of the aquatic communities in the United States.

2. Criteria Recommendations for Priority Pollutants, Non Priority Pollutants and Organoleptic Effects

This compilation lists all priority toxic pollutants and some non priority toxic pollutants, and both human health effect and organoleptic effect criteria issued pursuant to CWA §304(a). Blank spaces indicate that EPA has no CWA §304(a) criteria recommendations. For a number of non-priority toxic pollutants not listed, CWA §304(a) "water + organism" human health criteria are not available, but EPA has published MCLs under the SDWA that may be used in establishing water quality standards to protect water supply designated uses. Because of variations in chemical nomenclature systems, this listing of toxic pollutants does not duplicate the listing in Appendix A of 40 CFR Part 423. Also listed are the Chemical Abstracts Service CAS registry numbers, which provide a unique identification for each chemical.

3. Human Health Risk

The human health criteria for the priority and non priority pollutants are based on carcinogenicity of 10-6 risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10-5, move the decimal point in the recommended criterion one place to the right).

4. Water Quality Criteria published pursuant to Section 304(a) or Section 303(c) of the CWA

Many of the values in the compilation were published in the California Toxics Rule. Although such values were published pursuant to Section 303(c) of the CWA, they represent the Agency's most recent calculation of water quality criteria and are thus the Agency's 304(a) criteria.

5. Calculation of Dissolved Metals Criteria

The 304(a) criteria for metals, shown as dissolved metals, are calculated in one of two ways. For freshwater metals criteria that are hardness-dependent, the dissolved metal criteria were calculated using a hardness of 100 mg/l as $CaCO_3$ for illustrative purposes only. Saltwater and freshwater metals' criteria that are not hardness-dependent are calculated by multiplying the total recoverable criteria before rounding by the appropriate conversion factors. The final dissolved metals' criteria in the table are rounded to two significant figures. Information regarding the calculation of hardness dependent conversion factors are included in the footnotes.

6. **Maximum Contaminant Levels**

The compilation includes footnotes for pollutants with Maximum Contaminant Levels (MCLs) more stringent than the recommended water quality criteria in the compilation. MCLs for these pollutants are not included in the compilation, but can be found in the appropriate drinking water regulations (40 CFR 141.11-16 and 141.60-63), or can be accessed through the Safe Drinking Water Hotline (800-426-4791) or online.

7. **Organoleptic Effects**

The compilation contains 304(a) criteria for pollutants with toxicity-based criteria as well as non-toxicity based criteria. The basis for the non-toxicity based criteria are organoleptic effects (e.g., taste and odor) which would make water and edible aquatic life unpalatable but not toxic to humans. The table includes criteria for organoleptic effects for 23 pollutants. Pollutants with organoleptic effect criteria more stringent than the criteria based on toxicity (e.g., included in both the priority and non-priority pollutant tables) are footnoted as such.

8. **Gold Book**

The Gold Book is Quality Criteria for Water: 1986. EPA 440/5-86-001.

9. **Correction of Chemical Abstract Services Number**

The Chemical Abstract Services number (CAS) for Bis(2-Chlorisoprpyl) Ether, has been revised in IRIS and in the table. The correct CAS number for this chemical is 108-60-1. The previous CAS number for this pollutant was 39638-32-9.

10. **Contaminants with Blanks**

EPA has not calculated criteria for contaminants with blanks. However, permit authorities should address these contaminants in NPDES permit actions using the States' existing narrative criteria for toxics.

11. **Specific Chemical Calculations**

Selenium — Aquatic Life This compilation contains aquatic life criteria for selenium that are the same as those published in the proposed CTR. In the CTR, EPA proposed an acute criterion for selenium based on the criterion proposed for selenium in the Water Quality Guidance for the Great Lakes System (61 FR 58444). The GLI and CTR proposals take into account data showing that selenium's two prevalent oxidation states in water, selenite and selenate, present differing potentials for aquatic toxicity, as well as new data indicating that various forms of selenium are additive. The new approach produces a different selenium acute criterion concentration, or CMC, depending upon the relative proportions of selenite, selenate, and other forms of selenium that are present. EPA is currently undertaking a reassessment of selenium, and expects the 304(a) criteria for selenium will be revised based on the final reassessment (63 FR 26186). However, until such time as revised water quality criteria for selenium are published by the Agency, the recommended water quality criteria in this compilation are EPA's current 304(a) criteria.

Appendices

Appendix A — Conversion Factors for Dissolved Metals

Metal	Conversion Factor			
	freshwater CMC	freshwater CCC	saltwater CMC	saltwater CCC[1]
Arsenic	1.000	1.000	1.000	1.000
Cadmium	1.136672-[(ln hardness)(0.041838)]	1.101672-[(ln hardness)(0.041838)]	0.994	0.994
Chromium III	0.316	0.860	—	—
Chromium VI	0.982	0.962	0.993	0.993
Copper	0.960	0.960	0.83	0.83
Lead	1.46203-[(ln hardness)(0.145712)]	1.46203-[(ln hardness)(0.145712)]	0.951	0.951
Mercury	0.85	0.85	0.85	0.85
Nickel	0.998	0.997	0.990	0.990
Selenium	—	—	0.998	0.998
Silver	0.85	—	0.85	—
Zinc	0.978	0.986	0.946	0.946

Appendix B — Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent

Chemical	mA	bA	mC	bC	Freshwater Conversion Factors (CF)	
					CMC	CCC
Cadmium	1.0166	-3.924	0.7409	-4.719	1.136672-[(*ln*hardness)(0.041838)]	1.101672-[(*ln*hardness)(0.041838)]
Chromium III	0.8190	3.7256	0.8190	0.6848	0.316	0.860
Copper	0.9422	-1.700	0.8545	-1.702	0.960	0.960
Lead	1.273	-1.460	1.273	-4.705	1.46203-[(*ln*hardness)(0.145712)]	1.46203-[(*ln*hardness)(0.145712)]
Nickel	0.8460	2.255	0.8460	0.0584	0.998	0.997
Silver	1.72	-6.59	—	—	0.85	—
Zinc	0.8473	0.884	0.8473	0.884	0.978	0.986

Hardness-dependant metals' criteria may be calculated from the following:

CMC (dissolved) = $\exp\{m_A [\ln(\text{hardness})] + b_A\}$ (CF)

CCC (dissolved) = $\exp\{m_C [\ln(\text{hardness})] + b_C\}$ (CF)

Appendix C — Calculation of Freshwater Ammonia Criterion

1. The one-hour average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CMC (acute criterion) calculated using the following equations:

   - Where salmonid fish are present:

     $$CMC = (0.275/(1 + 10^{7.204-pH})) + (39.0/(1 + 10^{pH-7.204}))$$

   - Or where salmonid fish are not present:

     $$CMC = (0.411/(1 + 10^{7.204-pH})) + (58.4/(1 + 10^{pH-7.204}))$$

2. A. The thirty-day average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on theaverage, the CCC (chronic criterion) calculated using the following equations:

   - When fish early life stages are present:

     - $CCC = ((0.0577/(1 + 10^{7.688-pH})) + (2.487/(1 + 10^{pH-7.688}))) \times MIN(2.85, 1.45 \bullet 10^{0.028 \bullet (25-T)})$

   - When fish early life stages are absent:

     - $CCC = ((0.0577/(1 + 10^{7.688-pH})) + (2.487/(1 + 10^{pH-7.688}))) \times 1.45 \bullet 10^{0.028 \bullet (25-MAX(T,7))}$

   B. In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the CCC.

United States Environmental Protection Agency

OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)

November 2002

EPA530-D-02-004

DRAFT GUIDANCE
FOR
EVALUATING THE VAPOR INTRUSION TO INDOOR AIR PATHWAY FROM GROUNDWATER AND SOILS

(Subsurface Vapor Intrusion Guidance)

I. INTRODUCTION

A. General

One of the primary objectives of the Office of Solid Waste and Emergency Response (OSWER) under EPA's Strategic Plan is stated as:

> "By 2005, EPA and its state, tribal and local partners will reduce or control the risk to human health and the environment at more than 374,000 contaminated Superfund, RCRA, underground storage tank (UST), brownfields and oil sites, and have the planning and preparedness capabilities to respond successfully to all known emergencies to reduce the risk to human health and the environment."

In order to effectively "reduce or control the risk to human health and the environment," it is necessary to determine if specific exposure pathways exist. If an exposure pathway exists, we need to evaluate the site to determine whether contamination is present at levels that may pose a significant risk to human health or the environment.

B. What Is The Intent Of This Guidance?

This draft guidance specifically addresses the evaluation of a single exposure pathway – the "vapor intrusion pathway." The intent of this draft guidance is to provide a tool to help the user conduct a screening evaluation as to whether or not the vapor intrusion exposure pathway is complete and, if so, whether it poses an unacceptable risk to human health. A complete pathway means that humans are exposed to vapors originating from site contamination. The approach suggested in this draft guidance begins with simple and generally reasonable conservative screening approaches and gradually progresses toward a more complex assessment involving increasingly greater use of site-specific data. For those sites determined to have an *incomplete* vapor intrusion pathway, EPA generally recommends that further consideration of the current site situation is not needed. For those sites determined to have a *complete* pathway, recommendations are provided on how to evaluate whether the pathway does or does not pose a potential significant risk to human health.

This guidance is not intended to provide recommendations on how to delineate the extent of risk or how to eliminate the risk, only to determine if there is a potential for an unacceptable risk. We generally recommend that a reevaluation of a screened-out site be carried out if site conditions or building/facility uses change in a way that might change

the screening-out decision or other new information suggests greater conservatism is warranted in assessing this exposure pathway.

Please recognize that this is a guidance document, not a regulation. This document presents current technical and policy recommendations of the Office of Solid Waste and Emergency Response, based on our current understanding of the phenomenon of subsurface vapor intrusion. EPA personnel (and of course, states) are free to use and accept other technically sound approaches, either on their own initiative, or at the suggestion of responsible parties or other interested parties. In addition, personnel who use this guidance document are free to modify the approach recommended in this guidance. This guidance document does not impose any requirements or obligations on EPA, states, or the regulated community. Rather, the sources of authority and requirements for addressing subsurface vapor intrusion are the relevant statutes and regulations (e.g., RCRA, CERCLA and the NCP).

C. At What Sites Are We Currently Suggesting You Use This Guidance?

The draft guidance is suggested for use at RCRA Corrective Action, CERCLA (National Priorities List and Superfund Alternative Sites), and Brownfields sites, but is not recommended for use at Subtitle I Underground Storage Tank (UST) sites at this time. The draft guidance recommends certain conservative assumptions that may not be appropriate at a majority of the current 145,000 petroleum releases from USTs. As such, the draft guidance is unlikely to provide an appropriate mechanism for screening the vapor pathway at UST sites.

We recommend that State and Regional UST corrective action programs continue to use a risk based decision making approach as described in OSWER Directive 9610.17: *Use of Risk-Based Decision Making in UST Corrective Action Program* to address this pathway. A majority of State programs are successfully implementing this directive at their UST cleanups and use the recommended approaches where appropriate, to prioritize and remediate their sites, including risk associated with vapor migration to indoor air in a manner that is protective of human health and the environment.

EPA also acknowledges that there are many unique issues specific to petroleum releases from underground storage tanks. EPA is forming an EPA-State working group to further study the behavior of petroleum and petroleum products in the subsurface associated with the vapor intrusion pathway.

D. What Is The Scope Of The Guidance?

This draft guidance is intended to address the incremental increases in exposures and risks from subsurface contaminants that may be intruding into indoor air. The approaches suggested in this draft guidance are primarily designed to ensure protection of the public in residential settings but may be adjusted for other land uses (e.g., commercial/industrial, recreational), so that human exposures in non-residential settings may also be considered under this guidance, as described below.

1) Occupational settings where persons are in a working situation.

There may be occupational settings where persons present are employees and hazardous constituents may be intruding into the air space from the vapor intrusion pathway. Such settings could include workplaces where workers are handling hazardous chemicals (e.g., manufacturing facilities) similar to or different from those in the subsurface contamination, as well as other workplaces, such as administrative and other office buildings where chemicals are not routinely handled in daily activities. OSHA and EPA have agreed that OSHA generally will take the lead role in addressing occupational exposures. Workers will generally understand the workplace (e.g., Occupational Safety and Health Administration, OSHA) regulations (and monitoring, as needed) that already apply and provide for their protection. For example, workplaces are subject to a written Hazard Communication and Monitoring Plan.

In general, therefore, EPA does not expect this guidance be used for settings that are primarily occupational.[1] However, employees and their employers may not be aware of subsurface contaminants that may be contributing to the indoor air environment of their workplaces, particularly since vapor intrusion may include constituents that are no longer or were never used in a particular workplace, may originate from elsewhere, or be modified by bio-degradation or other subsurface transformation processes. Therefore, we recommend that regional or State authorities notify the facility of the potential for this exposure pathway to cause a hazard or be recognized as a hazard and suggest that they consider any potential risk that may result. Any change in the future use of the building/facility might suggest a need to reevaluate the indoor air pathway.

2) Non-residential settings where persons are in a non-working situation.

Non-residential buildings may need to be evaluated where people (typically non-workers – see above) may be exposed to hazardous constituents entering into the air space from the subsurface. This would include for example buildings where the general public may be present, e.g., schools, libraries, hospitals, hotels, and stores. EPA recommends the appropriate environmental (public health protection) screening levels be applied to these situations.

The recommendations in this guidance may be appropriate for such situations, although we recommend adjustments appropriate for non-residential exposure durations, the building specific air volumes and air exchange rates, as well as other relevant factors be considered. The model used in this guidance accommodates the inclusion of these kinds of variables and for comparison of computed values with the recommended numerical criteria in Tables 2 and 3.

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[1]It should be noted that at CERCLA sites, the cleanup levels are generally determined either by ARARs or risk range considerations; the OSHA standards are not ARARs under the CERCLA statute and regulations. Therefore, there may be instances (under CERCLA and other cleanup programs) where standards other than the OSHA standards are used to determine whether the exposure pathway presents a risk to human health.

E. Will This Guidance Supersede Existing Guidance?

This draft guidance supersedes the draft RCRA EI Supplemental Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway (December 2001). It does not supersede State guidance. However, we believe that States will find this guidance useful and States will consider this guidance in making Current Human Exposures Under Control EI determinations. Additionally, the lead regulatory authority for a site may determine that criteria other than those recommended herein are more appropriate for the specific site or area. For example, site-specific indoor air criteria may differ from the generic indoor air criteria generally recommended in this guidance and, consequently, the corresponding soil gas or groundwater screening levels may differ. Also, the site-specific relationship between indoor air concentrations and subsurface soil gas or groundwater concentrations may differ from that assumed in developing this guidance. Therefore, we suggest that the first step generally be to consult with the lead regulatory authority to identify the most appropriate approach for evaluation of any potential vapor intrusion to indoor air pathway.

F. Will We Continue To Evaluate Data And Revise This Document Accordingly?

Vapor intrusion is a rapidly developing field of science and policy and this draft guidance is intended to aid in evaluating the potential for human exposure via this pathway given the state-of-the-science at this time. EPA will continue to explore this area and improve our understanding of this complex exposure pathway. As our understanding improves, this guidance will be revised as appropriate. EPA and State site managers are encouraged to provide OSWER with relevant site information that can be added to the OSWER database to facilitate EPA's efforts (for more information see Site-Specific Investigations).

II. EXPLANATION OF VAPOR INTRUSION

Vapor Intrusion is the migration of volatile chemicals from the subsurface into overlying buildings. Volatile chemicals in buried wastes and/or contaminated groundwater can emit vapors that may migrate through subsurface soils and into indoor air spaces of overlying buildings in ways similar to that of radon gas seeping into homes, as shown in Figure 1. (However, this guidance is not intended for evaluation of intrusion of radon gas.) As the figure illustrates, this vapor intrusion pathway may be important for buildings both with and without a basement.

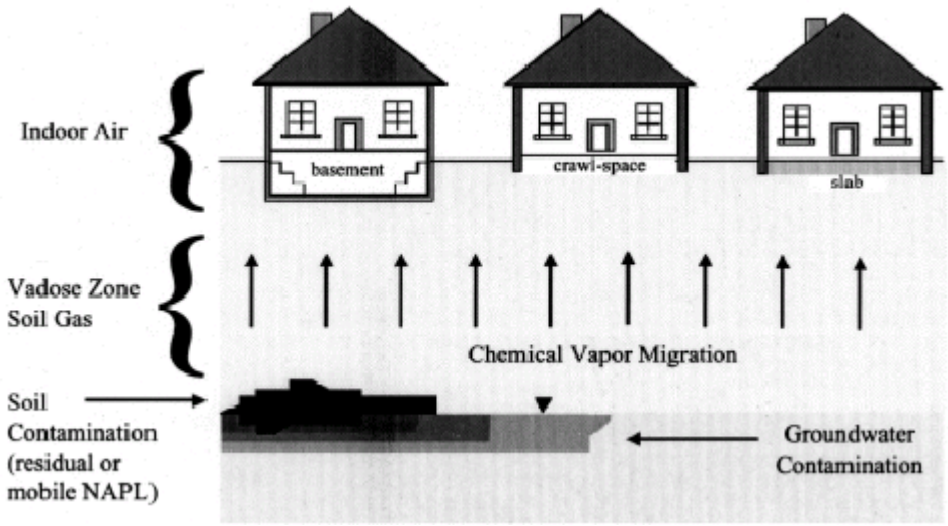


Figure 1: Generalized schematic of the pathway for subsurface vapor intrusion into indoor air.

A. Why Should You Be Concerned With This Pathway?

In extreme cases, the vapors may accumulate in dwellings or occupied buildings to levels that may pose near-term safety hazards (e.g., explosion), acute health effects, or aesthetic problems (e.g., odors). Typically however, the chemical concentration levels are low or, depending on site-specific conditions, vapors may not be present at detectable concentrations. In residences with low concentrations, the main concern is whether the chemicals may pose an unacceptable risk of chronic health effects due to long-term exposure to these low levels. A complicating factor in evaluating the potential chronic risk from vapor intrusion is the potential presence of some of the same chemicals at or above background concentrations (from the ambient (outdoor) air and/or emission sources in the building e.g., household solvents, gasoline, cleaners) that may pose, separately or in combination with vapor intrusion, a significant human health risk.

B. How Is This Exposure Pathway Different From Other Pathways?

The inhalation exposure pathway from vapor intrusion differs from other pathways in several respects. First, there is much less experience for risk assessors to draw upon when assessing the subsurface vapor to indoor air pathway than there is for the assessment of other pathways (e.g., groundwater ingestion and direct exposure to contaminated soils). Consequently, the key issues and technical challenges are not as fully understood. Second, response options will typically be different. For example, where groundwater used as drinking water is found to be highly contaminated, the groundwater plume may be cleaned up or its volume/concentration reduced, or people may drink bottled water, or they can be connected to other potable sources. In the case of significant vapor intrusion, ventilation is likely the most appropriate approach. Third, assessing the vapor intrusion pathway can be more complex than assessing other pathways because it typically involves the use of indirect measurements and modeling

(e.g., using soil gas or groundwater data) to assess the potential for indoor inhalation risks. Fourth, it is our judgment that indoor air sampling results can be misleading because it is difficult and sometimes impossible to eliminate or adequately account for contributions from "background" sources.

III. SUMMARY OF DRAFT GUIDANCE

This draft guidance employs a tiered approach to assist the user in determining whether the exposure pathway is complete (i.e., subsurface vapors intrude into indoor air spaces); and, if so, whether the vapors are present at levels that may pose an unacceptable exposure risk. Although vapors may be present in soils beneath a building, the vapors may or may not pose a risk to human health. It may also be predicted that a plume would reach a development or that future construction may occur over a plume that would result in a potential for exposure via this pathway. Estimating human health risk from indoor air exposure depends upon human exposure to the vapors. If contaminant vapors do not enter the building, the exposure pathway from the source of contamination to a person (receptor) is not "complete," and in such circumstances the person cannot be considered to be at risk from indoor air exposure due to vapor intrusion. In other situations, vapors may enter the building, but be present at such low levels that the risk is considered negligible. However, in some cases, vapors may seep into a building and accumulate at levels that may pose an unacceptable risk to human health.

A. How Should You Use This Draft Guidance?

The overall approach presented here is similar to that used in the February 5, 1999, RCRA Corrective Action Current Human Exposures Under Control EI Guidance. Record sheets containing a series of questions guide users through a recommended series of analytical steps to help determine if the subsurface vapor intrusion into indoor air pathway is complete and may present unacceptable risks. The record sheets encourage documentation of the facts and considerations that typically drive responses. Documentation is important to ensure clarity and transparency of the decisions. We recommend those who use this guidance consider the technical objectives, apply professional judgment, and attempt to assess the completeness of the vapor intrusion pathway in a technically defensible fashion. Users may find the discussions included in the attached Appendices to be useful in applying professional judgment to the evaluation of the vapor intrusion pathway.

B. How Do I Start And What Are The Different Tiers?

OSWER's fundamental approach to evaluating contaminated sites uses ***Guidance for the Data Quality Objectives (DQO) Process, EPA QA/G-4*** (EPA/600/R-96/055;August 2000); (URL = http://www.epa.gov/quality/qs-docs/g4-final.pdf) which calls for proceeding in a careful stepwise fashion. We recommend that site investigators use the specific sequential approach outlined in the DQO process to adequately determine the nature and extent of contamination, and identify potential exposure pathways and receptors that may be at risk (see Appendix A for more information). The first step in the

DQO process is to develop a Conceptual Site Model (CSM). A CSM is a three-dimensional "picture" of site conditions illustrating the contaminant sources, their movement of contaminants in the environment, their exposure pathways and the potential receptors (see Appendix B for more information).

The flowchart presented in Figure 2 summarizes the evaluation approach presented in this draft guidance. There are three tiers of assessment that involve increasing levels of complexity and specificity.

- Tier 1 - Primary Screening is designed to be used with general knowledge of a site and the chemicals known or reasonably suspected to be present in the subsurface; it does not call for specific media concentration measurements for each constituent of concern;
- Tier 2 - Secondary Screening is designed to be used with some limited site-specific information about the contamination source and subsurface conditions (e.g., measured or reasonably estimated concentrations of target chemicals in groundwater or soil gas, and depth of contamination and soil type); and
- Tier 3 - Site-Specific Pathway Assessment involves collecting more detailed site-specific information and conducting confirmatory subslab and/or indoor air sampling.

The evaluation process shown in Figure 2 presents a logical and linear progression designed to screen out sites ordinarily not needing further consideration and focuses attention on those sites that generally need further consideration of the vapor intrusion pathway or action. We suggest that a user of this guidance start at tier 1. However, the user does not need to begin with tier 1 and may proceed directly to tier 2 or 3 if they so choose. In addition, as noted earlier, the user may use other technically sound approaches in evaluating the vapor intrusion pathway.

C. What Are The Steps Associated With Each Tier And How Do I Use Them?

Tier 1 - Primary Screening: This step is designed to help quickly identify whether or not a potential exists at a specific site for subsurface vapor intrusion, and, if so, whether immediate action may be warranted. Criteria recommended for making these determinations under the guidance are presented in Questions 1 through 3, which focus on identifying:

a) if chemicals of sufficient volatility and toxicity are present or reasonably suspected to be present (Question 1);
b) if inhabited buildings are located (or will be constructed under future development scenarios – except for Environmental Indicator determinations, see section IV.C below) above or in close proximity to subsurface contamination (Question 2); and
c) if current conditions warrant immediate action (Question 3).

If the Primary Screening does not support a conclusion that the pathway is incomplete, or that immediate action is warranted to mitigate risks, we recommend the user proceed to Secondary Screening.

Tier 2 - Secondary Screening: This analysis involves comparing measured or reasonably estimated concentrations of target chemicals in various media (groundwater, soil gas, and/or indoor air) to recommended numerical criteria identified in Questions 4 and 5. These "generic criteria" reflect generally reasonable worst-case conditions. Question 4 provides a conservative first-pass screening of groundwater and soil gas data. Question 5 (based on a mathematical model) considers the relationship (if any) between groundwater and soil gas target criteria to such site-specific conditions as depth of contamination and soil type. Under the guidance, the site risk manager may choose to select media-specific target concentrations for screening at three cancer risk levels: 10^{-4}, 10^{-5}, and 10^{-6}, or a hazard quotient of 1 for non-cancer risk, whichever is appropriate. When results from secondary screening do not support a determination that the pathway is incomplete, we recommend the user proceed to the Site-Specific Pathway Assessment.

Tier 3 - Site-Specific Pathway Assessment: This tier specifically examines vapor migration and potential exposures in more detail (Question 6). At this level of assessment, the guidance generally recommends direct measurement of foundation air and/or indoor air concentrations from a subset of the potentially affected buildings and complementary site-specific mathematical modeling as appropriate. Modeling is considered to be useful for determining which combination of complex factors (e.g., soil type, depth to groundwater, building characteristics, etc.) lead to the greatest impact and, consequently, aid in the selection of buildings to be sampled. It is recommended that sampling of subslab or crawlspace vapor concentrations and/or sampling of indoor air concentrations be conducted before a regulator makes a final decision that there is not a potential problem with respect to vapor intrusion. When indoor air sampling is conducted to determine if a significant risk exists, we recommend that it be conducted more than once and the sampling program be designed to identify ambient (outdoor) and indoor air emission sources of contaminants.

IV. USE OF THIS GUIDANCE

A. Under What Conditions Do We Recommend You Consider This Pathway/Guidance?

We recommend that you consider the possibility of exposure by this pathway if you have or suspect the presence, in soil or groundwater, of volatile chemicals (Henry's Law Constant > 10^{-5} atm m^3/mol) at your site as follows:

- located 100 ft or less in depth or
- located in close proximity to existing buildings or future buildings (see Primary Screening Question #2 for definition of close proximity) or
- To the expected footprint of potential future buildings (for non-EI determinations).

B. Does This Guidance Address Setting Risk Management Goals?

No. The tiered approach to evaluating the vapor intrusion pathway described in this guidance uses computed target media-specific concentrations generally based on consensus toxicity values, where available, to aid in determining whether an unacceptable inhalation exposure risk is posed by the site contamination. The tables in this guidance provide target media-specific concentrations that may be used (where appropriate) for those contaminants for which a determination has been made that a pathway is complete. An adequate site evaluation demands careful consideration of all relevant chemical and site-specific factors as well as appropriate application of professional judgment. Risk management action decisions may need to consider other factors depending on the regulatory program that applies and/or site-specific circumstances. We recommend that the lead regulatory authority select the most appropriate value to consider for site evaluation purposes.

C. How Is The Guidance To Be Used In Making Current Human Exposures Under Control Environmental Indicator (EI) Determinations?

We recommend that the approaches suggested in this guidance be used, where appropriate, to support Current Human Exposures Under Control EI determinations. However, we do not believe that confirmatory sampling will generally be necessary in that context. Current Human Exposures Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and current land use conditions. We believe that not recommending confirmatory sampling is appropriate because of the conservative nature of the assumptions made. Additionally, the recommended approaches are designed to help site decision makers to differentiate those sites for which there is more likely to be unacceptable vapor intrusion from those where unacceptable vapor intrusion exposures are less likely.

Finally, this guidance provides targeted indoor air concentrations set at 10^{-4}, 10^{-5}, and 10^{-6} (incremental individual lifetime cancer risk) levels and a Hazard Quotient (HQ) of 1 for non-cancer risk. For the purposes of making Current Human Exposures Under Control EI determinations with respect to vapor intrusion under RCRA and CERCLA, EPA generally recommends the use of 10^{-5} values. This level, in EPA's view, serves as a generally reasonable screening mechanism for the vapor intrusion pathway. Additionally, it takes into account practical issues associated with the analytical difficulties in taking air measurements and the possible presence of many constituents of concern due to contributions from "background" sources, including ambient (outdoor) air and/or emitted from indoor sources.

D. How Will This Guidance Be Used In The RCRA And CERCLA (Superfund) Programs?

We recommend that this draft guidance be used in making Current Human Exposures Under Control EI determinations at RCRA and NPL sites, as well as in CERCLA remedial investigations and RCRA facility investigations. It is not designed to help the site decision makers conduct a more detailed (e.g., site-specific) assessment of current and future risks at NPL sites and it does not address cumulative risk that includes other exposure pathways.[2] Likewise, this draft guidance is not designated to be used during the process for determining whether, and to what extent, cleanup action is warranted at these sites.

E. What Has Changed From Previous Guidance Related To Vapor Intrusion That I Should Be Aware Of?

This draft guidance provides improved methodologies designed to be used at any site evaluation involving a potential vapor intrusion pathway. Much work has been done to improve methodologies and coordinate various cleanup programmatic interests, especially the major OSWER regulatory programs, in developing this vapor intrusion guidance. EPA believes that this guidance should prove useful and beneficial to these programs as well as to others by providing the most up-to-date recommended approach for use in evaluating potential exposures via the vapor intrusion pathway. Specifically, it should be noted that:

- The Johnson and Ettinger Model (1991) is used in Questions 5 and 6 of this draft guidance. EPA/OSWER re-evaluated the strengths and limitations of the model which led to revisions of the previous spreadsheets developed by the Superfund Program in 1997. The revisions include new default parameters that EPA generally recommends be used in vapor intrusion pathway evaluations. The new spreadsheets are available on the following website at: http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm

- EPA is also issuing *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (SG) (OSWER 9355.4-24) which updates the 1996 Soil Screening Guidance and includes non-residential exposure scenarios. The site-specific methodologies and tools presented in the SG are consistent with this vapor intrusion guidance.

- As further improvements in practice are developed, for example sampling techniques described in Appendix E, they will be further evaluated and considered for updating of this vapor intrusion guidance and notification on the OSWER website.

[2] The draft guidance does not specifically address the issue of "additive risk." At sites where there are a limited number of constituents in the subsurface environment, this likely is not an issue. However, at those sites where a number of contaminants are identified in the subsurface environment, the Regions and states may want to consider the additively of these contaminants. For further guidance on additively, you could review Section 2.1.1 of the Soil Screening Guidance: Technical Background Document, EPA/540/R-95/128, May 1996.

F. If I Have Indoor Air Measurements Do I Need To Follow All The Steps Described In This Guidance?

We do not recommend that indoor air quality monitoring be conducted prior to going through the steps recommended in this guidance. In those cases where indoor air quality data are available at the beginning of the evaluation, however, we generally recommend that these data be considered. We recommend that a site-specific evaluation be performed simultaneously with the subsurface assessment if indoor air concentrations exceed target levels. In some cases, the responsible party or others may decide to proactively eliminate exposures through avoidance or mechanical systems as a cost-effective approach. This option may be appropriate at any time in the assessment.

In addition, there may be circumstances in which a lead authority or a responsible party elects to initiate indoor air quality monitoring to determine whether there are any potential risks rather than pursue assessment of the pathway via the steps recommended in this guidance. If a responsible party decides to initiate indoor air monitoring, coordination and approval of air monitoring plans with the lead regulatory authority is recommended.[3]

G. What Else Might I Consider If I Have Indoor Air Concentrations Data?

Using other information in conducting a screening evaluation of the vapor intrusion pathway beyond the guidance presented in this document may be appropriate and would be consistent with the need to consider all relevant data/information in screening and/or assessing vapor intrusion to a building. For example, in some cases, a building may be positively pressurized as an inherent design of the heating, ventilation, and air conditioning system. It may be possible to show that the pathway, in this case, is incomplete, at the current time, by demonstrating a significant pressure differential from the building to the subsurface.

H. How Should "Background" Be Considered In Evaluating The Contribution Of Subsurface Contamination To Indoor Air Contamination?

We believe that it is critical to consider the presence of background concentrations in assessing the vapor intrusion pathway. Background concentrations may be impacted by volatile chemicals commonly found in the home or found in local atmospheric emissions. For example, in urban areas air quality is often affected by multiple atmospheric emission sources. In addition, human activities (e.g., smoking, craft hobbies) or consumer products (e.g., cleaners, paints, and glues) typically found in the home provide additional indoor vapor emission sources that can contribute to increased indoor air concentrations of some chemicals. In fact, there may be dozens of detectable chemicals in indoor air even absent subsurface contribution. These two types of sources can contribute to background indoor air levels of VOCs, and we recommend they be considered in

[3] While proactive indoor air monitoring may be initiated at any time, EPA recommends that it is generally not necessary if the pathway can be confirmed to be incomplete considering other site-specific data and factors.

evaluating the contribution of subsurface contamination to indoor air contamination in dwellings at a cleanup site. Additionally, we recommend that: 1) an inspection be conducted of the residence, 2) an occupant survey be completed to adequately identify the presence of (or occupant activities that could generate) any possible indoor air emissions of target VOCs in the dwelling (see appendices E, H and I), 3) all possible indoor air emission sources be removed, and 4) ambient (outdoor) air samples be collected in conjunction with any indoor air samples. We recommend the evaluation of existing indoor air data focus on constituents (and any potential degradation products) present in subsurface sources of contamination. We recommend the relative contributions of background sources be carefully considered (see Appendix I) in order to properly assess the potential inhalation exposure risks that can be attributed to the vapor intrusion pathway.

It may be a challenge to distinguish "background" (ambient outdoor and indoor air) sources of vapors from site-related contamination. However, we recommend vapors attributable to background sources be accounted for during the "Site Specific Assessment" to properly assess the potential risk posed by exposures via the vapor intrusion pathway. To the extent practicable, we recommend that background sources of contamination be removed or excluded from the site dwellings or occupied buildings selected for sampling before any indoor air sampling is conducted. If this is not possible, then we recommend the contribution from these sources be carefully considered when evaluating any indoor air sampling results. (See Site-Specific Question # 6)

Compile Site Information

- Develop Data Quality Objectives
- Develop Conceptual Site Model

Tier 1 - Primary Screening

- Determine if volatile and toxic chemicals are present (see Table 1).
- Determine if inhabited buildings are, or in the future could potentially be, located near subsurface contaminants.
  - If toxic volatile chemicals are present and current, or future, human exposure is suspected, proceed with screening.
- Determine if potential risks warrant immediate action.
  - If immediate action does not appear to be necessary, proceed to secondary screening.

Tier 2 - Secondary Screening

Question 4

- If indoor air data are available, compare to appropriate target concentration (Table 2a, b, or c).
  - If indoor air data exceed the target concentration proceed to Question 6.
- Determine if there is any potential for contamination of soils in the unsaturated zone.
  - If contamination of the unsaturated zone is suspected, assess soil gas data.
  - If contamination of the unsaturated zone is <u>not</u> suspected, assess groundwater data.
- Compare soil gas or groundwater data to appropriate target concentration (Table 2a, b, or c).
  - If groundwater data exceed the target concentration, assess soil gas data.
  - If soil gas data exceed the target concentration proceed to Question 5.
- Determine if data are adequate to characterize the site and support an assessment.
  - If adequate data are not available, develop a sampling and analysis plan that satisfies the established data quality objectives.
- Determine if site conditions, or data limitations, would preclude the use of generic attenuation factors used in Tables 2a, b, and c.
- If appropriate data do <u>not</u> exceed target media concentration, pathway is considered to be incomplete.

Question 5

- Determine if there is any potential for contamination of soils in the unsaturated zone.
  - If contamination of the unsaturated zone is suspected, assess soil gas data.
  - If contamination of the unsaturated zone is <u>not</u> suspected, assess groundwater data.
- Compare soil gas or groundwater data to appropriate target concentration (Table 3a, b, or c).
  - If groundwater data exceed the target concentration, assess soil gas data.
  - If soil gas data exceed the target concentration proceed to Question 6.
- If adequate data are not available, develop a sampling and analysis plan that satisfies the established data quality objectives.
- Determine if site conditions, or data limitations, would preclude the use of scenario-specific attenuation factors used in Tables 3a, b, and c.
- If appropriate data do <u>not</u> exceed target media concentration, pathway is considered to be incomplete.

Tier 3 - Site Specific Pathway Assessment

Question 6

- Determine if the nature and extent of contamination has been adequately characterized to identify the buildings that are most likely to be impacted.
  - If no, develop a sampling and analysis plan that satisfies the data quality objectives.
- Compare sub-slab soil gas or indoor air data to appropriate target concentration.
  - If sub-slab data exceed target concentration, assess indoor air data.
- Determine whether or not site data meet data quality objectives and background/ambient sources have been adequately accounted for.
- Determine if exposure pathway is complete.

Figure 2. Schematic flow diagram: evaluation process recommended in guidance.

IV. TIER 1 - Primary Screening

Primary Screening is designed to help quickly screen out sites at which the vapor intrusion pathway does not ordinarily need further consideration, and point out the sites that do typically need further consideration. This evaluation involves determining whether any potential exists at a specific site for vapor intrusion to result in unacceptable indoor inhalation risks and, if so, whether immediate action may be warranted. Recommended criteria for making these determinations are presented in Questions 1 through 3, which focus on identifying:

a) if chemicals of sufficient volatility and toxicity are present or reasonably suspected to be present (Question 1);
b) if inhabited buildings are located (or will be constructed under future development scenarios – except for Environmental Indicator determinations, see section IV.C below) above or in close proximity to subsurface contamination (Question 2); and
c) if current conditions warrant immediate action (Question 3).

This primary screening process is illustrated in a flow diagram included in Appendix C.

A. Primary Screening – Question #1

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface (e.g., in unsaturated soils, soil gas, or the uppermost portions of the ground water and/or capillary fringe – see Table 1)? (We recommend this consideration involve DQOs (see Appendix A) used in acquiring the site data as well as an appropriately scaled Conceptual Site Model (CSM) for vapor intrusion (see Appendix B).)

_____ If **YES** - check here, check off the relevant chemicals on Table 1, and continue with Question 2. The chemicals identified here (and any degradation products) are evaluated as constituents of potential concern in subsequent questions.

_____ If **NO** - check here, provide the rationale and references below, and then go to the Summary Page to document that the subsurface vapor to indoor air pathway is incomplete (i.e., no further consideration of this pathway is needed); or

_____ If sufficient data are not available, go to the Summary Page and document the need for more information. After collecting the necessary data, Question 1 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

1. What is the goal of this question?

This question is designed to help quickly screen out sites at which the vapor intrusion pathway generally does not need further consideration. This evaluation involves determining whether or not any potential exists at a specific site for the vapor intrusion

pathway to result in unacceptable indoor air inhalation risks. Table 1 lists chemicals that may be found at hazardous waste sites and indicates whether, in our judgment, they are sufficiently volatile (Henry's Law Constant > 10^{-5} atm m^3/mol) to result in potentially significant vapor intrusion and sufficiently toxic (either an incremental lifetime cancer risk greater than 10^{-6} or a non-cancer hazard index greater than 1, or in some cases both) to result in potentially unacceptable indoor air inhalation risks. The approach used to develop Table 1 is documented in Appendix D and can be used, where appropriate, to evaluate volatile chemicals not included in the Table. We recommend that if any of the chemicals listed in Table 1 that are sufficiently volatile and toxic are present at a site, those chemicals become constituents of potential concern for the vapor intrusion pathway and are evaluated in subsequent questions in this guidance. If the chemicals listed in Table 1 are not present at a site, and no other volatile chemicals are present, we suggest that the vapor intrusion pathway be considered incomplete and no further consideration of this pathway is needed.

2. What should you keep in mind?

In evaluating the available site data, we recommend the DQOs used in collecting the data be reviewed to ensure those objectives are consistent with the DQOs for the vapor intrusion pathway (see Appendix A). We recommend the detection limits associated with the available groundwater data be reviewed to ensure they are not too high to detect volatile contaminants of potential concern. Also, we suggest that the adequacy of the definition of the nature and extent of contamination in groundwater and/or the vadose zone be assessed to ensure that all contaminants of concern and areas of contamination have been identified. Additionally, we recommend groundwater concentrations be measured or reasonably estimated using samples collected from wells screened at, or across the top of the water table. We recommend users read Appendices B (Conceptual Site Model for the Vapor Intrusion Pathway) and E (Relevant Methods and Techniques) to obtain a greater understanding of the important considerations in evaluating data for use in screening assessments of the vapor intrusion pathway.

3. Rationale and References:

B. Primary Screening – Question #2

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located *near* (see discussion below) subsurface contaminants found in Table 1?

_____ If **YES** – check here, identify buildings and/or areas of concern below, and document on the Summary Page whether the potential for impacts from the vapor intrusion pathway applies to currently inhabited buildings or areas of concern under reasonably anticipated future development scenarios, or both. (Note that for EI considerations, we recommend only current risks be evaluated.) Then proceed with Question 3.

_____ If **NO** – check here, describe the rationale below, and then go to the Summary Page to document that there is no potential for the vapor intrusion pathway to impact either currently inhabited buildings or areas of concern under future development scenarios (i.e., no further evaluation of this pathway is needed). (Note that for EI considerations, only current risks are evaluated.); or

_____ If sufficient data are not available – check here and document the need for more information on the Summary Page. After collecting the necessary data, Question 2 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

1. What is the goal of this question?

The goal of this question is to help determine whether inhabited buildings currently are located (or may be reasonably expected to be located under future development scenarios) above or in close proximity to subsurface contamination that potentially could result in unacceptable indoor air inhalation risks. If inhabited buildings and/or future development are not located "near" the area of concern, we suggest that the vapor intrusion pathway be considered incomplete and no further consideration of the pathway should be needed.

For the purposes of this question, **"inhabited buildings"** are structures with enclosed air space that are designed for human occupancy. Table 1, discussed above in Question 1, lists the **"subsurface contaminants demonstrating sufficient volatility and toxicity**" to potentially pose an inhalation risk. We recommend that an inhabited building generally be considered **"near"** subsurface contaminants if it is located within approximately 100 ft laterally or vertically of known or interpolated soil gas or groundwater contaminants listed in Table 1 (or others not included in table 1 – see Question 1) and the contamination occurs in the unsaturated zone and/or the uppermost saturated zone. If the source of contamination is groundwater, we recommend migration of the contaminant plume be considered when evaluating the potential for future risks. The distance suggested above (100 feet) may not be appropriate for all sites (or contaminants) and,

consequently, we recommend that professional judgment be used when evaluating the potential for vertical and horizontal vapor migration.

2. How did we develop the suggested distance?

The recommended distance is designed to allow for the assessment to focus on buildings (or areas with the potential to be developed for human habitation) most likely to have a complete vapor intrusion pathway. Vapor concentrations generally decrease with increasing distance from a subsurface vapor source, and eventually at some distance the concentrations become negligible. The distance at which concentrations are negligible is a function of the mobility, toxicity and persistence of the chemical, as well as the geometry of the source, subsurface materials, and characteristics of the buildings of concern. Available information suggests that 100 feet laterally and vertically is a reasonable criterion when considering vapor migration fundamentals, typical sampling density, and uncertainty in defining the actual contaminant spatial distribution. The recommended lateral distance is supported by empirical data from Colorado sites where the vapor intrusion pathway has been evaluated. At these sites, no significant indoor air concentrations have been found in residences at a distance greater than one house lot (approximately 100 feet) from the interpolated edge of ground water plumes. Considering the nature of diffusive vapor transport and the typical anisotropy in soil permeability, in our judgment a similar criterion of 100 feet for vertical transport is generally conservative. These recommended distances will be re-evaluated and, if necessary, adjusted by EPA as additional empirical data are compiled.

3. What should you keep in mind when evaluating this criterion?

It is important to consider whether **significant preferential pathways** could allow vapors to migrate more than 100 feet laterally. For the purposes of this guidance, a "significant" preferential pathway is a naturally occurring or anthropogenic subsurface pathway that is expected to have a high gas permeability and be of sufficient volume and proximity to a building so that it may be reasonably anticipated to influence vapor intrusion into the building. Examples include fractures, macropores, utility conduits, and subsurface drains that intersect vapor sources or vapor migration pathways. Note that naturally occurring fractures and macropores may serve as preferential pathways for either vertical or horizontal vapor migration, whereas anthropogenic features such as utility conduits are relatively shallow features and would likely serve only as a preferential pathway for horizontal migration. In either case, we recommend that buildings with significant preferential pathways be evaluated even if they are further than 100 ft from the contamination.

We also recommend that the potential for mobile "vapor clouds" (gas plumes) emanating from near-surface sources of contamination into the subsurface be considered when evaluating site data. Examples of such mobile "vapor clouds" include: 1) those originating in landfills where methane may serve as a carrier gas; and 2) those originating in commercial/industrial settings (such as dry cleaning facilities) where vapor can be released within an enclosed space and the density of the chemicals' vapor may result in

significant advective transport of the vapors downward through cracks/openings in floors and into the vadose zone. In these cases, diffusive transport of vapors is usually overridden by advective transport, and the vapors may be transported in the vadose zone several hundred feet from the source of contamination.

Finally, this guidance is intended to be applied to existing groundwater plumes as they are currently defined (e.g., MCLs, State Standards, or Risk-Based Concentrations). However, it is very important to recognize that some non-potable aquifers may have plumes that have been defined by threshold concentrations significantly higher than drinking-water concentrations. In these cases, contamination that is not technically considered part of the plume may still pose significant risks via the vapor intrusion pathway and, consequently, the plume definition may need to be expanded. Similarly, we recommend evaluating the technologies used to obtain soil gas and indoor air concentrations to determine if appropriate methods were used to ensure adequate data quality at the time analyses were conducted.

4. Identify Inhabited Buildings (or Areas With Potential for Future Residential Development) Within Distances of Possible Concern:

C. Primary Screening Stage-– Question #3

Q3: Does evidence suggest immediate action may be warranted to mitigate current risks?

_____ If **YES** – check here and proceed with appropriate actions to verify or eliminate imminent risks. Some examples of actions may include but are not limited to indoor air quality monitoring, engineered containment or ventilation systems, or relocation of people. The action(s) should be appropriate for the site-specific situation.

_____ If **NO** – check here and continue with Question 4.

1. What is the goal of this question?

This question is intended to help determine whether immediate action may be warranted for those buildings identified in Question 2 as located within the areas of concern. For the purposes of this guidance, "immediate action" means such action is necessary to verify or abate imminent and substantial threats to human health.

2. What are the qualitative criteria generally considered sufficient to indicate a need for immediate actions?

Odors reported by occupants, particularly if described as "chemical," or "solvent," or "gasoline." The presence of odors does not necessarily correspond to adverse health and/or safety impacts and the odors could be the result of indoor vapor sources; however, we believe it is generally prudent to investigate any reports of odors as the odor threshold for some chemicals exceeds their respective acceptable target breathing zone concentrations.

Physiological effects reported by occupants (dizziness, nausea, vomiting, confusion, etc.) may, or may not be due to subsurface vapor intrusion or even other indoor vapor sources, but, should generally be evaluated.

Wet basements, in areas **where chemicals of sufficient volatility and toxicity** (see Table 1) **are known to be present in groundwater and the water table is shallow enough that the basements are prone to groundwater intrusion or flooding.** This has been proven to be especially important where there is evidence of light, non-aqueous phase liquids (LNAPLs) floating on the water table directly below the building, and/or any direct evidence of contamination (liquid chemical or dissolved in water) inside the building.

Short-term safety concerns are known, or are reasonably suspected to exist, including: a) measured or likely explosive or acutely toxic concentrations of vapors in the building or connected utility conduits, sumps, or other subsurface drains directly connected to the

building and b) measured or likely vapor concentrations that may be flammable/combustible, corrosive, or chemically reactive.

3. Rationale and Reference(s):

V. TIER 2 - SECONDARY SCREENING

The vapor intrusion pathway is complex and, consequently, we recommend that a comprehensive assessment of this pathway using all available lines of evidence be conducted before drawing conclusions about the risks posed by this pathway. Users are encouraged to consider the evidence for vapor intrusion in sequential steps, starting with the source of vapors (contaminated groundwater or unsaturated soils), proceeding to soil gas in the unsaturated zone above the source, and upward to the exposure point (e.g., subslab or crawlspace vapor). Then, if indicated by the results of previous steps, collect and evaluate indoor air data. In our judgment, this sequential evaluation of independent lines of evidence provides a logical and cost-effective approach for identifying whether or not subsurface vapor intrusion is likely to contribute significantly to unacceptable indoor air quality. However, in those cases where indoor air quality data are available at the beginning of an evaluation, this guidance recognizes these data will generally be considered early in the process.

Collection of indoor air quality data without evidence to support the potential for vapor intrusion from subsurface sources can lead to confounding results. Indoor air quality can be influenced by 'background' levels of volatile chemicals. For example, consumer products typically found in the home (e.g., cleaners, paints, and glues) or occupant activities (e.g., craft hobbies, smoking) may serve as contributory sources of indoor air contaminants. Additionally, ambient (outdoor) air in urban areas often contains detectable concentrations of many volatile chemicals. In either case, the resulting indoor air concentrations can be similar to or higher than levels that are calculated to pose an unacceptable chronic inhalation risk in screening calculations. In fact, there may be dozens of detectable chemicals in indoor air even absent subsurface contributions. Thus, we recommend focusing the evaluation of existing indoor air data on constituents (and any potential degradation products) present in subsurface sources of contamination. We recommend considering the relative contributions of background sources (see Appendices E and I) in order to properly assess the potential inhalation exposure risks that can be attributed to the subsurface vapor intrusion pathway.

Using a sequential approach, the secondary screening suggested in this guidance involves comparing available measured or reasonably estimated concentrations of constituents of potential concern (identified in Question 1) in groundwater and/or soil gas to target concentrations identified in Questions 4 and 5. More detailed studies, including foundation and/or indoor air sampling and vapor intrusion modeling, are generally conducted in the site-specific assessment in Question 6. The sequential evaluation approach is illustrated in flow diagrams included in Appendix C. Question 4 uses conservative "generic" attenuation factors that reflect generally reasonable worst-case conditions for a first-pass screening of groundwater and soil gas data. Question 5 uses attenuation factors (based on a generally conservative use of the Johnson-Ettinger mathematical model) that relate groundwater and soil gas target concentrations to such site-specific conditions as depth of contamination and soil type. In performing the secondary screening assessment, the user will need to identify whether the contamination (source of vapors) occurs in groundwater or in the unsaturated zone. In our judgment, if

there is a contaminant source in the unsaturated zone, soil gas data are needed to evaluate the vapor intrusion pathway in the vicinity of the unsaturated zone source. However, we recommend that groundwater data still be evaluated, particularly if the plume extends beyond an unsaturated zone source of vapors, but only in conjunction with soil gas data. If the secondary screening indicates the vapor intrusion pathway is complete, the guidance recommends the user perform a site-specific assessment following the guidelines in Question 6. If the secondary screening indicates this pathway is incomplete and/or does not pose an unacceptable risk to human health, then no further assessment of the pathway is recommended, unless conditions change.

The media-specific target concentrations used in Questions 4 and 5 were developed considering a generic conceptual model for vapor intrusion consisting of a groundwater and/or vadose zone source of volatile vapors that diffuse upwards through unsaturated soils towards the surface. Under the model, the soil in the vadose zone is considered to be relatively homogeneous and isotropic, though horizontal layers of soil types can be accommodated. The receptors at the surface used in the model are residents in homes with poured concrete foundations (e.g., basement or slab on grade foundations or crawlspace homes with a liner or other vapor barrier). The underlying assumption for this generic model is that site-specific subsurface characteristics will tend to reduce or attenuate vapor concentrations as vapors migrate upward from the source and into structures. Thus, application of the secondary screening target concentrations necessitates at least rudimentary knowledge of the contamination source, subsurface conditions (e.g., measured or reasonably estimated concentrations of target chemicals in soil or groundwater, and depth of contamination and soil type), and building construction at the site (e.g., foundation type). Specific factors that may result in unattenuated or enhanced transport of vapors towards a receptor, and consequently are likely to render the use of the secondary screening target concentrations inappropriate, are discussed in each question below. Factors such as biodegradation that can result in accelerated attenuation of vapors are not considered in the conceptual model. In general, it is recommended that the user consider whether the assumptions underlying the generic conceptual model are applicable at each site, and use professional judgment to make whatever adjustments (including not considering the model at all) are appropriate.

A. Secondary Screening – Question #4: Generic Screening

Q4(a): Are indoor air quality data available? (Collection of indoor air quality data without evidence to indicate the potential for vapor intrusion from subsurface sources is not recommended at this level of screening, but if such data are available, we recommend they be evaluated along with the available subsurface data.)

_____ If **YES** - check here and proceed to **Question 4(b).**

_____ If **NO** – check here and proceed to **Subsurface Source Identification - Question 4(c**).

Q4(b): Do measured indoor air concentrations of constituents of potential concern identified in Question 1 (and any degradation products) exceed the target concentrations given in Tables 2(a), 2(b), or 2(c)?

_____ If **YES** - check here, document representative indoor air concentrations on Table 2, and **initiate a site-specific assessment** following the guidelines in Question 6. (We recommend the user also proceed with the subsurface evaluation to evaluate whether there is sufficient evidence to indicate the elevated indoor concentrations are due to vapor intrusion from subsurface sources, and not from background or other sources)

_____ If **NO** – check here and proceed to **Subsurface Source Identification - Question 4(c).** (Here, the recommendation to proceed with the subsurface evaluation is based on the assumption that only limited indoor air data are available and, therefore, the available subsurface data need to be evaluated to ensure that all possible areas potentially affected by the vapor intrusion pathway are evaluated. However, in our judgment, if the site has been adequately characterized and sufficient indoor air data are available (see Question 6 for a discussion of data needs), the **pathway is incomplete** and/or does not pose an unacceptable risk to human health, and no further assessment of the pathway is recommended. Document the finding as described in Question 6.)

Subsurface Source Identification:

Q4(c): Is there any potential contamination (source of vapors) in the unsaturated zone soil at any depth above the water table? (In our judgment, if there is a contaminant source in the unsaturated zone, soil gas data are needed to evaluate the vapor intrusion pathway in the vicinity of the source and, consequently, use of the groundwater target concentrations may be inappropriate. However, we recommend that groundwater data still be evaluated, particularly if a contaminant plume extends beyond the unsaturated zone source, but that the evaluation be performed only in conjunction with an evaluation of soil gas data. Other vapor sources that typically make the use of groundwater target concentrations inappropriate include: 1) those originating in landfills where methane may serve as a carrier gas; 2) those originating in commercial/industrial settings (such as dry cleaning facilities) where vapor can be released within an enclosed space and the density of the chemicals' vapor may result in significant advective transport of the vapors downward through cracks/openings in floors and into the vadose zone; and 3) leaking vapors from underground storage tanks. In these cases, diffusive transport of vapors is often overridden by advective transport and the vapors may be transported in the vadose zone several hundred feet from the source of contamination.)

_____ If **YES**-check here and skip to **Soil Gas Assessment - Question 4 (g)** below.

_____ If **NO**- check here and continue with **Groundwater Assessment - Question 4(d)** below.

Groundwater Assessment:

Q4(d): Do measured or reasonably estimated groundwater concentrations exceed the generic target media-specific concentrations given in Tables 2(a), 2(b), or 2(c)? (For more information on the use of data for this part, please see the sections below entitled "How should data be used in this question?" and "How do you know you have unusable data?".)

_____ If **YES** (or if the detection limit for any constituents of potential concern is above the target concentration) - check here and document representative groundwater concentrations on Table 2. If **soil gas data are available**, proceed to **Soil Gas Assessment - Question 4(g)** below, **otherwise** proceed to **Question 5.**

_____ If **NO** – check here and **proceed to Question 4(e).**

Q4(e): Is the **nature and extent of groundwater contamination adequately characterized** (see Appendices B & E) in areas with inhabited buildings (or areas with the potential for future development of inhabited buildings)?

_____ If **YES** - check here and continue with **Question 4(f)** below.

_____ If **NO** - check here, go to Summary Page and document that more information is needed. We recommend the next step be expeditious collection of the needed data in accordance with proper DQOs. Question 4 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Q4(f): Are there site conditions and/or data limitations that make the use of the recommended generic groundwater attenuation factors inappropriate? We recommend this consideration involve comparison of the generic conceptual model to an appropriately scaled and updated Conceptual Site Model (CSM) for vapor intrusion (see Appendix B), as well as the proper DQOs (see Appendix A). We also recommend evaluation of the generic attenuation factors used to develop the media-specific attenuation factors (see the section below titled "What is in Tables 2(a), 2(b), and 2(c) and how did we develop them?" and Appendix F.)

Factors that, in our judgment, typically make the use of generic groundwater attenuation factors inappropriate include:

- Very shallow groundwater sources (e.g., depths to water less than 5 ft below foundation level); or
- Relatively shallow groundwater sources (e.g., depths to water less than 15 ft below foundation), and one or more of the following:

- buildings with significant openings to the subsurface (e.g., sumps, unlined crawlspaces, earthen floors), or
- significant preferential pathways, either naturally-occurring and/or anthropogenic (see discussion below under "What Should I Keep in Mind When Evaluating Data"), or
- buildings with very low air exchange rates (e.g., < 0.25/hr) or very high sustained indoor/outdoor pressure differentials (e.g., > 10 Pascals).

_____ If **YES** - check here, briefly document the issues below, and proceed to **Site-Specific Assessment - Question 6**.

_____ If **NO** - check here, briefly document the rationale below and document on the Summary Page that the groundwater data indicate the **pathway is incomplete** and/or does not pose an unacceptable risk to human health. In order to increase confidence in the assessment that the pathway is incomplete, we recommend that soil gas data **also** be evaluated (**Question 4(g)**).

_____ If sufficient data (of acceptable quality) are not available - check here, go to Summary Page and document that more information is needed. We recommend the next step be expeditious collection of the needed data in accord with proper DQOs. Question 4 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

<u>Soil Gas Assessment:</u>

Q4(g): Do measured or reasonably estimated soil gas concentrations exceed the generic target media-specific concentrations given in Tables 2(a), 2(b), or 2(c) (see Appendix D)? For more information on the use of data for this part, please see the section below entitled "How should data be used in this question?"

_____ If **YES** (or if the detection limit for any constituents of potential concern is above the target concentration) - check here. Document representative soil gas concentrations on Table 2 and proceed to **Question 5**.

_____ If **NO** – check here and proceed to **Question 4(h)**.

Q4(h): Is the **nature and extent of soil contamination adequately characterized** and has an adequate demonstration been made to show that the **soil gas sampling techniques used could reasonably detect an elevated concentration of vapors** if they were present in the site setting?

_____ If **YES** - check here and continue with **Question 4(i)** below.

_____ If **NO** - check here. Skip to Summary Page and document that more information is needed. We recommend the next step be expeditious collection of the needed

data in accord with proper DQOs. Question 4 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Q4(i): Are there site conditions and/or data limitations that may make the use of generic soil gas attenuation factors inappropriate? (We recommend that this consideration involve an appropriately scaled and updated Conceptual Site Model (CSM) for vapor intrusion (see Appendix B), as well as the proper DQOs (see Appendix A). We also recommend evaluation of the generic attenuation factors used to develop the media-specific attenuation factors (see the section below titled "What is in Tables 2(a), 2(b), and 2(c) and how did we develop them?" and Appendix F.))

Factors that, in our judgment, typically make the use of generic soil gas attenuation factors inappropriate include:

- Shallow soil contamination vapor sources (e.g., less than 15 ft below foundation level), and one or more of the following:
  - buildings with significant openings to the subsurface (e.g., sumps, unlined crawlspaces, earthen floors), or
  - significant preferential pathways, either naturally-occurring and/or anthropogenic (see discussion below under "What Should I Keep in Mind When Evaluating Data"), or
  - buildings with very low air exchange rates (e.g., < 0.25/hr) or very high sustained indoor/outdoor pressure differentials (e.g., > 10 Pascals).

_____ If **YES** - check here, briefly document the issues below, and proceed to **Site-Specific Assessment - Question 6**.

_____ If **NO** - check here, briefly document the rationale below and document on the Summary Page that the soil gas data indicate the **pathway is incomplete** and/or does not pose an unacceptable risk to human health. In this case, no further assessment of the vapor intrusion pathway is recommended.

_____ If sufficient data (of acceptable quality) are not available - check here, go to Summary Page and document that more information is needed. We recommend the next step be expeditious collection of the needed data in accord with proper DQOs or proceed to **Question 5**. When additional data are collected, Question 4 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

1. What is the goal of this question?

Question 4 is intended to allow a rapid screening of available site data using measured or reasonably estimated groundwater and/or soil gas concentrations. The term "measured or

reasonably estimated" is used above (and throughout this document) in recognition of the fact that measurements adjacent to or in all buildings of concern may not be practical or necessary. For example, groundwater concentrations beneath buildings are commonly estimated from concentrations collected in wells distributed about a larger area of interest.

2. How should data be used in this question?

Question 4 calls for comparison of site data with generic target media-specific concentrations given in Tables 2(a), 2(b), and 2(c). These target media-specific concentrations correspond to indoor air concentrations associated with a specific incremental lifetime cancer risk of (a) 10^{-4}, (b) 10^{-5}, (c) 10^{-6} or a hazard quotient greater than 1 (whichever is more restrictive). Under this question, the user selects the appropriate screening risk level for the site and compares the soil gas and/or groundwater concentrations observed at the site to the corresponding target media concentrations in the table. If the detection limit for any constituent of potential concern is above its target screening level, we recommend the user continue the evaluation as though the target level is exceeded.

In order to select the appropriate target media concentrations for comparison, it is important to identify whether a source of vapors in an area occurs in the unsaturated zone (contaminated soil). This allows the site data to be segregated into two categories: a) data representing areas where contaminated groundwater is the only source of contaminant vapors, and b) data representing areas where the underlying unsaturated zone soil contains a source of vapors. In case (a) either the groundwater or soil gas target concentrations in Tables 2(a), 2(b), or 2(c) are generally appropriate to use. In case (b), we recommend that only soil gas target concentrations and soil gas samples collected above the vapor source zone be used. This is because the groundwater target concentrations have been derived assuming no other vapor sources exist between the water table and the building foundation. However, we recommend that groundwater data still be evaluated, particularly if a contaminant plume extends beyond the unsaturated zone source, but the evaluation be performed only in conjunction with an evaluation of soil gas data. In either case, because of the complexity of the vapor intrusion pathway, we recommend that professional judgment be used when applying the target concentrations.

This screening approach is based on a conceptual model that assumes diffusive transport of vapors in the unsaturated zone. Consequently, we recommend the target concentrations used in this secondary screening not be applied to data from sites in which advection significantly influences vapor transport. Thus, the exclusionary criteria listed above in Questions 4(f) and 4(i) are designed to identify those situations in which advective vapor transport may result in unattenuated or enhanced vapor intrusion (e.g., shallow vapor sources at depths less than 15 ft below foundation level and buildings with significant openings to the subsurface, or very high sustained pressure differentials, or significant vertical preferential pathways).

3. What is in Tables 2(a), 2(b), and 2(c) and how did we develop them?

Tables 2(a), 2(b), or 2(c) contain generally recommended target concentrations for indoor air, soil gas, and groundwater for each chemical listed. A separate table is provided for each of the three cancer risk levels considered (a) 10^{-4}, (b) 10^{-5}, and (c) 10^{-6} including non-cancer risk values where applicable for Hazard Quotient = 1. Details regarding the derivation of Tables 2(a), 2(b), and 2(c) are provided in Appendix D. The tabulated indoor air concentrations are risk-based screening levels calculated following an approach consistent with EPA's ***Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*** (EPA, 2002). These recommended target indoor air concentrations were calculated using toxicity information current as of the date indicated on the tables. The user is encouraged to visit the EPA web-page to determine whether updated tables are available.

The soil gas and groundwater target concentrations were calculated to correspond to the target indoor air concentrations using media-specific attenuation factors. Shallow soil gas (e.g., subslab gas and soil gas measured at 5 feet or less from the base of the foundation) is conservatively assumed to intrude into indoor spaces with an attenuation factor of 0.1. Note that in general samples taken less than 5 feet below the building foundation are not recommended unless the sample was taken from directly under the foundation slab or repeated sampling is performed to ensure a representative soil gas value. For deep soil gas (e.g., soil gas samples taken at depths greater than approximately 5 feet below the foundation level), an attenuation factor of 0.01 (generally considered reasonably conservative) is used to calculate target concentrations. For groundwater, an attenuation factor of 0.001 (generally considered reasonably conservative) is used in combination with the conservative assumption that the partitioning of chemicals between groundwater and soil vapor is assumed to obey Henry's Law. (Note that if the risk-based concentration calculated for groundwater falls below the chemical's MCL, the MCL is recommended as the target concentrations.) EPA generally considers the attenuation factors used in this guidance to be reasonable upper bound values based on data from sites where paired indoor air, soil gas and groundwater samples were available (see Appendix F), and also theoretical considerations.

4. How do you know if you have usable data?

In comparing available site data to the target media-specific target concentrations in Table 2, we recommend that DQOs used in collecting the data be consistent with DQOs for the vapor intrusion pathway and that the sampling issues specific to evaluating this pathway be considered (see Appendices A and E). Some examples of sampling issues that we recommend be considered are: 1) groundwater samples be taken from wells screened (preferably over short intervals) across the top of the water table (only volatile contaminants in the uppermost portions of an aquifer, including the capillary fringe, are likely to volatilize into the vadose zone and potentially migrate into indoor air spaces); 2) fluctuations in water table elevation can lead to elevated source vapor concentrations and thus, we recommend soil gas samples be considered in these areas; 3) we recommend soil

gas samples be taken as close to the areas of interest as possible and preferably from directly underneath the building structure; and 4) as vapors are likely to migrate upward through the coarsest and/or driest material, we recommend that soil gas samples be collected from these materials. More detail regarding considerations for using groundwater and soil gas data to evaluate the vapor intrusion pathway are provided in Appendix E.

5. What should I keep in mind when evaluating data?

It is important to consider whether **significant preferential pathways** could allow vapors to migrate farther and at greater concentrations than expected. For purposes of this guidance, a preferential pathway is a naturally-occurring and/or anthropogenic subsurface 'pathway' that is expected to have a high intrinsic gas permeability (vadose zone) or high conductivity (saturated zone) and thus influence the flow or migration of contaminated vapors or groundwater. A preferential pathway is likely to have a significant influence on vapor intrusion if it is of sufficient volume and proximity to a currently occupied building so that it may be reasonably anticipated to influence the migration of contaminants to, or into, the building. Significant vertical preferential pathways may result in higher than anticipated concentrations in the overlying near surface soils, whereas significant horizontal preferential pathways may result in elevated concentrations in areas on the periphery of subsurface contamination. Naturally occurring preferential pathways may include fractured vadose zone geology or very permeable soils located between a relatively shallow source of contamination and a building. Anthropogenic preferential pathways may include utility conduits or subsurface drains that are directly connected to a building and a source of vapors. In highly developed residential areas, extensive networks of subsurface utility conduits could significantly influence the migration of contaminants. EPA recommends that buildings with significant preferential pathways be evaluated closely even if they are further than 100 feet from the contamination.

6. What if I have bulk soil data?

Soil (as opposed to soil gas) sampling and analysis is not currently recommended for assessing whether or not the vapor intrusion pathway is complete. This is because of the large uncertainties associated with measuring concentrations of volatile contaminants introduced during soil sampling, preservation, and chemical analysis, as well as the uncertainties associated with soil partitioning calculations. Thus, bulk soil target concentrations were not derived and the use of bulk soil target concentration is not generally recommended. Note however, if a NAPL source is suspected, a soil sample may be necessary to determine whether a NAPL source is present. Also, bulk soil concentration data could be used in a qualitative sense for delineation of sources, where appropriate. For example, high soil concentrations would indicate impacted soils; unfortunately, the converse is not always true and it is our judgment that non-detect analytical results can not be interpreted to indicate the absence of a vapor source.

7. Rationale and Reference(s):

Document Risk Level Used (Circle One): 10^{-4}, (b) 10^{-5}, or (c) 10^{-6}

B. Secondary Screening – Question #5: Semi-Site Specific Screening

Q5(a): Do groundwater and/or soil gas concentrations for any constituents of potential concern exceed target media-specific concentrations by a factor greater than 50? (Evaluation of limited site data in Question 5 allows the user to potentially screen sites using target concentrations that are higher by a factor of up to 50 times greater than the generic target concentrations used in Question 4. If observed concentrations are greater than 50 times the generic target concentrations, we recommend expeditious site-specific evaluation.)

_____ If **YES** - check here and briefly document the issues below and go to **Site-Specific Assessment - Question 6.**

_____ If **NO** - check here and continue with **Question 5(b)**.

Q5(b): Are there site conditions and/or data limitations under which we would not recommend the use of semi-site specific attenuation factors (based on the Johnson-Ettinger Model)? (To determine whether use of the Johnson-Ettinger model is appropriate, we recommend the user consider an appropriately scaled and updated Conceptual Site Model (CSM) for vapor intrusion (see Appendix B) and DQOs (see Appendix A). We also recommend users refer to Appendix G, which lists the limitations of the Johnson-Ettinger Model.)

Factors that, in our judgment, typically make the use of semi-site specific attenuation factors inappropriate include:

- Very shallow vapor sources (e.g., depths less than 5 ft below foundation level); or
- Relatively shallow vapor sources (e.g., depths less than 15 ft below foundation level), and one or more of the following:
  - buildings with significant openings to the subsurface (e.g., sumps, unlined crawlspaces, earthen floors), or
  - significant preferential pathways, either naturally-occurring and/or anthropogenic (see discussion in Question 4), or
  - buildings with very low air exchange rates (e.g., < 0.25/hr) or very high sustained indoor/outdoor pressure differentials (e.g., > 10 Pascals), or
  - soil types outside the range shown in Table 4, or
- Any other situation for which the Johnson-Ettinger Model is deemed inappropriate.

_____ If **YES** - check here and briefly document the issues below and go to **Site-Specific Assessment - Question 6.**

_____ If **NO** - check here and continue with **Question 5(c)**.

_____ If sufficient data (of acceptable quality) are not available - check here and skip to Summary Page and document that more information is needed. We recommend that the next step be expeditious collection of the needed data in accord with proper DQOs. Question 5 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Q5(c): Are the **depth to vapor source and the overlying unsaturated zone soil type adequately characterized** in areas with inhabited buildings (or areas with the potential for future development of inhabited buildings)?

_____ If **YES** - check here and continue with **Question 5(d)** below.

_____ If **NO** - check here, go to Summary Page and document that more information is needed. We recommend the next step be expeditious collection of the needed data in accord with proper DQOs. Question 5 can then be revisited with the newly collected data to re-evaluate the completeness of the vapor intrusion pathway.

Subsurface Source Identification

Q5(d): **Is there any potential contamination (source of vapors) in the unsaturated zone soil at any depth above the water table?** (In our judgment, if there is a contaminant source in the unsaturated zone, soil gas data are needed to evaluate the vapor intrusion pathway in the vicinity of the source and, consequently, use of the groundwater target concentrations may be inappropriate. However, we recommend that groundwater data still be evaluated, particularly if a contaminant plume extends beyond the unsaturated zone source, but that the evaluation be performed only in conjunction with an evaluation of soil gas data. Other vapor sources that we believe typically make the use of groundwater target concentrations inappropriate include: 1) those originating in landfills where methane may serve as a carrier gas; 2) those originating in commercial/industrial settings (such as dry cleaning facilities) where vapor can be released within an enclosed space and the density of the chemicals' vapor may result in significant advective transport of the vapors downward through cracks/openings in floors and into the vadose zone; and 3) leaking vapors from underground storage tanks. In these cases, diffusive transport of vapors is often overridden by advective transport and the vapors may be transported in the vadose zone several hundred feet from the source of contamination.)

_____ If **YES** - check here and skip to **Soil Gas Assessment – Question 5(f)** below.

_____ If **NO** - check here and continue with Groundwater Assessment - **Question 5(e)** below.

Groundwater Assessment:

Q5(e): Do measured or reasonably estimated groundwater concentrations exceed the target media-specific concentrations given in Tables 3(a), 3(b), or 3(c) for the appropriate attenuation factor (given that the conditions listed above in 5(b) are not present and that sampling issues described Appendix E have been considered)?

_____ If **YES** - check here, document the soil type, depth to groundwater and attenuation factor used in the assessment on the summary page, and document the representative groundwater concentrations on Table 3. If **soil gas data are available**, proceed to **Soil Gas Assessment - Question 5(f)** below**, otherwise** proceed to **Site Specific Assessment - Question 6**.

_____ If **NO** – check here and document that the groundwater data indicate that the **pathway is incomplete** and/or does not pose an unacceptable risk to human health on the Summary Page. In order to increase confidence in the assessment that the pathway is incomplete, EPA recommends that soil gas data also be evaluated following the soil gas assessment guidelines below (**Question 5(f)**).

Soil Gas Assessment:

Q5(f): Do measured or reasonably estimated soil gas concentrations exceed the target media-specific concentrations given in Tables 3(a), 3(b), or 3(c) for the appropriate attenuation factor (given that the conditions listed above in 5(b) are not present, or that other site specific factors make consideration of this analysis inappropriate, and that sampling issues described in Appendix E have been considered)?

_____ If **YES** - check here, document the soil type, depth to source and attenuation factor used in the assessment on the summary page, document representative soil gas concentrations on Table 3 and proceed to **Site Specific Assessment - Question 6**.

_____ If **NO** – check here and document that the subsurface vapor to indoor air **pathway is incomplete** and/or does not pose an unacceptable risk to human health on the Summary Page. In this case, we recommend no further assessment of the vapor intrusion pathway.

1. What is the goal of this question?

The goal of this question is to provide a means of evaluating the vapor intrusion pathway using tables of generally recommended target media-specific concentrations that incorporate limited site-specific information. Specifically, Question 5 factors in consideration of soil type and depth to source in screening the available groundwater and soil gas data. Soil gas- and groundwater-to-indoor air attenuation factors generally

depend (as described in Appendix G) on building characteristics, chemical type, soil type, and depth of the source (which is defined as either a measured soil gas concentration at the specified sample collection depth below the building, or the ground water concentration at the depth of the water table). By using the Johnson and Ettinger Model (1991) and keeping all factors besides source depth and soil type constant (and reasonably conservative), a set of attenuation factors can be derived that allows for the selection of semi-site specific target media concentrations that are more representative of the user's site. The semi-site-specific target values provided in Question 5 are less conservative (higher by a factor of 2 to 50 times, depending on soil type and depth to source) than the generic screening values used in Question 4. The increase in target concentrations corresponds to a decrease in the calculated attenuation factors as depth to source increases and soil type becomes finer grained (see Figures 3(a) and (b) and Section 3 below). In our judgment, if observed concentrations are greater than 50 times the generic target concentrations provided in Question 4, there is no benefit in using the criteria in Question 5 and we recommend expeditious site-specific evaluation.

2. How do you use the Graphs and the Tables?

The user selects a representative attenuation factor for soil gas from Figure 3(a) and for groundwater from Figure 3(b) based on measured site-specific information about soil type and depth to source. The selected attenuation factors are then rounded up to the nearest attenuation factor shown in Figure 3. Then, the columns in Tables 3(a), 3(b), and 3(c) corresponding to the attenuation factors selected from Figure 3(a) or 3(b) can be used to determine the appropriate target media concentrations for this level of screening. The values in Tables 3(a), 3(b), and 3(c) were derived as discussed in Appendix D.

3. How did we develop the media-specific target concentrations?

The Johnson and Ettinger (1991) Model was used as described in Appendix G to calculate the attenuation factors shown in Figures 3(a) and 3(b). Generally reasonable building characteristics were selected and held constant in these calculations and the chemicals were assumed not to degrade. To capture the effect of changes in soil properties, the U.S. Soil Conservation Service (SCS) soil texture classifications were considered, and a subset of these was selected. This subset was chosen so that their relevant properties (porosity and moisture content) would collectively span the range of conditions most commonly encountered in the field. Then, plots of attenuation factor versus depth were calculated, and these results are presented in Figures 3(a) and 3(b). The two graphs are different because the soil gas attenuation factors (Figure 3(a)) do not have to account for transport across the capillary fringe whereas the groundwater attenuation factors (Figure 3(b)) do. Details of the input parameters and calculations used to derive the graphs are included in Appendix G.

4. What should you keep in mind when using the graphs?

The generally recommended depth to source used to select a scenario-specific attenuation factor is: 1) the vertical separation between the soil gas sampling point and the building

foundation for use of Figure 3(a), or 2) the vertical separation between the water table and the building foundation for use of Figure 3(b). Note that we recommend that groundwater or soil gas samples collected at depths less than 5 feet (1.5 m) below the building foundation not be evaluated with these graphs. If contaminated groundwater is within 5 feet of the foundation level, or if the only soil gas samples available for screening were obtained from depths less than 5 feet below foundation level and the soil gas concentrations are greater than target levels, we recommend the user perform a site specific assessment. If the depth to source across the site varies, we recommend that the minimum depth be used in this assessment.

We recommend that the soil type used to select a scenario-specific attenuation factor represent the material most permeable to vapors between the building foundation and the contaminant source (e.g., the coarsest and/or driest soils). The graphs below use the U.S. Soil Conservation Service system of soil classification, in which the soil texture classes are based on the proportionate distribution of sand, silt and clay sized particles in soil. The generally preferred method for determining the SCS soil class is to use lithological information combined with the results of grain size distribution tests on selected soil samples. Table 4 below has been developed to assist users in selecting an appropriate SCS soil type in cases where lithological and grain size information is limited. Note that in Table 4 there is no soil texture class represented as consisting primarily of clay. Exclusion of clay was deliberate since homogenous unfractured clay deposits are rare.

Table 4. Guidance for selection of soil type curves in Figures 3(a) and 3(b).

If your boring log indicates that the following materials are the predominant soil types …	Then we recommend the following texture classification when obtaining the attenuation factor.
Sand or Gravel or Sand and Gravel, with less than about 12 % fines, where “fines” are smaller than 0.075 mm in size.	Sand
Sand or Silty Sand, with about 12 % to 25 % fines	Loamy Sand
Silty Sand, with about 25 % to 50 % fines	Sandy Loam
Silt and Sand or Silty Sand or Clayey, Silty Sand or Sandy Silt or Clayey, Sandy Silt, with about 50 to 85 % fines	Loam

5. Rationale for Selecting Semi-Site Specific Attenuation Factor and Reference(s):

Document Risk Level Used (Circle One): 10^{-4}, (b) 10^{-5}, or (c) 10^{-6}

Figure 3a- DRAFT
Vapor Attenuation Factors - Soil Vapor to Indoor Air Pathway
Basement Foundations

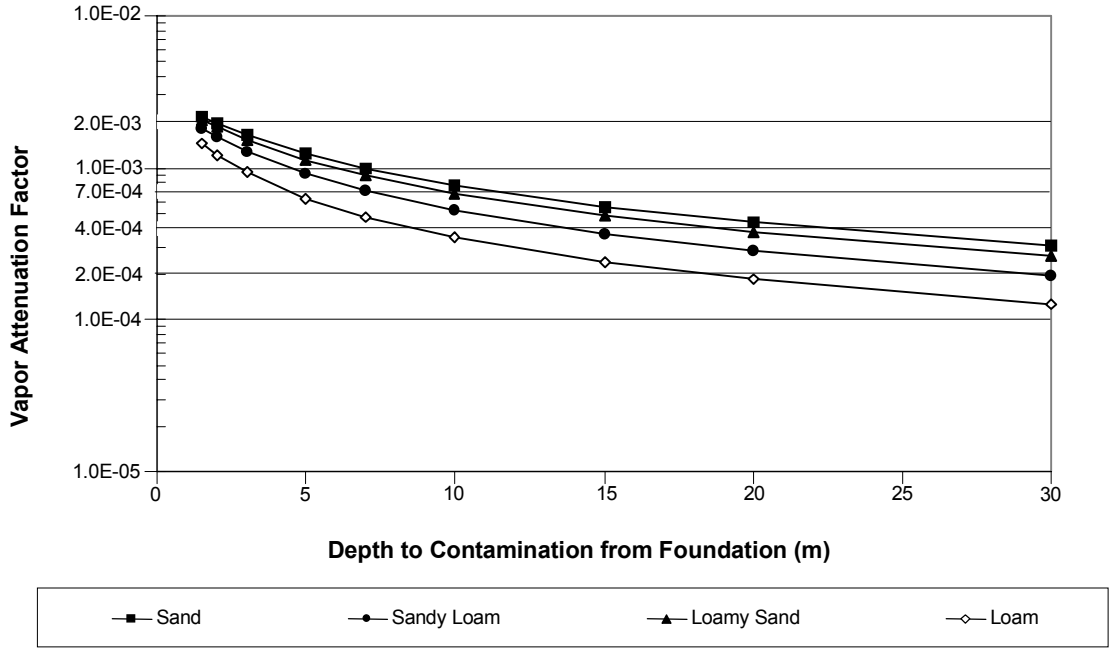
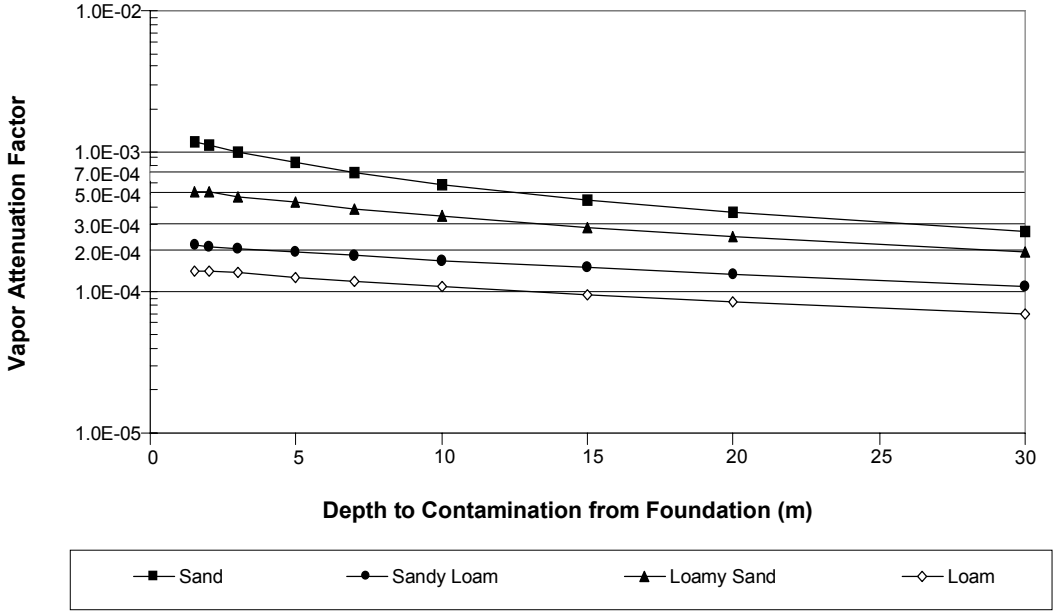


Figure 3b- DRAFT
Vapor Attenuation Factors - Ground Water to Indoor Air Pathway
Basement Foundations



VI. Tier 3 - Site-Specific Assessment

If primary and secondary screening results do not assist in excluding the existence of a vapor intrusion pathway, we recommend a site-specific assessment. In this case, this guidance recommends: (1) direct measurement of foundation air concentrations before any indoor air measurements; (2) direct measurement of indoor air concentrations coupled with a home survey (see Appendix H) and sampling to identify background sources of vapor in ambient (outdoor) and/or indoor air; 3) removal of all indoor air sources before sampling indoors; and (4) complementary site-specific mathematical modeling as appropriate. The sampling of foundation air (e.g., subslab and /or crawlspace air) and ambient (outdoor) air in conjunction with indoor air is intended to distinguish the exposures that originate from subsurface contaminant vapor intrusion from those due to background sources.

The recommended site-specific modeling is intended to be complementary to the more direct building-related measurements collected from a selected subset of the potentially impacted buildings. Considering the complexities involved in evaluating the vapor intrusion pathway (due to the sensitivity of attenuation factors to soil type, depth to source, and building characteristics), mathematical modeling may be useful in determining which combination of factors leads to the greatest impact and, consequently, aid in identifying appropriate buildings to be sampled. However, if an appropriate model is not available or cannot be modified to represent the conceptual site model, the only available option may be a site-specific assessment that relies entirely on direct measures of potential exposures.

We recommend that since site-specific assessments are based on direct evidence (confirmatory sampling of subslab or crawlspace vapor concentrations and/or indoor air concentrations), decisions made that "no further action with respect to vapor intrusion is needed", are likely to be "final decisions." Additionally, we recommend that the approaches suggested in the site-specific assessment be used, where appropriate, to support Current Human Exposures Under Control EI determinations. However, we do not believe that confirmatory sampling will generally be necessary in that context. Current Human Exposures Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and current land use conditions. We believe that not recommending confirmatory sampling to support Current Human Exposures Under Control EI determinations is appropriate because of the conservative nature of the assumptions made.

If buildings are not available or not appropriate for sampling, for example in cases where future potential impacts need to be evaluated, we recommend mathematical modeling be used to evaluate the potential for unacceptable inhalation risks due to the vapor intrusion pathway. Where modeling indicates there is the potential that vapor intrusion may result in unacceptable exposures, other more direct measures of potential impacts, such as emission flux chambers or soil gas surveys, may need to be conducted in areas underlain by subsurface contamination. Alternately, it may be appropriate to reduce potential

exposures with a mechanical ventilation system in the event buildings are constructed over subsurface vapor sources. EPA recommends that these sites be reevaluated when they are being developed, as appropriate, and that management decisions be made based on evaluation results at that time.

The data collected during site-specific evaluations of the vapor intrusion pathway can also serve to increase the level of understanding about key issues and important factors in the assessment of this pathway. Because the Agency is interested in improving the understanding of the modeling approach to evaluate the vapor intrusion pathway, EPA requests that the relevant data collected in site specific assessments be submitted electronically to an EPA repository that will be established by OSWER. EPA plans to develop a database structure specific to vapor intrusion evaluations to facilitate electronic entry of the relevant data and electronic submission to the repository. Once developed, EPA plans to make the database structure accessible through OERR's and OSW's web sites.

EPA plans to review and analyze these submitted data on an ongoing basis and consider appropriately refining this draft guidance for assessing the vapor intrusion pathway. EPA plans to post any revisions/addenda on the OSWER's website.

A. Site Specific Assessment – Question 6

Q6(a): Have the **nature and extent of contaminated soil vapor, unsaturated soil, and/or groundwater as well as potential preferential pathways and overlying building characteristics been adequately characterized to identify the most-likely-to-be-impacted buildings?** (Consider an appropriately-scaled Conceptual Site Model (CSM) for vapor intrusion (see Appendix B) and DQOs (see Appendix A)).

_____ If **YES** - check here, briefly document the basis below and **proceed to Question 6(b).** If a model was used, we recommend it be an appropriate and applicable model that represents the conceptual site model. If other means were used, document how you determined the potentially most impacted areas to sample.

_____ If **NO**, or if insufficient data (of acceptable quality) are available - check here, briefly **document the needed data** below, and skip to the Summary Page and document that more information is needed. After collecting the additional data, you can return to this question. However**, if indoor air data are available go to Question 6(e)**.

Q6(b): Are you conducting an EI determination and are you using an appropriate and applicable model?

_____ If **YES** - check here and continue with **Question 6(c)** below.

_____ If **NO** - check here and continue with **Question 6(d)**.

Q6(c): Does the model predict an unacceptable risk? (EPA recommends that predictive modeling can be used to support Current Human Exposures Under Control EI determinations without confirmatory sampling to support this determination. Current Human Exposures Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and current land use conditions.)

_____ If **YES** - check here and continue with **Question 6(d)** below.

_____ If **NO** - check here and document that the **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health for EI determinations. However, this determination does not necessarily reflect a final decision that the site is clean without confirmatory sampling.

Q6(d): Are subslab soil gas data available?

_____ If **YES** - check here and continue with **Question 6(e)** below.

_____ If **NO** - check here and continue with **Question 6(g)**.

Q6(e): Do measured subslab soil gas concentrations exceed the target shallow soil gas concentrations given in Tables 2(a), 2(b), or 2(c)?

_____ If **YES** - check here, document representative subslab soil gas concentrations on Table 2, collect indoor air data and **go to Question 6(g).**

_____ If **NO** – check here and **continue to Question 6(f)**.

Q6(f): Is the subslab sampling data adequate? (We recommend doing subslab sampling before indoor air sampling) Some factors we recommend for consideration in this question include:

- Do analytical results meet the required detection thresholds?
- Do the data account for seasonal and/or temporal transience?
- Do the data account for spatial variability?
- Is there any reason to suspect random (sampling) or systematic (analytical) error?
- How do the data account for the site conceptual model?
- Was "background" ambient (outdoor) air or other vapor sources considered?

_____ If **YES** - check here and document that the **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health.

_____ If **NO** or unsure - check here, briefly document the needed data below, and skip to the Summary Page and document that more information is needed. After collecting the additional data, return to Question 6(e).

Q6(g): Do measured indoor air concentrations exceed the target concentrations given in Tables 2(a), 2(b), or 2(c)? (We recommend that before any indoor air sampling occurs: 1) an inspection of the residence be conducted, 2) an occupant survey be completed to adequately identify the presence of (or occupant activities that could generate) any possible indoor air emissions of target VOCs in the dwelling (see appendix E, H and I), 3) all possible indoor air emission sources be removed, and 4) that the analysis be done only for the constitutes of potential concern found on the site.)

_____ If **YES** - check here, document representative indoor air concentrations on Table 2, and go to Question 6(i).

_____ If **NO** – check here and continue to Question 6(h).

Q6(h): Do the indoor air concentrations adequately account for seasonal variability and represent the most impacted buildings or area (see Appendix E)? Some factors we recommend for consideration in this question include:

- Do analytical results meet the required detection thresholds?
- Do the data account for seasonal and/or temporal transience?
- Do the data account for spatial variability?
- Is there any reason to suspect random (sampling) or systematic (analytical) error?
- How do the data account for the site conceptual model?

_____ If **YES** - check here, document that **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health. If a model was used to predict the indoor air concentrations also document the relationship between the predicted concentrations and the measured concentrations.

_____ If **NO** - check here, go to the summary page and document that more information is needed. If the data do not account for seasonal variability, we recommend designing a sampling plan to account for seasonal variability, resample and return to Question 6(g). If the data do not represent most impacted building or area, skip to the Summary Page and document that more information is needed. After collecting the additional data, you can return to Question 6(g).

Q6(i): Have background sources of vapor in indoor air and ambient (outdoor) air been adequately accounted for?

_____ If **YES** - check here, document results and document that **Pathway is Complete**. If a model was used to predict the indoor air concentrations, also document the relationship between the predicted concentrations and the measured concentrations.

_____ If **NO** - check here, briefly document the needed data below, and skip to the Summary Page and document that more information is needed. After collecting the additional data, you can return to Question 6(g).

1. What is the goal of this question?

The Site-Specific Pathway Assessment is designed to be used where site-specific conditions warrant further consideration prior to concluding either that the pathway is incomplete, or that some form of exposure control may be needed. In general, this final step recommends direct measures of potential impacts (e.g., building-specific foundation vapor concentrations – subslab sampling and/or indoor air concentrations) coupled with site-specific mathematical modeling where an appropriate model is available. However, EPA recommends that predictive modeling can be used to support Current Human Exposures Under Control EI determinations without confirmatory sampling these determination. Current Human Exposures Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and current land use conditions. The purpose of this site-specific approach is to help assess whether or not the vapor intrusion pathway is a likely problem. It is not meant to provide detailed guidance on how to delineate the extent of impacted buildings.

2. How should you complete this evaluation?

We recommend that the first step in conducting the site-specific evaluation be to update the site-specific conceptual site model and determine what additional information (e.g., direct sampling) you may need to determine the most-likely-to-be-impacted buildings (e.g., professional judgment or a model such as the J&E model). Confirmatory subslab/crawlspace and/or indoor air sampling is recommended at a percentage of the buildings at each potentially affected site that you have determined to be the most-likely-to-be-impacted. If sampling confirms that unacceptable inhalation risks due to vapor intrusion do not occur at the site, we recommend that the vapor intrusion pathway be considered incomplete and/or does not pose an unacceptable risk to human health. If sampling confirms that any building is impacted on the site, we recommend that the pathway be considered complete. In such case, we recommend that further analysis be conducted to delineate the extent of the impacted building(s) and that mitigation or avoidance measures be considered for the impacted buildings. These tasks are critically important, but are outside the scope of this guidance.

3. Why do we recommend updating your conceptual site model?

A conceptual model of the site and potential subsurface vapor transport and vapor intrusion mechanisms will be needed to adequately support the Site-Specific Pathway Assessment recommended in this guidance. We recommend that the site-specific conceptual model be developed in the typical source-pathway-receptor framework, and that it identify how the site-specific conceptual model is similar to, and different from, the generic conceptual model used in this guidance (see Introduction and Secondary

Screening). Under the guidance approach, key components of the conceptual model need to be justified with site-specific data, including, but not limited to, the source (chemical constituents, concentrations, mass, phase distribution, depth, and aerial extent), pathway (soil texture, moisture, and layering) and building (building design, construction, and ventilation). Some of the necessary data might already be available from previous site characterization efforts, but if not, we recommend collecting or developing appropriate site-specific data for evaluating the vapor intrusion pathway.

4. What should you keep in mind when you conduct indoor air or subslab sampling?

Collection of indoor air quality data without evidence to indicate the potential for vapor intrusion from subsurface sources can lead to confounding results. Indoor air quality can be influenced by 'background' levels of volatile chemicals (e.g., due to indoor and/or outdoor ambient sources). For example, consumer products typically found in the home (e.g., cleaners, fuels, paints, and glues) may serve as ancillary sources of indoor air contaminants. Additionally, ambient outdoor air in urban areas often contains detectable concentrations of many volatile chemicals. In either case, the resulting indoor air concentrations can be similar to or higher than levels that are calculated to pose an unacceptable chronic inhalation risk. Thus, we recommend the evaluation of existing indoor air data focus on constituents (and any potential degradation products) present in subsurface sources of contamination and the relative contributions of background sources be considered (see Appendix I). Additionally, see Appendix E for other items to keep in mind when doing subslab sampling.

5. What direct measurements should be considered and what do they mean?

Direct measures of indoor air and building foundation air (e.g., subslab and/or crawlspace concentrations) are recommended to verify whether or not the vapor intrusion pathway is complete. We recommend that the building specific sampling program be designed to identify and account for background sources. Prior to indoor air sampling, it is recommended that an inspection of the residence be conducted and an occupant survey be completed to adequately identify the presence of (or occupant activities that could generate) any possible indoor air emission sources of target VOCs in the dwelling (see discussion above and Appendices E, H & I) and then, if possible remove these sources. The Massachusetts Department of Environmental Protection (MA DEP) has prepared a useful ***Indoor Air Sampling and Evaluation Guide (April 2002)*** which is available at the following URL: http://www.state.ma.us/dep/ors/files/indair.pdf.

In collecting indoor air samples, it is important to recognize that indoor air quality can be influenced by 'background' levels of volatile chemicals (e.g., due to indoor and/or outdoor ambient sources), as discussed in the above section. Thus, we recommend the evaluation of existing indoor air data focus on constituents (and any potential degradation products) present in subsurface sources of contamination and determine the relative contributions of background sources (see Appendix I) in order to properly assess the potential inhalation exposure risks that can be attributed to the subsurface vapor intrusion

pathway. Where air concentrations in upper level living spaces are greater than basement levels, intrusion is not likely to have occurred. Indoor air quality data also are subject to homeostatic fluctuations and temporal trends. Thus, to properly evaluate the indoor air data, we recommend that sufficient information be obtained to identify seasonal and spatial variations in indoor air concentrations. Additionally, we recommend careful consideration of subsurface data from the site in order to determine whether the most likely to be impacted structures were sampled.

Sampling of foundation air (e.g., subslab and/or crawlspace air) provides a direct measure of the potential for exposures from vapor intrusion. When collected in conjunction with indoor air sampling, foundation samples can be used to identify the exposures that originate from vapor intrusion and distinguish those due to background sources. Subslab vapor is defined as the soil gas in contact with the building envelope immediately beneath or within the sub-floor construction materials. Subslab samples are recommended to be, but do not need to be, collected via holes through the flooring as close to the center of the floor space as possible. Soil gas sampling using angled or horizontal borings from outside under the foundation also may be effective. Appendix E provides more detailed recommendations on subslab and soil gas sampling methodologies. The recommended attenuation factor for sub-slab soil gas samples in this step is 0.1 (see Appendix F). The recommended attenuation factor to apply for crawl-space air samples is 1.0 (i.e., the same as target indoor air concentrations).

6. Why should you consider using site-specific modeling at this time?

Site-specific modeling is intended to complement the evaluation of samples collected from a subset of the potentially impacted buildings. We recommend that only models appropriate for the site setting be used and that the direct evidence from the sampled buildings be used to verify the accuracy of the model's site-specific predictive capability. Where predictions and direct evidence from the indoor air sampling are consistent, the model can be used to direct the selection of buildings to be sampled. Considering the complex influence of soil type, depth to groundwater, and building characteristics on vapor attenuation factors, the model may help to determine which combination of factors leads to the greatest impact. Additionally, the model may be used to justify the decreased need for more direct evidence from the remaining contaminated area. We recommend that site-specific modeling be performed with inputs derived from direct measurements at the site. This may necessitate the collection of more detailed information regarding subsurface properties, nature and extent of contamination, and building construction characteristics.

EPA has developed a spreadsheet version of the Johnson and Ettinger (JE) Model (1991), which is one of the available screening level models for evaluating the vapor intrusion pathway. As described in Question 5, the JE Model was used to develop conservative attenuation factors linked to soil type and depth to source at a site. This model and documentation for the model are available at the following web site:

URL = http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm

If the JE model is used in a site-specific assessment of the vapor intrusion pathway, we recommend that model inputs and assumptions that are different from the generic assumptions used in Question 5 and described in Appendix G be supported with site-specific information. If a model other than the JE Model is used, EPA recommends model inputs and outputs be identified and appropriately justified.

7. How do you appropriately involve the community when evaluating the vapor intrusion pathway?

Prior to conducting any direct sampling efforts, we recommend appropriately involving the community. It has been our experience that proper community involvement efforts are critical to the effective implementation of this level of screening. We recommend that users refer to the Community Involvement Guidance in Appendix H. Under the approach recommended in this guidance, we recommend the user consider the following: 1) getting to know the neighborhood, key stakeholders and the concerns of the community; 2) informing stakeholders of the situation; 3) developing a community involvement plan that highlights key community concerns; 4) obtaining written permission, and involving the property owner in identifying or removing potential indoor air sources, including inspection of residence and completing an occupant survey: 5) fully communicating sampling results (with visuals, maps etc.); and 6) a commitment to ongoing communications activities throughout site cleanup efforts. Appendix H contains and cites examples of guidance that could be considered for site-specific adaptation for interaction/involvement with building/dwelling occupants prior to indoor air sampling.

8. What do you do if the pathway is found to be complete?

If the pathway is judged to be complete during the Site-Specific Screening, the next recommended step is to identify the impacted buildings or areas of concern. This may result in some buildings or areas being included and some being excluded from the areas of concern. For these areas, we recommend that the pathway be considered to remain complete unless some action is taken to reduce occupants' exposure to the site contamination. Possible actions include:

- engineered containment systems (subslab de-pressurization, soil vacuum extraction, vapor barriers),
- ventilation systems (building pressurization, indoor air purifiers),
- avoidance (temporary or permanent resident relocation), or
- removal actions to reduce the mass and concentrations of subsurface chemicals to acceptable levels (i.e., remediation efforts).

This draft guidance is not intended to provide direction on how to fully delineate the extent of impacted buildings or what action should be taken after the pathway is confirmed. It is intended to be a quick screening process to help guide the user in determining if vapor intrusion is or is not a problem on the site.

9. Rationale and Reference(s):

Document Risk Level Used (Circle One): 10^{-4}, (b) 10^{-5}, or (c) 10^{-6}

VII. VAPOR INTRUSION PATHWAY SUMMARY PAGE

Facility Name: _____

Facility Address: _____

Primary Screening Summary

☐ *Q1: Constituents of concern Identified?*

_____ *Yes*

_____ *No* (If NO, skip to the conclusion section below and check NO to indicate the pathway is *incomplete.)*

☐ *Q2: Currently inhabited buildings near subsurface contamination?*

_____ *Yes*

_____ *No*

Areas of future concern near subsurface contamination?

_____ *Yes*

_____ *No* (If NO, skip to the conclusion section below and check NO to indicate the pathway is *incomplete.)*

☐ *Q3: Immediate Actions Warranted?*

_____ *Yes*

_____ *No*

Secondary Screening Summary

☐ *Vapor source identified:*

_____ *Groundwater*

_____ *Soil*

_____*Insufficient data*

☐ *Indoor air data available?*

_____ *Yes*

_____ *No*

☐ *Indoor air concentrations exceed target levels?*

_____ *Yes*

_____ *No*

☐ *Subsurface data evaluation: (Circle appropriate answers below)*

Medium	Q4 Levels Exceeded?	Q5 Levels Exceeded?	Data Indicates Pathway is Complete?
Groundwater	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS
Soil Gas	YES / NO / NA / INS	YES / NO / NA / INS	YES / NO / INS

NA = not applicable
INS = insufficient data available to make a determination

Site-Specific Summary

☐ *Have the nature and extent of subsurface contamination, potential preferential pathways and overlying building characteristics been adequately characterized to identify the most-likely-to-be-impacted buildings?*

_____ *Yes*

_____ *No*

_____ *N/A*

EPA recommends that if a model was used, it be an appropriate and applicable model that represents the conceptual site model. If other means were used, document how you determined the potentially most impacted areas to sample. EPA recommends that predictive modeling can be used to support Current Human Exposures Under Control EI determinations without confirmatory sampling to support this determination. Current Human Exposures Under Control EI determinations are intended to reflect a reasonable conclusion by EPA or the State that current human exposures are under control with regard to the vapor intrusion pathway and current land use conditions. Therefore, if conducting evaluation for an EI determination, document that the **Pathway is Incomplete** and/or does not pose an unacceptable risk to human health for EI determinations.

☐ *Are you making an EI determination based on modeling and does the model prediction indicate that determination is expected to be adequately protective to support Current Human Exposures Under Control EI determinations?*

_____ *Yes*

_____ *No*

_____ *N/A*

☐ *Do subslab vapor concentrations exceed target levels?*

_____ *Yes*

_____ *No*

_____ *N/A*

Do indoor air concentrations exceed target levels?

_____ *Yes*

_____ *No*

Conclusion

Is there a Complete Pathway for subsurface vapor intrusion to indoor air?

Below, check the appropriate conclusion for the Subsurface Vapor to Indoor Air Pathway evaluation and attach supporting documentation as well as a map of the facility.

_____ NO - the "Subsurface Vapor Intrusion to Indoor Air Pathway" has been verified to be incomplete for the _____ facility, EPA ID #_____, located at _____. This determination is based on a review of site information, as suggested in this guidance, check as appropriate:

_____ for current and reasonably expected conditions, or

_____ based on performance monitoring evaluations for engineered exposure controls. This determination may be re-evaluated, where appropriate, when the Agency/State becomes aware of any significant changes at the facility.

_____ YES –The "Subsurface Vapor to Indoor Air Pathway" is Complete. Engineered controls, avoidance actions, or removal actions taken include: _____

_____

_____

_____ UNKNOWN - More information is needed to make a determination.

Locations where References may be found:

_____

_____

_____

_____

_____

Contact telephone and e-mail numbers:

(name) _____

(phone #) _____

(e-mail) _____

Reminder: As discussed above, this is a guidance document, not a regulation. Therefore, conclusions reached based on the approaches suggested in this guidance are not binding on EPA or the regulated community. If information suggests that the conclusions reached using the approaches recommend are inappropriate, EPA may (on it's own initiative or at the suggestion of interested parties) choose to act at variance with these conclusions.

References

Burning of Hazardous Waste in Boilers and Industrial Furnaces; Final Rule (58 FR 7135, February 21, 1991)

Draft Exposure Assessment Guidance for RCRA Hazardous Waste Combustions Facilities (April/May 1994)

Guidance for the Data Quality Objectives (DQO) Process, EPA QA/G 4. (EPA/600/R-96/055; August 2000);(URL = http://www.epa.gov/quality/qs_docs/g4_final.pdf)

Johnson and Ettinger (JE) Model (1991)
(URL = http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm)

Massachusetts Department of Environmental Protection (MA DEP) Indoor Air Sampling and Evaluation Guide - WSC Policy#02-430 (April 2002) (URL = http://www.state.ma.us/dep/bwsc/finalpol.htm)

EPA Strategic Plan - Goal 5: Better Waste Management, Restoration of Contaminated Waste Sites, and Emergency Response (p.40-41) (EPA 190-R-00-002); (URL = http://www.epa.gov/ocfo/plan/2000strategicplan.pdf)

RCRA Corrective Action Environmental Indicator (EI) Guidance (Feb 5, 1999)
(URL = http://www.epa.gov/epaoswer/hazwaste/ca/eis/ei_guida.pdf)

RCRA draft Supplemental Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway (EPA/600/SR-93/140 - Dec 2001)
(URL= http://www.epa.gov/epaoswer/hazwaste/ca/eis/vapor.htm)

Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites
(Peer Review Draft: March 2001) Office of Emergency and Remedial Response/EPA
(URL = http://www.epa.gov/superfund/resources/soil/ssgmarch01.pdf)
[final version will issue concurrently with the *Subsurface Vapor Intrusion Guidance*.]

Use of Risk-Based Decision Making in UST Corrective Action Programs. OSWER **Directive 9610.17 (EPA; Mar 1, 1995);(URL= http://www.epa.gov/swerust1/directiv/od961017.htm)**

Table 1

Table 2

Table 3

Appendix A. Data Quality Assurance Considerations

Appendix B. Development Of Conceptual Site Model (CMS) For Assessment Of The Vapor Intrusion Pathway

Appendix C. Detailed Flow Diagrams Of The Evaluation Approach Used In This Guidance

Appendix D. Development Of Tables 1, 2, And 3

Appendix E. Relevant Methods and Techniques

Appendix F. Empirical Attenuation Factors And Reliability Assessment

Appendix G. Considerations For The Use Of Johnson and Ettinger Vapor Intrusion Model

Appendix H. Community Involvement Guidance

Appendix I. Consideration of Background Indoor Air VOC Levels In Evaluating The Subsurface Vapor Intrusion Pathway

Table 1: Question 1 Summary Sheet.

CAS No.	Chemical	Is Chemical Sufficiently Toxic? [1]	Is Chemical Sufficiently Volatile? [2]	Check Here if Known or Reasonably Suspected To Be Present [3]
83329	Acenaphthene	YES	YES	
75070	Acetaldehyde	YES	YES	
67641	Acetone	YES	YES	
75058	Acetonitrile	YES	YES	
98862	Acetophenone	YES	YES	
107028	Acrolein	YES	YES	
107131	Acrylonitrile	YES	YES	
309002	Aldrin	YES	YES	
319846	alpha-HCH (alpha-BHC)	YES	YES	
62533	Aniline	YES	NO	NA
120127	Anthracene	NO	YES	NA
56553	Benz(a)anthracene	YES	NO	NA
100527	Benzaldehyde	YES	YES	
71432	Benzene	YES	YES	
50328	Benzo(a)pyrene	YES	NO	NA
205992	Benzo(b)fluoranthene	YES	YES	
207089	Benzo(k)fluoranthene	NO	NO	NA
65850	Benzoic Acid	NO	NO	NA
100516	Benzyl alcohol	YES	NO	NA
100447	Benzylchloride	YES	YES	
91587	beta-Chloronaphthalene	YES	YES	
319857	beta-HCH (beta-BHC)	YES	NO	NA
92524	Biphenyl	YES	YES	
111444	Bis(2-chloroethyl)ether	YES	YES	
108601	Bis(2-chloroisopropyl)ether	YES	YES	
117817	Bis(2-ethylhexyl)phthalate	NO	NO	NA
542881	Bis(chloromethyl)ether	YES	YES	
75274	Bromodichloromethane	YES	YES	
75252	Bromoform	YES	YES	
106990	1,3-Butadiene	YES	YES	
71363	Butanol	YES	NO	NA
85687	Butyl benzyl phthalate	NO	NO	NA
86748	Carbazole	YES	NO	NA
75150	Carbon disulfide	YES	YES	
56235	Carbon tetrachloride	YES	YES	
57749	Chlordane	YES	YES	
126998	2-Chloro-1,3-butadiene (chloroprene)	YES	YES	
108907	Chlorobenzene	YES	YES	
109693	1-Chlorobutane	YES	YES	
124481	Chlorodibromomethane	YES	YES	
75456	Chlorodifluoromethane	YES	YES	
75003	Chloroethane (ethyl chloride)	YES	YES	
67663	Chloroform	YES	YES	
95578	2-Chlorophenol	YES	YES	
75296	2-Chloropropane	YES	YES	
218019	Chrysene	YES	YES	
156592	cis-1,2-Dichloroethylene	YES	YES	
123739	Crotonaldehyde (2-butenal)	YES	YES	
98828	Cumene	YES	YES	
72548	DDD	YES	NO	NA
72559	DDE	YES	YES	
50293	DDT	YES	NO	NA
53703	Dibenz(a,h)anthracene	YES	NO	NA
132649	Dibenzofuran	YES	YES	
96128	1,2-Dibromo-3-chloropropane	YES	YES	
106934	1,2-Dibromoethane (ethylene dibromide)	YES	YES	
541731	1,3-Dichlorobenzene	YES	YES	
95501	1,2-Dichlorobenzene	YES	YES	
106467	1,4-Dichlorobenzene	YES	YES	
91941	3,3-Dichlorobenzidine	YES	NO	NA
75718	Dichlorodifluoromethane	YES	YES	

Table 1: Question 1 Summary Sheet.

CAS No.	Chemical	Is Chemical Sufficiently Toxic? [1]	Is Chemical Sufficiently Volatile? [2]	Check Here if Known or Reasonably Suspected To Be Present [3]
75343	1,1-Dichloroethane	YES	YES	
107062	1,2-Dichloroethane	YES	YES	
75354	1,1-Dichloroethylene	YES	YES	
120832	2,4-Dichlorophenol	YES	NO	NA
78875	1,2-Dichloropropane	YES	YES	
542756	1,3-Dichloropropene	YES	YES	
60571	Dieldrin	YES	YES	
84662	Diethylphthalate	YES	NO	NA
105679	2,4-Dimethylphenol	YES	NO	NA
131113	Dimethylphthalate	NA	NO	NA
84742	Di-n-butyl phthalate	NO	NO	NA
534521	4,6-Dinitro-2-methylphenol (4,6-dinitro-o-cresol)	YES	NO	NA
51285	2,4-Dinitrophenol	YES	NO	NA
121142	2,4-Dinitrotoluene	YES	NO	NA
606202	2,6-Dinitrotoluene	YES	NO	NA
117840	Di-n-octyl phthalate	NO	YES	NA
115297	Endosulfan	YES	YES	
72208	Endrin	YES	NO	NA
106898	Epichlorohydrin	YES	YES	
60297	Ethyl ether	YES	YES	
141786	Ethylacetate	YES	YES	
100414	Ethylbenzene	YES	YES	
75218	Ethylene oxide	YES	YES	
97632	Ethylmethacrylate	YES	YES	
206440	Fluoranthene	NO	YES	NA
86737	Fluorene	YES	YES	
110009	Furan	YES	YES	
58899	gamma-HCH (Lindane)	YES	YES	
76448	Heptachlor	YES	YES	
1024573	Heptachlor epoxide	YES	NO	NA
87683	Hexachloro-1,3-butadiene	YES	YES	
118741	Hexachlorobenzene	YES	YES	
77474	Hexachlorocyclopentadiene	YES	YES	
67721	Hexachloroethane	YES	YES	
110543	Hexane	YES	YES	
74908	Hydrogen cyanide	YES	YES	
193395	Indeno(1,2,3-cd)pyrene	NO	NO	NA
78831	Isobutanol	YES	YES	
78591	Isophorone	YES	NO	NA
7439976	Mercury (elemental)	YES	YES	
126987	Methacrylonitrile	YES	YES	
72435	Methoxychlor	YES	YES	
79209	Methyl acetate	YES	YES	
96333	Methyl acrylate	YES	YES	
74839	Methyl bromide	YES	YES	
74873	Methyl chloride (chloromethane)	YES	YES	
108872	Methylcyclohexane	YES	YES	
74953	Methylene bromide	YES	YES	
75092	Methylene chloride	YES	YES	
78933	Methylethylketone (2-butanone)	YES	YES	
108101	Methylisobutylketone	YES	YES	
80626	Methylmethacrylate	YES	YES	
91576	2-Methylnaphthalene	YES	YES	
108394	3-Methylphenol (m-cresol)	YES	NO	NA
95487	2-Methylphenol (o-cresol)	YES	NO	NA
106455	4-Methylphenol (p-cresol)	YES	NO	NA
99081	m-Nitrotoluene	YES	NO	NA
1634044	MTBE	YES	YES	
108383	m-Xylene	YES	YES	
91203	Naphthalene	YES	YES	
104518	n-Butylbenzene	YES	YES	

Table 1: Question 1 Summary Sheet.

CAS No.	Chemical	Is Chemical Sufficiently Toxic? [1]	Is Chemical Sufficiently Volatile? [2]	Check Here if Known or Reasonably Suspected To Be Present [3]
98953	Nitrobenzene	YES	YES	
100027	4-Nitrophenol	YES	NO	NA
79469	2-Nitropropane	YES	YES	
924163	N-Nitroso-di-n-butylamine	YES	YES	
621647	N-Nitrosodi-n-propylamine	YES	NO	NA
86306	N-Nitrosodiphenylamine	YES	NO	NA
103651	n-Propylbenzene	YES	YES	
88722	o-Nitrotoluene	YES	YES	
95476	o-Xylene	YES	YES	
106478	p-Chloroaniline	YES	NO	NA
87865	Pentachlorophenol	YES	NO	NA
108952	Phenol	YES	NO	NA
99990	p-Nitrotoluene	YES	NO	NA
106423	p-Xylene	YES	YES	
129000	Pyrene	YES	YES	
110861	Pyridine	YES	NO	NA
135988	sec-Butylbenzene	YES	YES	
100425	Styrene	YES	YES	
98066	tert-Butylbenzene	YES	YES	
630206	1,1,1,2-Tetrachloroethane	YES	YES	
79345	1,1,2,2-Tetrachloroethane	YES	YES	
127184	Tetrachloroethylene	YES	YES	
108883	Toluene	YES	YES	
8001352	Toxaphene	YES	NO	NA
156605	trans-1,2-Dichloroethylene	YES	YES	
76131	1,1,2-Trichloro-1,2,2-trifluoroethane	YES	YES	
120821	1,2,4-Trichlorobenzene	YES	YES	
79005	1,1,2-Trichloroethane	YES	YES	
71556	1,1,1-Trichloroethane	YES	YES	
79016	Trichloroethylene	YES	YES	
75694	Trichlorofluoromethane	YES	YES	
95954	2,4,5-Trichlorophenol	YES	NO	NA
88062	2,4,6-Trichlorophenol	YES	NO	NA
96184	1,2,3-Trichloropropane	YES	YES	
95636	1,2,4-Trimethylbenzene	YES	YES	
108678	1,3,5-Trimethylbenzene	YES	YES	
108054	Vinyl acetate	YES	YES	
75014	Vinyl chloride (chloroethene)	YES	YES	

[1] A chemical is considered sufficiently toxic if the vapor concentration of the pure component (see Appendix D) poses an incremental lifetime cancer risk greater than 10^{-6} or a non-cancer hazard index greater than 1.

[2] A chemical is considered sufficiently volatile if its Henry's Law Constant is 1×10^{-5} atm-m^3/mol or greater (US EPA, 1991).

[3] Users should check off compounds that meet the criteria for toxicity <u>and</u> volatility and are known or reasonably suspected to be present.

Table 2a: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-4}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-4}, HI=1) C_{target} (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
83329	Acenaphthene	X	NC	2.1E+02	3.3E+01		2.1E+03	3.3E+02		2.1E+04	3.3E+03		**	
75070	Acetaldehyde		NC	9.0E+00	5.0E+00		9.0E+01	5.0E+01		9.0E+02	5.0E+02		2.8E+03	
67641	Acetone	X	NC	3.5E+02	1.5E+02		3.5E+03	1.5E+03		3.5E+04	1.5E+04		2.2E+05	
75058	Acetonitrile		NC	6.0E+01	3.6E+01		6.0E+02	3.6E+02		6.0E+03	3.6E+03		4.2E+04	
98862	Acetophenone	X	NC	3.5E+02	7.1E+01		3.5E+03	7.1E+02		3.5E+04	7.1E+03		8.0E+05	
107028	Acrolein		NC	2.0E-02	8.7E-03		2.0E-01	8.7E-02		2.0E+00	8.7E-01		4.0E+00	
107131	Acrylonitrile		NC	2.0E+00	9.2E-01		2.0E+01	9.2E+00		2.0E+02	9.2E+01		4.7E+02	
309002	Aldrin		C	5.0E-02	3.3E-03		5.0E-01	3.3E-02		5.0E+00	3.3E-01		7.1E+00	
319846	alpha-HCH (alpha-BHC)		C	1.4E-01	1.1E-02		1.4E+00	1.1E-01		1.4E+01	1.1E+00		3.1E+02	
100527	Benzaldehyde	X	NC	3.5E+02	8.1E+01		3.5E+03	8.1E+02		3.5E+04	8.1E+03		3.6E+05	
71432	Benzene		C	3.1E+01	9.8E+00		3.1E+02	9.8E+01		3.1E+03	9.8E+02		1.4E+02	
205992	Benzo(b)fluoranthene	X	C	1.2E+00	1.1E-01		**	**		**	**		**	
100447	Benzylchloride	X	C	5.0E+00	9.7E-01		5.0E+01	9.7E+00		5.0E+02	9.7E+01		3.0E+02	
91587	beta-Chloronaphthalene	X	NC	2.8E+02	4.2E+01		2.8E+03	4.2E+02		2.8E+04	4.2E+03		**	
92524	Biphenyl	X	NC	1.8E+02	2.8E+01		1.8E+03	2.8E+02		1.8E+04	2.8E+03		**	
111444	Bis(2-chloroethyl)ether		C	7.4E-01	1.3E-01		7.4E+00	1.3E+00		7.4E+01	1.3E+01		1.0E+03	
108601	Bis(2-chloroisopropyl)ether		C	2.4E+01	3.5E+00		2.4E+02	3.5E+01		2.4E+03	3.5E+02		5.1E+03	
542881	Bis(chloromethyl)ether		C	3.9E-03	8.4E-04		3.9E-02	8.4E-03		3.9E-01	8.4E-02		4.5E-01	
75274	Bromodichloromethane	X	C	1.4E+01	2.1E+00		1.4E+02	2.1E+01		1.4E+03	2.1E+02		2.1E+02	
75252	Bromoform		C	2.2E+02	2.1E+01		2.2E+03	2.1E+02		2.2E+04	2.1E+03		8.3E-01	
106990	1,3-Butadiene		C	8.7E-01	3.9E-01		8.7E+00	3.9E+00		8.7E+01	3.9E+01		2.9E-01	
75150	Carbon disulfide		NC	7.0E+02	2.2E+02		7.0E+03	2.2E+03		7.0E+04	2.2E+04		5.6E+02	
56235	Carbon tetrachloride		C	1.6E+01	2.6E+00		1.6E+02	2.6E+01		1.6E+03	2.6E+02		1.3E+01	
57749	Chlordane		NC	7.0E-01	4.2E-02		7.0E+00	4.2E-01		7.0E+01	4.2E+00		**	
126998	2-Chloro-1,3-butadiene (chloroprene)		NC	7.0E+00	1.9E+00		7.0E+01	1.9E+01		7.0E+02	1.9E+02		1.4E+01	
108907	Chlorobenzene		NC	6.0E+01	1.3E+01		6.0E+02	1.3E+02		6.0E+03	1.3E+03		3.9E+02	
109693	1-Chlorobutane	X	NC	1.4E+03	3.7E+02		1.4E+04	3.7E+03		1.4E+05	3.7E+04		2.0E+03	
124481	Chlorodibromomethane	X	C	1.0E+01	1.2E+00		1.0E+02	1.2E+01		1.0E+03	1.2E+02		3.2E+02	
75456	Chlorodifluoromethane		NC	5.0E+04	1.4E+04		5.0E+05	1.4E+05		**	**		**	
75003	Chloroethane (ethyl chloride)		NC	1.0E+04	3.8E+03		1.0E+05	3.8E+04		1.0E+06	3.8E+05		2.8E+04	
67663	Chloroform		C	1.1E+01	2.2E+00		1.1E+02	2.2E+01		1.1E+03	2.2E+02		8.0E+01 †	
95578	2-Chlorophenol	X	NC	1.8E+01	3.3E+00		1.8E+02	3.3E+01		1.8E+03	3.3E+02		1.1E+03	
75296	2-Chloropropane		NC	1.0E+02	3.2E+01		1.0E+03	3.2E+02		1.0E+04	3.2E+03		1.7E+02	
218019	Chrysene	X	*	*	*		*	*		*	*		*	
156592	cis-1,2-Dichloroethylene	X	NC	3.5E+01	8.8E+00		3.5E+02	8.8E+01		3.5E+03	8.8E+02		2.1E+02	
123739	Crotonaldehyde (2-butenal)	X	C	4.5E-01	1.6E-01		4.5E+00	1.6E+00		4.5E+01	1.6E+01		5.6E+02	
98828	Cumene		NC	4.0E+02	8.1E+01		4.0E+03	8.1E+02		4.0E+04	8.1E+03		8.4E+00	

Table 2a: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-4}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-4}, HI=1) C_{target} (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
72559	DDE	X	C	2.5E+00	1.9E-01		2.5E+01	1.9E+00		**	**		**	
132649	Dibenzofuran	X	NC	1.4E+01	2.0E+00		1.4E+02	2.0E+01		1.4E+03	2.0E+02		**	
96128	1,2-Dibromo-3-chloropropane		NC	2.0E-01	2.1E-02		2.0E+00	2.1E-01		2.0E+01	2.1E+00		3.3E+01	
106934	1,2-Dibromoethane (ethylene dibromide)		NC	2.0E-01	2.6E-02		2.0E+00	2.6E-01		2.0E+01	2.6E+00		6.6E+00	
541731	1,3-Dichlorobenzene	X	NC	1.1E+02	1.7E+01		1.1E+03	1.7E+02		1.1E+04	1.7E+03		8.3E+02	
95501	1,2-Dichlorobenzene		NC	2.0E+02	3.3E+01		2.0E+03	3.3E+02		2.0E+04	3.3E+03		2.6E+03	
106467	1,4-Dichlorobenzene		NC	8.0E+02	1.3E+02		8.0E+03	1.3E+03		8.0E+04	1.3E+04		8.2E+03	
75718	Dichlorodifluoromethane		NC	2.0E+02	4.0E+01		2.0E+03	4.0E+02		2.0E+04	4.0E+03		1.4E+01	
75343	1,1-Dichloroethane		NC	5.0E+02	1.2E+02		5.0E+03	1.2E+03		5.0E+04	1.2E+04		2.2E+03	
107062	1,2-Dichloroethane		C	9.4E+00	2.3E+00		9.4E+01	2.3E+01		9.4E+02	2.3E+02		2.3E+02	
75354	1,1-Dichloroethylene		NC	2.0E+02	5.0E+01		2.0E+03	5.0E+02		2.0E+04	5.0E+03		1.9E+02	
78875	1,2-Dichloropropane		NC	4.0E+00	8.7E-01		4.0E+01	8.7E+00		4.0E+02	8.7E+01		3.5E+01	
542756	1,3-Dichloropropene		NC	2.0E+01	4.4E+00		2.0E+02	4.4E+01		2.0E+03	4.4E+02		2.8E+01	
60571	Dieldrin		C	5.3E-02	3.4E-03		5.3E-01	3.4E-02		5.3E+00	3.4E-01		8.6E+01	
115297	Endosulfan	X	NC	2.1E+01	1.3E+00		2.1E+02	1.3E+01		**	**		**	
106898	Epichlorohydrin		NC	1.0E+00	2.6E-01		1.0E+01	2.6E+00		1.0E+02	2.6E+01		8.0E+02	
60297	Ethyl ether	X	NC	7.0E+02	2.3E+02		7.0E+03	2.3E+03		7.0E+04	2.3E+04		5.2E+02	
141786	Ethylacetate	X	NC	3.2E+03	8.7E+02		3.2E+04	8.7E+03		3.2E+05	8.7E+04		5.6E+05	
100414	Ethylbenzene		C	2.2E+02	5.1E+01		2.2E+03	5.1E+02		2.2E+04	5.1E+03		7.0E+02 †	
75218	Ethylene oxide		C	2.4E+00	1.4E+00		2.4E+01	1.4E+01		2.4E+02	1.4E+02		1.1E+02	
97632	Ethylmethacrylate	X	NC	3.2E+02	6.8E+01		3.2E+03	6.8E+02		3.2E+04	6.8E+03		9.1E+03	
86737	Fluorene	X	NC	1.4E+02	2.1E+01		1.4E+03	2.1E+02		**	**		**	
110009	Furan	X	NC	3.5E+00	1.3E+00		3.5E+01	1.3E+01		3.5E+02	1.3E+02		1.6E+01	
58899	gamma-HCH (Lindane)	X	C	6.6E-01	5.5E-02		6.6E+00	5.5E-01		6.6E+01	5.5E+00		1.1E+03	
76448	Heptachlor		C	1.9E-01	1.2E-02		1.9E+00	1.2E-01		1.9E+01	1.2E+00		4.0E-01 †	
87683	Hexachloro-1,3-butadiene		C	1.1E+01	1.0E+00		1.1E+02	1.0E+01		1.1E+03	1.0E+02		3.3E+01	
118741	Hexachlorobenzene		C	5.3E-01	4.5E-02		5.3E+00	4.5E-01		5.3E+01	4.5E+00		**	
77474	Hexachlorocyclopentadiene		NC	2.0E-01	1.8E-02		2.0E+00	1.8E-01		2.0E+01	1.8E+00		5.0E+01 †	
67721	Hexachloroethane		C	6.1E+01	6.3E+00		6.1E+02	6.3E+01		6.1E+03	6.3E+02		3.8E+02	
110543	Hexane		NC	2.0E+02	5.7E+01		2.0E+03	5.7E+02		2.0E+04	5.7E+03		2.9E+00	
74908	Hydrogen cyanide		NC	3.0E+00	2.7E+00		3.0E+01	2.7E+01		3.0E+02	2.7E+02		5.5E+02	
78831	Isobutanol	X	NC	1.1E+03	3.5E+02		1.1E+04	3.5E+03		1.1E+05	3.5E+04		2.2E+06	
7439976	Mercury (elemental)		NC	3.0E-01	3.7E-02		3.0E+00	3.7E-01		3.0E+01	3.7E+00		6.8E-01	
126987	Methacrylonitrile		NC	7.0E-01	2.6E-01		7.0E+00	2.6E+00		7.0E+01	2.6E+01		6.9E+01	
72435	Methoxychlor	X	NC	1.8E+01	1.2E+00		**	**		**	**		**	
79209	Methyl acetate	X	NC	3.5E+03	1.2E+03		3.5E+04	1.2E+04		3.5E+05	1.2E+05		7.2E+05	
96333	Methyl acrylate	X	NC	1.1E+02	3.0E+01		1.1E+03	3.0E+02		1.1E+04	3.0E+03		1.4E+04	

Table 2a: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-4}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-4}, HI=1) C_{target} (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
74839	Methyl bromide		NC	5.0E+00	1.3E+00		5.0E+01	1.3E+01		5.0E+02	1.3E+02		2.0E+01	
74873	Methyl chloride (chloromethane)		NC	9.0E+01	4.4E+01		9.0E+02	4.4E+02		9.0E+03	4.4E+03		2.5E+02	
108872	Methylcyclohexane		NC	3.0E+03	7.5E+02		3.0E+04	7.5E+03		3.0E+05	7.5E+04		7.1E+02	
74953	Methylene bromide	X	NC	3.5E+01	4.9E+00		3.5E+02	4.9E+01		3.5E+03	4.9E+02		9.9E+02	
75092	Methylene chloride		C	5.2E+02	1.5E+02		5.2E+03	1.5E+03		5.2E+04	1.5E+04		5.8E+03	
78933	Methylethylketone (2-butanone)		NC	1.0E+03	3.4E+02		1.0E+04	3.4E+03		1.0E+05	3.4E+04		4.4E+05	
108101	Methylisobutylketone		NC	8.0E+01	2.0E+01		8.0E+02	2.0E+02		8.0E+03	2.0E+03		1.4E+04	
80626	Methylmethacrylate		NC	7.0E+02	1.7E+02		7.0E+03	1.7E+03		7.0E+04	1.7E+04		5.1E+04	
91576	2-Methylnaphthalene	X	NC	7.0E+01	1.2E+01		7.0E+02	1.2E+02		7.0E+03	1.2E+03		3.3E+03	
1634044	MTBE		NC	3.0E+03	8.3E+02		3.0E+04	8.3E+03		3.0E+05	8.3E+04		1.2E+05	
108383	m-Xylene	X	NC	7.0E+03	1.6E+03		7.0E+04	1.6E+04		7.0E+05	1.6E+05		2.3E+04	
91203	Naphthalene		NC	3.0E+00	5.7E-01		3.0E+01	5.7E+00		3.0E+02	5.7E+01		1.5E+02	
104518	n-Butylbenzene	X	NC	1.4E+02	2.6E+01		1.4E+03	2.6E+02		1.4E+04	2.6E+03		2.6E+02	
98953	Nitrobenzene		NC	2.0E+00	4.0E-01		2.0E+01	4.0E+00		2.0E+02	4.0E+01		2.0E+03	
79469	2-Nitropropane		C	9.0E-02	2.5E-02		9.0E-01	2.5E-01		9.0E+00	2.5E+00		1.8E+01	
924163	N-Nitroso-di-n-butylamine		C	1.5E-01	2.4E-02		1.5E+00	2.4E-01		1.5E+01	2.4E+00		1.2E+01	
103651	n-Propylbenzene	X	NC	1.4E+02	2.8E+01		1.4E+03	2.8E+02		1.4E+04	2.8E+03		3.2E+02	
88722	o-Nitrotoluene	X	NC	3.5E+01	6.2E+00		3.5E+02	6.2E+01		3.5E+03	6.2E+02		6.8E+04	
95476	o-Xylene	X	NC	7.0E+03	1.6E+03		7.0E+04	1.6E+04		7.0E+05	1.6E+05		3.3E+04	
106423	p-Xylene	X	NC	7.0E+03	1.6E+03		7.0E+04	1.6E+04		7.0E+05	1.6E+05		2.2E+04	
129000	Pyrene	X	NC	1.1E+02	1.3E+01		**	**		**	**		**	
135988	sec-Butylbenzene	X	NC	1.4E+02	2.6E+01		1.4E+03	2.6E+02		1.4E+04	2.6E+03		2.5E+02	
100425	Styrene		NC	1.0E+03	2.3E+02		1.0E+04	2.3E+03		1.0E+05	2.3E+04		8.9E+03	
98066	tert-Butylbenzene	X	NC	1.4E+02	2.6E+01		1.4E+03	2.6E+02		1.4E+04	2.6E+03		2.9E+02	
630206	1,1,1,2-Tetrachloroethane		C	3.3E+01	4.8E+00		3.3E+02	4.8E+01		3.3E+03	4.8E+02		3.3E+02	
79345	1,1,2,2-Tetrachloroethane		C	4.2E+00	6.1E-01		4.2E+01	6.1E+00		4.2E+02	6.1E+01		3.0E+02	
127184	Tetrachloroethylene		C	8.1E+01	1.2E+01		8.1E+02	1.2E+02		8.1E+03	1.2E+03		1.1E+02	
108883	Toluene		NC	4.0E+02	1.1E+02		4.0E+03	1.1E+03		4.0E+04	1.1E+04		1.5E+03	
156605	trans-1,2-Dichloroethylene	X	NC	7.0E+01	1.8E+01		7.0E+02	1.8E+02		7.0E+03	1.8E+03		1.8E+02	
76131	1,1,2-Trichloro-1,2,2-trifluoroethane		NC	3.0E+04	3.9E+03		3.0E+05	3.9E+04		3.0E+06	3.9E+05		1.5E+03	
120821	1,2,4-Trichlorobenzene		NC	2.0E+02	2.7E+01		2.0E+03	2.7E+02		2.0E+04	2.7E+03		3.4E+03	
79005	1,1,2-Trichloroethane		C	1.5E+01	2.8E+00		1.5E+02	2.8E+01		1.5E+03	2.8E+02		4.1E+02	
71556	1,1,1-Trichloroethane		NC	2.2E+03	4.0E+02		2.2E+04	4.0E+03		2.2E+05	4.0E+04		3.1E+03	
79016	Trichloroethylene [††]	X	C	2.2E+00	4.1E-01		2.2E+01	4.1E+00		2.2E+02	4.1E+01		5.3E+00	
75694	Trichlorofluoromethane		NC	7.0E+02	1.2E+02		7.0E+03	1.2E+03		7.0E+04	1.2E+04		1.8E+02	
96184	1,2,3-Trichloropropane		NC	4.9E+00	8.1E-01		4.9E+01	8.1E+00		4.9E+02	8.1E+01		2.9E+02	
95636	1,2,4-Trimethylbenzene		NC	6.0E+00	1.2E+00		6.0E+01	1.2E+01		6.0E+02	1.2E+02		2.4E+01	

Table 2a: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-4}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-4}, HI=1) C_{target} (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m^3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
108678	1,3,5-Trimethylbenzene		NC	6.0E+00	1.2E+00		6.0E+01	1.2E+01		6.0E+02	1.2E+02		2.5E+01	
108054	Vinyl acetate		NC	2.0E+02	5.7E+01		2.0E+03	5.7E+02		2.0E+04	5.7E+03		9.6E+03	
75014	Vinyl chloride (chloroethene)		C	2.8E+01	1.1E+01		2.8E+02	1.1E+02		2.8E+03	1.1E+03		2.5E+01	

[1] AF = 0.1 for Shallow Soil Gas Target Concentration
AF = 0.01 for Deep Soil Gas Target Concentration
AF = 0.001 for Groundwater Target Concentration

* Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete)

** Target soil gas concentration exceeds maximum possible vapor concentration (pathway incomplete)

† The target groundwater concentration is the MCL. (The MCL for chloroform is the MCL for total Trihalomethanes. The MCL listed for m-Xylene, o-Xylene, and p-Xylene is the MCL for total Xylenes.)

†† The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further. (See Appendix D.)

Table 2b: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-5}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-5}, HI=1) C_{target} (ug/m3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
83329	Acenaphthene	X	NC	2.1E+02	3.3E+01		2.1E+03	3.3E+02		2.1E+04	3.3E+03		**	
75070	Acetaldehyde		NC	9.0E+00	5.0E+00		9.0E+01	5.0E+01		9.0E+02	5.0E+02		2.8E+03	
67641	Acetone	X	NC	3.5E+02	1.5E+02		3.5E+03	1.5E+03		3.5E+04	1.5E+04		2.2E+05	
75058	Acetonitrile		NC	6.0E+01	3.6E+01		6.0E+02	3.6E+02		6.0E+03	3.6E+03		4.2E+04	
98862	Acetophenone	X	NC	3.5E+02	7.1E+01		3.5E+03	7.1E+02		3.5E+04	7.1E+03		8.0E+05	
107028	Acrolein		NC	2.0E-02	8.7E-03		2.0E-01	8.7E-02		2.0E+00	8.7E-01		4.0E+00	
107131	Acrylonitrile		C	3.6E-01	1.7E-01		3.6E+00	1.7E+00		3.6E+01	1.7E+01		8.5E+01	
309002	Aldrin		C	5.0E-03	3.3E-04		5.0E-02	3.3E-03		5.0E-01	3.3E-02		7.1E-01	
319846	alpha-HCH (alpha-BHC)		C	1.4E-02	1.1E-03		1.4E-01	1.1E-02		1.4E+00	1.1E-01		3.1E+01	
100527	Benzaldehyde	X	NC	3.5E+02	8.1E+01		3.5E+03	8.1E+02		3.5E+04	8.1E+03		3.6E+05	
71432	Benzene		C	3.1E+00	9.8E-01		3.1E+01	9.8E+00		3.1E+02	9.8E+01		1.4E+01	
205992	Benzo(b)fluoranthene	X	C	1.2E-01	1.1E-02		1.2E+00	1.1E-01		**	**		**	
100447	Benzylchloride	X	C	5.0E-01	9.7E-02		5.0E+00	9.7E-01		5.0E+01	9.7E+00		3.0E+01	
91587	beta-Chloronaphthalene	X	NC	2.8E+02	4.2E+01		2.8E+03	4.2E+02		2.8E+04	4.2E+03		**	
92524	Biphenyl	X	NC	1.8E+02	2.8E+01		1.8E+03	2.8E+02		1.8E+04	2.8E+03		**	
111444	Bis(2-chloroethyl)ether		C	7.4E-02	1.3E-02		7.4E-01	1.3E-01		7.4E+00	1.3E+00		1.0E+02	
108601	Bis(2-chloroisopropyl)ether		C	2.4E+00	3.5E-01		2.4E+01	3.5E+00		2.4E+02	3.5E+01		5.1E+02	
542881	Bis(chloromethyl)ether		C	3.9E-04	8.4E-05		3.9E-03	8.4E-04		3.9E-02	8.4E-03		4.5E-02	
75274	Bromodichloromethane	X	C	1.4E+00	2.1E-01		1.4E+01	2.1E+00		1.4E+02	2.1E+01		2.1E+01	
75252	Bromoform		C	2.2E+01	2.1E+00		2.2E+02	2.1E+01		2.2E+03	2.1E+02		8.3E-02	
106990	1,3-Butadiene		C	8.7E-02	3.9E-02		8.7E-01	3.9E-01		8.7E+00	3.9E+00		2.9E-02	
75150	Carbon disulfide		NC	7.0E+02	2.2E+02		7.0E+03	2.2E+03		7.0E+04	2.2E+04		5.6E+02	
56235	Carbon tetrachloride		C	1.6E+00	2.6E-01		1.6E+01	2.6E+00		1.6E+02	2.6E+01		5.0E+00 †	
57749	Chlordane		C	2.4E-01	1.5E-02		2.4E+00	1.5E-01		2.4E+01	1.5E+00		**	
126998	2-Chloro-1,3-butadiene (chloroprene)		NC	7.0E+00	1.9E+00		7.0E+01	1.9E+01		7.0E+02	1.9E+02		1.4E+01	
108907	Chlorobenzene		NC	6.0E+01	1.3E+01		6.0E+02	1.3E+02		6.0E+03	1.3E+03		3.9E+02	
109693	1-Chlorobutane	X	NC	1.4E+03	3.7E+02		1.4E+04	3.7E+03		1.4E+05	3.7E+04		2.0E+03	
124481	Chlorodibromomethane	X	C	1.0E+00	1.2E-01		1.0E+01	1.2E+00		1.0E+02	1.2E+01		3.2E+01	
75456	Chlorodifluoromethane		NC	5.0E+04	1.4E+04		5.0E+05	1.4E+05		**	**		**	
75003	Chloroethane (ethyl chloride)		NC	1.0E+04	3.8E+03		1.0E+05	3.8E+04		1.0E+06	3.8E+05		2.8E+04	
67663	Chloroform		C	1.1E+00	2.2E-01		1.1E+01	2.2E+00		1.1E+02	2.2E+01		8.0E+01 †	
95578	2-Chlorophenol	X	NC	1.8E+01	3.3E+00		1.8E+02	3.3E+01		1.8E+03	3.3E+02		1.1E+03	
75296	2-Chloropropane		NC	1.0E+02	3.2E+01		1.0E+03	3.2E+02		1.0E+04	3.2E+03		1.7E+02	
218019	Chrysene	X	C	1.2E+01	1.2E+00		**	**		**	**		**	
156592	cis-1,2-Dichloroethylene	X	NC	3.5E+01	8.8E+00		3.5E+02	8.8E+01		3.5E+03	8.8E+02		2.1E+02	
123739	Crotonaldehyde (2-butenal)	X	C	4.5E-02	1.6E-02		4.5E-01	1.6E-01		4.5E+00	1.6E+00		5.6E+01	
98828	Cumene		NC	4.0E+02	8.1E+01		4.0E+03	8.1E+02		4.0E+04	8.1E+03		8.4E+00	

Table 2b: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-5}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-5}, HI=1) C_{target} (ug/m3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
72559	DDE	X	C	2.5E-01	1.9E-02		2.5E+00	1.9E-01		2.5E+01	1.9E+00		**	
132649	Dibenzofuran	X	NC	1.4E+01	2.0E+00		1.4E+02	2.0E+01		1.4E+03	2.0E+02		**	
96128	1,2-Dibromo-3-chloropropane		NC	2.0E-01	2.1E-02		2.0E+00	2.1E-01		2.0E+01	2.1E+00		3.3E+01	
106934	1,2-Dibromoethane (ethylene dibromide)		C	1.1E-01	1.4E-02		1.1E+00	1.4E-01		1.1E+01	1.4E+00		3.6E+00	
541731	1,3-Dichlorobenzene	X	NC	1.1E+02	1.7E+01		1.1E+03	1.7E+02		1.1E+04	1.7E+03		8.3E+02	
95501	1,2-Dichlorobenzene		NC	2.0E+02	3.3E+01		2.0E+03	3.3E+02		2.0E+04	3.3E+03		2.6E+03	
106467	1,4-Dichlorobenzene		NC	8.0E+02	1.3E+02		8.0E+03	1.3E+03		8.0E+04	1.3E+04		8.2E+03	
75718	Dichlorodifluoromethane		NC	2.0E+02	4.0E+01		2.0E+03	4.0E+02		2.0E+04	4.0E+03		1.4E+01	
75343	1,1-Dichloroethane		NC	5.0E+02	1.2E+02		5.0E+03	1.2E+03		5.0E+04	1.2E+04		2.2E+03	
107062	1,2-Dichloroethane		C	9.4E-01	2.3E-01		9.4E+00	2.3E+00		9.4E+01	2.3E+01		2.3E+01	
75354	1,1-Dichloroethylene		NC	2.0E+02	5.0E+01		2.0E+03	5.0E+02		2.0E+04	5.0E+03		1.9E+02	
78875	1,2-Dichloropropane		NC	4.0E+00	8.7E-01		4.0E+01	8.7E+00		4.0E+02	8.7E+01		3.5E+01	
542756	1,3-Dichloropropene		C	6.1E+00	1.3E+00		6.1E+01	1.3E+01		6.1E+02	1.3E+02		8.4E+00	
60571	Dieldrin		C	5.3E-03	3.4E-04		5.3E-02	3.4E-03		5.3E-01	3.4E-02		8.6E+00	
115297	Endosulfan	X	NC	2.1E+01	1.3E+00		2.1E+02	1.3E+01		**	**		**	
106898	Epichlorohydrin		NC	1.0E+00	2.6E-01		1.0E+01	2.6E+00		1.0E+02	2.6E+01		8.0E+02	
60297	Ethyl ether	X	NC	7.0E+02	2.3E+02		7.0E+03	2.3E+03		7.0E+04	2.3E+04		5.2E+02	
141786	Ethylacetate	X	NC	3.2E+03	8.7E+02		3.2E+04	8.7E+03		3.2E+05	8.7E+04		5.6E+05	
100414	Ethylbenzene		C	2.2E+01	5.1E+00		2.2E+02	5.1E+01		2.2E+03	5.1E+02		7.0E+02 †	
75218	Ethylene oxide		C	2.4E-01	1.4E-01		2.4E+00	1.4E+00		2.4E+01	1.4E+01		1.1E+01	
97632	Ethylmethacrylate	X	NC	3.2E+02	6.8E+01		3.2E+03	6.8E+02		3.2E+04	6.8E+03		9.1E+03	
86737	Fluorene	X	NC	1.4E+02	2.1E+01		1.4E+03	2.1E+02		**	**		**	
110009	Furan	X	NC	3.5E+00	1.3E+00		3.5E+01	1.3E+01		3.5E+02	1.3E+02		1.6E+01	
58899	gamma-HCH (Lindane)	X	C	6.6E-02	5.5E-03		6.6E-01	5.5E-02		6.6E+00	5.5E-01		1.1E+02	
76448	Heptachlor		C	1.9E-02	1.2E-03		1.9E-01	1.2E-02		1.9E+00	1.2E-01		4.0E-01 †	
87683	Hexachloro-1,3-butadiene		C	1.1E+00	1.0E-01		1.1E+01	1.0E+00		1.1E+02	1.0E+01		3.3E+00	
118741	Hexachlorobenzene		C	5.3E-02	4.5E-03		5.3E-01	4.5E-02		5.3E+00	4.5E-01		1.0E+00 †	
77474	Hexachlorocyclopentadiene		NC	2.0E-01	1.8E-02		2.0E+00	1.8E-01		2.0E+01	1.8E+00		5.0E+01 †	
67721	Hexachloroethane		C	6.1E+00	6.3E-01		6.1E+01	6.3E+00		6.1E+02	6.3E+01		3.8E+01	
110543	Hexane		NC	2.0E+02	5.7E+01		2.0E+03	5.7E+02		2.0E+04	5.7E+03		2.9E+00	
74908	Hydrogen cyanide		NC	3.0E+00	2.7E+00		3.0E+01	2.7E+01		3.0E+02	2.7E+02		5.5E+02	
78831	Isobutanol	X	NC	1.1E+03	3.5E+02		1.1E+04	3.5E+03		1.1E+05	3.5E+04		2.2E+06	
7439976	Mercury (elemental)		NC	3.0E-01	3.7E-02		3.0E+00	3.7E-01		3.0E+01	3.7E+00		6.8E-01	
126987	Methacrylonitrile		NC	7.0E-01	2.6E-01		7.0E+00	2.6E+00		7.0E+01	2.6E+01		6.9E+01	
72435	Methoxychlor	X	NC	1.8E+01	1.2E+00		**	**		**	**		**	
79209	Methyl acetate	X	NC	3.5E+03	1.2E+03		3.5E+04	1.2E+04		3.5E+05	1.2E+05		7.2E+05	
96333	Methyl acrylate	X	NC	1.1E+02	3.0E+01		1.1E+03	3.0E+02		1.1E+04	3.0E+03		1.4E+04	

Table 2b: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-5}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-5}, HI=1) C_{target} (ug/m3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
74839	Methyl bromide		NC	5.0E+00	1.3E+00		5.0E+01	1.3E+01		5.0E+02	1.3E+02		2.0E+01	
74873	Methyl chloride (chloromethane)		C	2.4E+01	1.2E+01		2.4E+02	1.2E+02		2.4E+03	1.2E+03		6.7E+01	
108872	Methylcyclohexane		NC	3.0E+03	7.5E+02		3.0E+04	7.5E+03		3.0E+05	7.5E+04		7.1E+02	
74953	Methylene bromide	X	NC	3.5E+01	4.9E+00		3.5E+02	4.9E+01		3.5E+03	4.9E+02		9.9E+02	
75092	Methylene chloride		C	5.2E+01	1.5E+01		5.2E+02	1.5E+02		5.2E+03	1.5E+03		5.8E+02	
78933	Methylethylketone (2-butanone)		NC	1.0E+03	3.4E+02		1.0E+04	3.4E+03		1.0E+05	3.4E+04		4.4E+05	
108101	Methylisobutylketone		NC	8.0E+01	2.0E+01		8.0E+02	2.0E+02		8.0E+03	2.0E+03		1.4E+04	
80626	Methylmethacrylate		NC	7.0E+02	1.7E+02		7.0E+03	1.7E+03		7.0E+04	1.7E+04		5.1E+04	
91576	2-Methylnaphthalene	X	NC	7.0E+01	1.2E+01		7.0E+02	1.2E+02		7.0E+03	1.2E+03		3.3E+03	
1634044	MTBE		NC	3.0E+03	8.3E+02		3.0E+04	8.3E+03		3.0E+05	8.3E+04		1.2E+05	
108383	m-Xylene	X	NC	7.0E+03	1.6E+03		7.0E+04	1.6E+04		7.0E+05	1.6E+05		2.3E+04	
91203	Naphthalene		NC	3.0E+00	5.7E-01		3.0E+01	5.7E+00		3.0E+02	5.7E+01		1.5E+02	
104518	n-Butylbenzene	X	NC	1.4E+02	2.6E+01		1.4E+03	2.6E+02		1.4E+04	2.6E+03		2.6E+02	
98953	Nitrobenzene		NC	2.0E+00	4.0E-01		2.0E+01	4.0E+00		2.0E+02	4.0E+01		2.0E+03	
79469	2-Nitropropane		C	9.0E-03	2.5E-03		9.0E-02	2.5E-02		9.0E-01	2.5E-01		1.8E+00	
924163	N-Nitroso-di-n-butylamine		C	1.5E-02	2.4E-03		1.5E-01	2.4E-02		1.5E+00	2.4E-01		1.2E+00	
103651	n-Propylbenzene	X	NC	1.4E+02	2.8E+01		1.4E+03	2.8E+02		1.4E+04	2.8E+03		3.2E+02	
88722	o-Nitrotoluene	X	NC	3.5E+01	6.2E+00		3.5E+02	6.2E+01		3.5E+03	6.2E+02		6.8E+04	
95476	o-Xylene	X	NC	7.0E+03	1.6E+03		7.0E+04	1.6E+04		7.0E+05	1.6E+05		3.3E+04	
106423	p-Xylene	X	NC	7.0E+03	1.6E+03		7.0E+04	1.6E+04		7.0E+05	1.6E+05		2.2E+04	
129000	Pyrene	X	NC	1.1E+02	1.3E+01		**	**		**	**		**	
135988	sec-Butylbenzene	X	NC	1.4E+02	2.6E+01		1.4E+03	2.6E+02		1.4E+04	2.6E+03		2.5E+02	
100425	Styrene		NC	1.0E+03	2.3E+02		1.0E+04	2.3E+03		1.0E+05	2.3E+04		8.9E+03	
98066	tert-Butylbenzene	X	NC	1.4E+02	2.6E+01		1.4E+03	2.6E+02		1.4E+04	2.6E+03		2.9E+02	
630206	1,1,1,2-Tetrachloroethane		C	3.3E+00	4.8E-01		3.3E+01	4.8E+00		3.3E+02	4.8E+01		3.3E+01	
79345	1,1,2,2-Tetrachloroethane		C	4.2E-01	6.1E-02		4.2E+00	6.1E-01		4.2E+01	6.1E+00		3.0E+01	
127184	Tetrachloroethylene		C	8.1E+00	1.2E+00		8.1E+01	1.2E+01		8.1E+02	1.2E+02		1.1E+01	
108883	Toluene		NC	4.0E+02	1.1E+02		4.0E+03	1.1E+03		4.0E+04	1.1E+04		1.5E+03	
156605	trans-1,2-Dichloroethylene	X	NC	7.0E+01	1.8E+01		7.0E+02	1.8E+02		7.0E+03	1.8E+03		1.8E+02	
76131	1,1,2-Trichloro-1,2,2-trifluoroethane		NC	3.0E+04	3.9E+03		3.0E+05	3.9E+04		3.0E+06	3.9E+05		1.5E+03	
120821	1,2,4-Trichlorobenzene		NC	2.0E+02	2.7E+01		2.0E+03	2.7E+02		2.0E+04	2.7E+03		3.4E+03	
79005	1,1,2-Trichloroethane		C	1.5E+00	2.8E-01		1.5E+01	2.8E+00		1.5E+02	2.8E+01		4.1E+01	
71556	1,1,1-Trichloroethane		NC	2.2E+03	4.0E+02		2.2E+04	4.0E+03		2.2E+05	4.0E+04		3.1E+03	
79016	Trichloroethylene ††	X	C	2.2E-01	4.1E-02		2.2E+00	4.1E-01		2.2E+01	4.1E+00		5.0E+00 †	
75694	Trichlorofluoromethane		NC	7.0E+02	1.2E+02		7.0E+03	1.2E+03		7.0E+04	1.2E+04		1.8E+02	
96184	1,2,3-Trichloropropane		NC	4.9E+00	8.1E-01		4.9E+01	8.1E+00		4.9E+02	8.1E+01		2.9E+02	
95636	1,2,4-Trimethylbenzene		NC	6.0E+00	1.2E+00		6.0E+01	1.2E+01		6.0E+02	1.2E+02		2.4E+01	

Table 2b: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-5}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-5}, HI=1) C_{target} (ug/m3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
108678	1,3,5-Trimethylbenzene		NC	6.0E+00	1.2E+00		6.0E+01	1.2E+01		6.0E+02	1.2E+02		2.5E+01	
108054	Vinyl acetate		NC	2.0E+02	5.7E+01		2.0E+03	5.7E+02		2.0E+04	5.7E+03		9.6E+03	
75014	Vinyl chloride (chloroethene)		C	2.8E+00	1.1E+00		2.8E+01	1.1E+01		2.8E+02	1.1E+02		2.5E+00	

[1] AF = 0.1 for Shallow Soil Gas Target Concentration
AF = 0.01 for Deep Soil Gas Target Concentration
AF = 0.001 for Groundwater Target Concentration

* Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete)

** Target soil gas concentration exceeds maximum possible vapor concentration (pathway incomplete)

† The target groundwater concentration is the MCL. (The MCL for chloroform is the MCL for total Trihalomethanes. The MCL listed for m-Xylene, o-Xylene, and p-Xylene is the MCL for total Xylenes.)

†† The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further. (See Appendix D.)

Table 2c: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-6}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-6}, HI=1] C_{target} (ug/m3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
83329	Acenaphthene	X	NC	2.1E+02	3.3E+01		2.1E+03	3.3E+02		2.1E+04	3.3E+03		**	
75070	Acetaldehyde		C	1.1E+00	6.1E-01		1.1E+01	6.1E+00		1.1E+02	6.1E+01		3.4E+02	
67641	Acetone	X	NC	3.5E+02	1.5E+02		3.5E+03	1.5E+03		3.5E+04	1.5E+04		2.2E+05	
75058	Acetonitrile		NC	6.0E+01	3.6E+01		6.0E+02	3.6E+02		6.0E+03	3.6E+03		4.2E+04	
98862	Acetophenone	X	NC	3.5E+02	7.1E+01		3.5E+03	7.1E+02		3.5E+04	7.1E+03		8.0E+05	
107028	Acrolein		NC	2.0E-02	8.7E-03		2.0E-01	8.7E-02		2.0E+00	8.7E-01		4.0E+00	
107131	Acrylonitrile		C	3.6E-02	1.7E-02		3.6E-01	1.7E-01		3.6E+00	1.7E+00		8.5E+00	
309002	Aldrin		C	5.0E-04	3.3E-05		5.0E-03	3.3E-04		5.0E-02	3.3E-03		7.1E-02	
319846	alpha-HCH (alpha-BHC)		C	1.4E-03	1.1E-04		1.4E-02	1.1E-03		1.4E-01	1.1E-02		3.1E+00	
100527	Benzaldehyde	X	NC	3.5E+02	8.1E+01		3.5E+03	8.1E+02		3.5E+04	8.1E+03		3.6E+05	
71432	Benzene		C	3.1E-01	9.8E-02		3.1E+00	9.8E-01		3.1E+01	9.8E+00		5.0E+00 †	
205992	Benzo(b)fluoranthene	X	C	1.2E-02	1.1E-03		1.2E-01	1.1E-02		1.2E+00	1.1E-01		**	
100447	Benzylchloride	X	C	5.0E-02	9.7E-03		5.0E-01	9.7E-02		5.0E+00	9.7E-01		3.0E+00	
91587	beta-Chloronaphthalene	X	NC	2.8E+02	4.2E+01		2.8E+03	4.2E+02		2.8E+04	4.2E+03		**	
92524	Biphenyl	X	NC	1.8E+02	2.8E+01		1.8E+03	2.8E+02		1.8E+04	2.8E+03		**	
111444	Bis(2-chloroethyl)ether		C	7.4E-03	1.3E-03		7.4E-02	1.3E-02		7.4E-01	1.3E-01		1.0E+01	
108601	Bis(2-chloroisopropyl)ether		C	2.4E-01	3.5E-02		2.4E+00	3.5E-01		2.4E+01	3.5E+00		5.1E+01	
542881	Bis(chloromethyl)ether		C	3.9E-05	8.4E-06		3.9E-04	8.4E-05		3.9E-03	8.4E-04		4.5E-03	
75274	Bromodichloromethane	X	C	1.4E-01	2.1E-02		1.4E+00	2.1E-01		1.4E+01	2.1E+00		2.1E+00	
75252	Bromoform		C	2.2E+00	2.1E-01		2.2E+01	2.1E+00		2.2E+02	2.1E+01		8.3E-03	
106990	1,3-Butadiene		C	8.7E-03	3.9E-03		8.7E-02	3.9E-02		8.7E-01	3.9E-01		2.9E-03	
75150	Carbon disulfide		NC	7.0E+02	2.2E+02		7.0E+03	2.2E+03		7.0E+04	2.2E+04		5.6E+02	
56235	Carbon tetrachloride		C	1.6E-01	2.6E-02		1.6E+00	2.6E-01		1.6E+01	2.6E+00		5.0E+00 †	
57749	Chlordane		C	2.4E-02	1.5E-03		2.4E-01	1.5E-02		2.4E+00	1.5E-01		1.2E+01	
126998	2-Chloro-1,3-butadiene (chloroprene)		NC	7.0E+00	1.9E+00		7.0E+01	1.9E+01		7.0E+02	1.9E+02		1.4E+01	
108907	Chlorobenzene		NC	6.0E+01	1.3E+01		6.0E+02	1.3E+02		6.0E+03	1.3E+03		3.9E+02	
109693	1-Chlorobutane	X	NC	1.4E+03	3.7E+02		1.4E+04	3.7E+03		1.4E+05	3.7E+04		2.0E+03	
124481	Chlorodibromomethane	X	C	1.0E-01	1.2E-02		1.0E+00	1.2E-01		1.0E+01	1.2E+00		3.2E+00	
75456	Chlorodifluoromethane		NC	5.0E+04	1.4E+04		5.0E+05	1.4E+05		**	**		**	
75003	Chloroethane (ethyl chloride)		NC	1.0E+04	3.8E+03		1.0E+05	3.8E+04		1.0E+06	3.8E+05		2.8E+04	
67663	Chloroform		C	1.1E-01	2.2E-02		1.1E+00	2.2E-01		1.1E+01	2.2E+00		8.0E+01 †	
95578	2-Chlorophenol	X	NC	1.8E+01	3.3E+00		1.8E+02	3.3E+01		1.8E+03	3.3E+02		1.1E+03	
75296	2-Chloropropane		NC	1.0E+02	3.2E+01		1.0E+03	3.2E+02		1.0E+04	3.2E+03		1.7E+02	
218019	Chrysene	X	C	1.2E+00	1.2E-01		1.2E+01	1.2E+00		**	**		**	
156592	cis-1,2-Dichloroethylene	X	NC	3.5E+01	8.8E+00		3.5E+02	8.8E+01		3.5E+03	8.8E+02		2.1E+02	
123739	Crotonaldehyde (2-butenal)	X	C	4.5E-03	1.6E-03		4.5E-02	1.6E-02		4.5E-01	1.6E-01		5.6E+00	
98828	Cumene		NC	4.0E+02	8.1E+01		4.0E+03	8.1E+02		4.0E+04	8.1E+03		8.4E+00	

Table 2c: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-6}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-6}, HI=1) C_{target} (ug/m3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
72559	DDE	X	C	2.5E-02	1.9E-03		2.5E-01	1.9E-02		2.5E+00	1.9E-01		2.9E+01	
132649	Dibenzofuran	X	NC	1.4E+01	2.0E+00		1.4E+02	2.0E+01		1.4E+03	2.0E+02		**	
96128	1,2-Dibromo-3-chloropropane		NC	2.0E-01	2.1E-02		2.0E+00	2.1E-01		2.0E+01	2.1E+00		3.3E+01	
106934	1,2-Dibromoethane (ethylene dibromide)		C	1.1E-02	1.4E-03		1.1E-01	1.4E-02		1.1E+00	1.4E-01		3.6E-01	
541731	1,3-Dichlorobenzene	X	NC	1.1E+02	1.7E+01		1.1E+03	1.7E+02		1.1E+04	1.7E+03		8.3E+02	
95501	1,2-Dichlorobenzene		NC	2.0E+02	3.3E+01		2.0E+03	3.3E+02		2.0E+04	3.3E+03		2.6E+03	
106467	1,4-Dichlorobenzene		NC	8.0E+02	1.3E+02		8.0E+03	1.3E+03		8.0E+04	1.3E+04		8.2E+03	
75718	Dichlorodifluoromethane		NC	2.0E+02	4.0E+01		2.0E+03	4.0E+02		2.0E+04	4.0E+03		1.4E+01	
75343	1,1-Dichloroethane		NC	5.0E+02	1.2E+02		5.0E+03	1.2E+03		5.0E+04	1.2E+04		2.2E+03	
107062	1,2-Dichloroethane		C	9.4E-02	2.3E-02		9.4E-01	2.3E-01		9.4E+00	2.3E+00		5.0E+00 †	
75354	1,1-Dichloroethylene		NC	2.0E+02	5.0E+01		2.0E+03	5.0E+02		2.0E+04	5.0E+03		1.9E+02	
78875	1,2-Dichloropropane		NC	4.0E+00	8.7E-01		4.0E+01	8.7E+00		4.0E+02	8.7E+01		3.5E+01	
542756	1,3-Dichloropropene		C	6.1E-01	1.3E-01		6.1E+00	1.3E+00		6.1E+01	1.3E+01		8.4E-01	
60571	Dieldrin		C	5.3E-04	3.4E-05		5.3E-03	3.4E-04		5.3E-02	3.4E-03		8.6E-01	
115297	Endosulfan	X	NC	2.1E+01	1.3E+00		2.1E+02	1.3E+01		**	**		**	
106898	Epichlorohydrin		NC	1.0E+00	2.6E-01		1.0E+01	2.6E+00		1.0E+02	2.6E+01		8.0E+02	
60297	Ethyl ether	X	NC	7.0E+02	2.3E+02		7.0E+03	2.3E+03		7.0E+04	2.3E+04		5.2E+02	
141786	Ethylacetate	X	NC	3.2E+03	8.7E+02		3.2E+04	8.7E+03		3.2E+05	8.7E+04		5.6E+05	
100414	Ethylbenzene		C	2.2E+00	5.1E-01		2.2E+01	5.1E+00		2.2E+02	5.1E+01		7.0E+02 †	
75218	Ethylene oxide		C	2.4E-02	1.4E-02		2.4E-01	1.4E-01		2.4E+00	1.4E+00		1.1E+00	
97632	Ethylmethacrylate	X	NC	3.2E+02	6.8E+01		3.2E+03	6.8E+02		3.2E+04	6.8E+03		9.1E+03	
86737	Fluorene	X	NC	1.4E+02	2.1E+01		1.4E+03	2.1E+02		**	**		**	
110009	Furan	X	NC	3.5E+00	1.3E+00		3.5E+01	1.3E+01		3.5E+02	1.3E+02		1.6E+01	
58899	gamma-HCH (Lindane)	X	C	6.6E-03	5.5E-04		6.6E-02	5.5E-03		6.6E-01	5.5E-02		1.1E+01	
76448	Heptachlor		C	1.9E-03	1.2E-04		1.9E-02	1.2E-03		1.9E-01	1.2E-02		4.0E-01 †	
87683	Hexachloro-1,3-butadiene		C	1.1E-01	1.0E-02		1.1E+00	1.0E-01		1.1E+01	1.0E+00		3.3E-01	
118741	Hexachlorobenzene		C	5.3E-03	4.5E-04		5.3E-02	4.5E-03		5.3E-01	4.5E-02		1.0E+00 †	
77474	Hexachlorocyclopentadiene		NC	2.0E-01	1.8E-02		2.0E+00	1.8E-01		2.0E+01	1.8E+00		5.0E+01 †	
67721	Hexachloroethane		C	6.1E-01	6.3E-02		6.1E+00	6.3E-01		6.1E+01	6.3E+00		3.8E+00	
110543	Hexane		NC	2.0E+02	5.7E+01		2.0E+03	5.7E+02		2.0E+04	5.7E+03		2.9E+00	
74908	Hydrogen cyanide		NC	3.0E+00	2.7E+00		3.0E+01	2.7E+01		3.0E+02	2.7E+02		5.5E+02	
78831	Isobutanol	X	NC	1.1E+03	3.5E+02		1.1E+04	3.5E+03		1.1E+05	3.5E+04		2.2E+06	
7439976	Mercury (elemental)		NC	3.0E-01	3.7E-02		3.0E+00	3.7E-01		3.0E+01	3.7E+00		6.8E-01	
126987	Methacrylonitrile		NC	7.0E-01	2.6E-01		7.0E+00	2.6E+00		7.0E+01	2.6E+01		6.9E+01	
72435	Methoxychlor	X	NC	1.8E+01	1.2E+00		**	**		**	**		**	
79209	Methyl acetate	X	NC	3.5E+03	1.2E+03		3.5E+04	1.2E+04		3.5E+05	1.2E+05		7.2E+05	
96333	Methyl acrylate	X	NC	1.1E+02	3.0E+01		1.1E+03	3.0E+02		1.1E+04	3.0E+03		1.4E+04	

Table 2c: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-6}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-6}, HI=1) C_{target} (ug/m3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
74839	Methyl bromide		NC	5.0E+00	1.3E+00		5.0E+01	1.3E+01		5.0E+02	1.3E+02		2.0E+01	
74873	Methyl chloride (chloromethane)		C	2.4E+00	1.2E+00		2.4E+01	1.2E+01		2.4E+02	1.2E+02		6.7E+00	
108872	Methylcyclohexane		NC	3.0E+03	7.5E+02		3.0E+04	7.5E+03		3.0E+05	7.5E+04		7.1E+02	
74953	Methylene bromide	X	NC	3.5E+01	4.9E+00		3.5E+02	4.9E+01		3.5E+03	4.9E+02		9.9E+02	
75092	Methylene chloride		C	5.2E+00	1.5E+00		5.2E+01	1.5E+01		5.2E+02	1.5E+02		5.8E+01	
78933	Methylethylketone (2-butanone)		NC	1.0E+03	3.4E+02		1.0E+04	3.4E+03		1.0E+05	3.4E+04		4.4E+05	
108101	Methylisobutylketone		NC	8.0E+01	2.0E+01		8.0E+02	2.0E+02		8.0E+03	2.0E+03		1.4E+04	
80626	Methylmethacrylate		NC	7.0E+02	1.7E+02		7.0E+03	1.7E+03		7.0E+04	1.7E+04		5.1E+04	
91576	2-Methylnaphthalene	X	NC	7.0E+01	1.2E+01		7.0E+02	1.2E+02		7.0E+03	1.2E+03		3.3E+03	
1634044	MTBE		NC	3.0E+03	8.3E+02		3.0E+04	8.3E+03		3.0E+05	8.3E+04		1.2E+05	
108383	m-Xylene	X	NC	7.0E+03	1.6E+03		7.0E+04	1.6E+04		7.0E+05	1.6E+05		2.3E+04	
91203	Naphthalene		NC	3.0E+00	5.7E-01		3.0E+01	5.7E+00		3.0E+02	5.7E+01		1.5E+02	
104518	n-Butylbenzene	X	NC	1.4E+02	2.6E+01		1.4E+03	2.6E+02		1.4E+04	2.6E+03		2.6E+02	
98953	Nitrobenzene		NC	2.0E+00	4.0E-01		2.0E+01	4.0E+00		2.0E+02	4.0E+01		2.0E+03	
79469	2-Nitropropane		C	9.0E-04	2.5E-04		9.0E-03	2.5E-03		9.0E-02	2.5E-02		1.8E-01	
924163	N-Nitroso-di-n-butylamine		C	1.5E-03	2.4E-04		1.5E-02	2.4E-03		1.5E-01	2.4E-02		1.2E-01	
103651	n-Propylbenzene	X	NC	1.4E+02	2.8E+01		1.4E+03	2.8E+02		1.4E+04	2.8E+03		3.2E+02	
88722	o-Nitrotoluene	X	NC	3.5E+01	6.2E+00		3.5E+02	6.2E+01		3.5E+03	6.2E+02		6.8E+04	
95476	o-Xylene	X	NC	7.0E+03	1.6E+03		7.0E+04	1.6E+04		7.0E+05	1.6E+05		3.3E+04	
106423	p-Xylene	X	NC	7.0E+03	1.6E+03		7.0E+04	1.6E+04		7.0E+05	1.6E+05		2.2E+04	
129000	Pyrene	X	NC	1.1E+02	1.3E+01		**	**		**	**		**	
135988	sec-Butylbenzene	X	NC	1.4E+02	2.6E+01		1.4E+03	2.6E+02		1.4E+04	2.6E+03		2.5E+02	
100425	Styrene		NC	1.0E+03	2.3E+02		1.0E+04	2.3E+03		1.0E+05	2.3E+04		8.9E+03	
98066	tert-Butylbenzene	X	NC	1.4E+02	2.6E+01		1.4E+03	2.6E+02		1.4E+04	2.6E+03		2.9E+02	
630206	1,1,1,2-Tetrachloroethane		C	3.3E-01	4.8E-02		3.3E+00	4.8E-01		3.3E+01	4.8E+00		3.3E+00	
79345	1,1,2,2-Tetrachloroethane		C	4.2E-02	6.1E-03		4.2E-01	6.1E-02		4.2E+00	6.1E-01		3.0E+00	
127184	Tetrachloroethylene		C	8.1E-01	1.2E-01		8.1E+00	1.2E+00		8.1E+01	1.2E+01		5.0E+00 †	
108883	Toluene		NC	4.0E+02	1.1E+02		4.0E+03	1.1E+03		4.0E+04	1.1E+04		1.5E+03	
156605	trans-1,2-Dichloroethylene	X	NC	7.0E+01	1.8E+01		7.0E+02	1.8E+02		7.0E+03	1.8E+03		1.8E+02	
76131	1,1,2-Trichloro-1,2,2-trifluoroethane		NC	3.0E+04	3.9E+03		3.0E+05	3.9E+04		3.0E+06	3.9E+05		1.5E+03	
120821	1,2,4-Trichlorobenzene		NC	2.0E+02	2.7E+01		2.0E+03	2.7E+02		2.0E+04	2.7E+03		3.4E+03	
79005	1,1,2-Trichloroethane		C	1.5E-01	2.8E-02		1.5E+00	2.8E-01		1.5E+01	2.8E+00		5.0E+00 †	
71556	1,1,1-Trichloroethane		NC	2.2E+03	4.0E+02		2.2E+04	4.0E+03		2.2E+05	4.0E+04		3.1E+03	
79016	Trichloroethylene ††	X	C	2.2E-02	4.1E-03		2.2E-01	4.1E-02		2.2E+00	4.1E-01		5.0E+00 †	
75694	Trichlorofluoromethane		NC	7.0E+02	1.2E+02		7.0E+03	1.2E+03		7.0E+04	1.2E+04		1.8E+02	
96184	1,2,3-Trichloropropane		NC	4.9E+00	8.1E-01		4.9E+01	8.1E+00		4.9E+02	8.1E+01		2.9E+02	
95636	1,2,4-Trimethylbenzene		NC	6.0E+00	1.2E+00		6.0E+01	1.2E+01		6.0E+02	1.2E+02		2.4E+01	

Table 2c: Question 4 Generic Screening Levels and Summary Sheet [1]

Risk = 1 x 10^{-6}

CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	Target Indoor Air Concentration to Satisfy Both the Prescribed Risk Level and the Target Hazard Index [R=10^{-6}, HI=1) C_{target} (ug/m3)	(ppbv)	Measured or Reasonably Estimated Indoor Air Concentration [if available] (specify units)	Target Shallow Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.1 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Shallow Soil Gas Concentration [if available] (specify units)	Target Deep Soil Gas Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor=0.01 $C_{soil-gas}$ (ug/m3)	(ppbv)	Measured or Reasonably Estimated Deep Soil Gas Concentration [if available] (specify units)	Target Groundwater Concentration Corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.001 and Partitioning Across the Water Table Obeys Henry's Law C_{gw} (ug/L)	Measured or Reasonably Estimated Groundwater Concentration [if available] (specify units)
108678	1,3,5-Trimethylbenzene		NC	6.0E+00	1.2E+00		6.0E+01	1.2E+01		6.0E+02	1.2E+02		2.5E+01	
108054	Vinyl acetate		NC	2.0E+02	5.7E+01		2.0E+03	5.7E+02		2.0E+04	5.7E+03		9.6E+03	
75014	Vinyl chloride (chloroethene)		C	2.8E-01	1.1E-01		2.8E+00	1.1E+00		2.8E+01	1.1E+01		2.0E+00 †	

[1] AF = 0.1 for Shallow Soil Gas Target Concentration
AF = 0.01 for Deep Soil Gas Target Concentration
AF = 0.001 for Groundwater Target Concentration

* Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete)

** Target soil gas concentration exceeds maximum possible vapor concentration (pathway incomplete)

† The target groundwater concentration is the MCL. (The MCL for chloroform is the MCL for total Trihalomethanes. The MCL listed for m-Xylene, o-Xylene, and p-Xylene is the MCL for total Xylenes.)

†† The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further. (See Appendix D.)

Table 3a-SG: Question 5 Soil Gas Screening Levels for Scenario-Specific Vapor Attenuation Factors (α) **DRAFT**

Risk = 1 x 10^{-4}

				Target Soil Gas Concentrations for Different Attenuation Factors									
				$\alpha = 2x10^{-3}$ $C_{soil-gas}$		$\alpha = 1x10^{-3}$ $C_{soil-gas}$		$\alpha = 7x10^{-4}$ $C_{soil-gas}$		$\alpha = 4x10^{-4}$ $C_{soil-gas}$		$\alpha = 2x10^{-4}$ $C_{soil-gas}$	
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)
83329	Acenaphthene	X	NC	**	**	**	**	**	**	**	**	**	**
75070	Acetaldehyde		NC	4.5E+03	2.5E+03	9.0E+03	5.0E+03	1.3E+04	7.1E+03	2.2E+04	1.2E+04	4.5E+04	2.5E+04
67641	Acetone	X	NC	1.8E+05	7.4E+04	3.5E+05	1.5E+05	5.0E+05	2.1E+05	8.8E+05	3.7E+05	1.8E+06	7.4E+05
75058	Acetonitrile		NC	3.0E+04	1.8E+04	6.0E+04	3.6E+04	8.6E+04	5.1E+04	1.5E+05	8.9E+04	3.0E+05	1.8E+05
98862	Acetophenone	X	NC	1.8E+05	3.6E+04	3.5E+05	7.1E+04	5.0E+05	1.0E+05	8.8E+05	1.8E+05	1.8E+06	3.6E+05
107028	Acrolein		NC	1.0E+01	4.4E+00	2.0E+01	8.7E+00	2.9E+01	1.2E+01	5.0E+01	2.2E+01	1.0E+02	4.4E+01
107131	Acrylonitrile		NC	1.0E+03	4.6E+02	2.0E+03	9.2E+02	2.9E+03	1.3E+03	5.0E+03	2.3E+03	1.0E+04	4.6E+03
309002	Aldrin		C	2.5E+01	1.7E+00	5.0E+01	3.3E+00	7.1E+01	4.8E+00	**	**	**	**
319846	alpha-HCH (alpha-BHC)		C	6.8E+01	5.7E+00	1.4E+02	1.1E+01	1.9E+02	1.6E+01	3.4E+02	2.8E+01	6.8E+02	5.7E+01
100527	Benzaldehyde	X	NC	1.8E+05	4.0E+04	3.5E+05	8.1E+04	5.0E+05	1.2E+05	8.8E+05	2.0E+05	1.8E+06	4.0E+05
71432	Benzene		C	1.6E+04	4.9E+03	3.1E+04	9.8E+03	4.5E+04	1.4E+04	7.8E+04	2.4E+04	1.6E+05	4.9E+04
205992	Benzo(b)fluoranthene	X	C	**	**	**	**	**	**	**	**	**	**
100447	Benzylchloride	X	C	2.5E+03	4.8E+02	5.0E+03	9.7E+02	7.2E+03	1.4E+03	1.3E+04	2.4E+03	2.5E+04	4.8E+03
91587	beta-Chloronaphthalene	X	NC	1.4E+05	2.1E+04	**	**	**	**	**	**	**	**
92524	Biphenyl	X	NC	8.8E+04	1.4E+04	**	**	**	**	**	**	**	**
111444	Bis(2-chloroethyl)ether		C	3.7E+02	6.3E+01	7.4E+02	1.3E+02	1.1E+03	1.8E+02	1.8E+03	3.2E+02	3.7E+03	6.3E+02
108601	Bis(2-chloroisopropyl)ether		C	1.2E+04	1.7E+03	2.4E+04	3.5E+03	3.5E+04	5.0E+03	6.1E+04	8.7E+03	1.2E+05	1.7E+04
542881	Bis(chloromethyl)ether		C	2.0E+00	4.2E-01	3.9E+00	8.4E-01	5.6E+00	1.2E+00	9.8E+00	2.1E+00	2.0E+01	4.2E+00
75274	Bromodichloromethane	X	C	6.9E+03	1.0E+03	1.4E+04	2.1E+03	2.0E+04	2.9E+03	3.4E+04	5.1E+03	6.9E+04	1.0E+04
75252	Bromoform		C	1.1E+05	1.1E+04	2.2E+05	2.1E+04	3.2E+05	3.1E+04	5.5E+05	5.4E+04	1.1E+06	1.1E+05
106990	1,3-Butadiene		C	4.3E+02	2.0E+02	8.7E+02	3.9E+02	1.2E+03	5.6E+02	2.2E+03	9.8E+02	4.3E+03	2.0E+03
75150	Carbon disulfide		NC	3.5E+05	1.1E+05	7.0E+05	2.2E+05	1.0E+06	3.2E+05	1.8E+06	5.6E+05	3.5E+06	1.1E+06
56235	Carbon tetrachloride		C	8.1E+03	1.3E+03	1.6E+04	2.6E+03	2.3E+04	3.7E+03	4.1E+04	6.5E+03	8.1E+04	1.3E+04
57749	Chlordane		NC	**	**	**	**	**	**	**	**	**	**
126998	2-Chloro-1,3-butadiene (chloroprene)		NC	3.5E+03	9.7E+02	7.0E+03	1.9E+03	1.0E+04	2.8E+03	1.8E+04	4.8E+03	3.5E+04	9.7E+03
108907	Chlorobenzene		NC	3.0E+04	6.5E+03	6.0E+04	1.3E+04	8.5E+04	1.8E+04	1.5E+05	3.2E+04	3.0E+05	6.5E+04
109693	1-Chlorobutane	X	NC	7.0E+05	1.8E+05	1.4E+06	3.7E+05	2.0E+06	5.3E+05	3.5E+06	9.2E+05	7.0E+06	1.8E+06
124481	Chlorodibromomethane	X	C	5.1E+03	6.0E+02	1.0E+04	1.2E+03	1.4E+04	1.7E+03	2.5E+04	3.0E+03	5.1E+04	6.0E+03
75456	Chlorodifluoromethane		NC	**	**	**	**	**	**	**	**	**	**
75003	Chloroethane (ethyl chloride)		NC	5.0E+06	1.9E+06	1.0E+07	3.8E+06	1.4E+07	5.4E+06	2.5E+07	9.5E+06	5.0E+07	1.9E+07
67663	Chloroform		C	5.3E+03	1.1E+03	1.1E+04	2.2E+03	1.5E+04	3.1E+03	2.6E+04	5.4E+03	5.3E+04	1.1E+04
95578	2-Chlorophenol	X	NC	8.8E+03	1.7E+03	1.8E+04	3.3E+03	2.5E+04	4.8E+03	4.4E+04	8.3E+03	8.8E+04	1.7E+04
75296	2-Chloropropane		NC	5.1E+04	1.6E+04	1.0E+05	3.2E+04	1.5E+05	4.5E+04	2.5E+05	7.9E+04	5.1E+05	1.6E+05
218019	Chrysene	X	*	*	*	*	*	*	*	*	*	*	*
156592	cis-1,2-Dichloroethylene	X	NC	1.8E+04	4.4E+03	3.5E+04	8.8E+03	5.0E+04	1.3E+04	8.8E+04	2.2E+04	1.8E+05	4.4E+04
123739	Crotonaldehyde (2-butenal)	X	C	2.2E+02	7.8E+01	4.5E+02	1.6E+02	6.4E+02	2.2E+02	1.1E+03	3.9E+02	2.2E+03	7.8E+02
98828	Cumene		NC	2.0E+05	4.1E+04	4.0E+05	8.1E+04	5.7E+05	1.2E+05	1.0E+06	2.0E+05	2.0E+06	4.1E+05
72559	DDE	X	C	**	**	**	**	**	**	**	**	**	**
132649	Dibenzofuran	X	NC	**	**	**	**	**	**	**	**	**	**
96128	1,2-Dibromo-3-chloropropane		NC	1.0E+02	1.0E+01	2.0E+02	2.1E+01	2.9E+02	3.0E+01	5.0E+02	5.2E+01	1.0E+03	1.0E+02
106934	1,2-Dibromoethane (ethylene dibromide)		NC	1.0E+02	1.3E+01	2.0E+02	2.6E+01	2.9E+02	3.7E+01	5.0E+02	6.5E+01	1.0E+03	1.3E+02
541731	1,3-Dichlorobenzene	X	NC	5.3E+04	8.7E+03	1.1E+05	1.7E+04	1.5E+05	2.5E+04	2.6E+05	4.4E+04	5.3E+05	8.7E+04

Table 3a-SG: Question 5 Soil Gas Screening Levels for Scenario-Specific Vapor Attenuation Factors (α) **DRAFT**

Risk = 1 x 10^{-4}

				Target Soil Gas Concentrations for Different Attenuation Factors									
		Compounds with Provisional Toxicity Data Extrapolated	Basis of Target Concentration C=cancer risk	α = 2x10^{-3} $C_{soil\text{-}gas}$		α = 1x10^{-3} $C_{soil\text{-}gas}$		α = 7x10^{-4} $C_{soil\text{-}gas}$		α = 4x10^{-4} $C_{soil\text{-}gas}$		α = 2x10^{-4} $C_{soil\text{-}gas}$	
CAS No.	Chemical	From Oral Sources	NC=noncancer risk	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)
95501	1,2-Dichlorobenzene		NC	1.0E+05	1.7E+04	2.0E+05	3.3E+04	2.9E+05	4.8E+04	5.0E+05	8.3E+04	1.0E+06	1.7E+05
106467	1,4-Dichlorobenzene		NC	4.0E+05	6.7E+04	8.0E+05	1.3E+05	1.1E+06	1.9E+05	2.0E+06	3.3E+05	4.0E+06	6.7E+05
75718	Dichlorodifluoromethane		NC	1.0E+05	2.0E+04	2.0E+05	4.0E+04	2.9E+05	5.8E+04	5.0E+05	1.0E+05	1.0E+06	2.0E+05
75343	1,1-Dichloroethane		NC	2.5E+05	6.2E+04	5.0E+05	1.2E+05	7.1E+05	1.8E+05	1.3E+06	3.1E+05	2.5E+06	6.2E+05
107062	1,2-Dichloroethane		C	4.7E+03	1.2E+03	9.4E+03	2.3E+03	1.3E+04	3.3E+03	2.3E+04	5.8E+03	4.7E+04	1.2E+04
75354	1,1-Dichloroethylene		NC	1.0E+05	2.5E+04	2.0E+05	5.0E+04	2.9E+05	7.2E+04	5.0E+05	1.3E+05	1.0E+06	2.5E+05
78875	1,2-Dichloropropane		NC	2.0E+03	4.3E+02	4.0E+03	8.7E+02	5.7E+03	1.2E+03	1.0E+04	2.2E+03	2.0E+04	4.3E+03
542756	1,3-Dichloropropene		NC	1.0E+04	2.2E+03	2.0E+04	4.4E+03	2.9E+04	6.3E+03	5.0E+04	1.1E+04	1.0E+05	2.2E+04
60571	Dieldrin		C	2.6E+01	1.7E+00	5.3E+01	3.4E+00	7.6E+01	4.9E+00	**	**	**	**
115297	Endosulfan	X	NC	**	**	**	**	**	**	**	**	**	**
106898	Epichlorohydrin		NC	5.0E+02	1.3E+02	1.0E+03	2.6E+02	1.4E+03	3.8E+02	2.5E+03	6.6E+02	5.0E+03	1.3E+03
60297	Ethyl ether	X	NC	3.5E+05	1.2E+05	7.0E+05	2.3E+05	1.0E+06	3.3E+05	1.8E+06	5.8E+05	3.5E+06	1.2E+06
141786	Ethylacetate	X	NC	1.6E+06	4.4E+05	3.2E+06	8.7E+05	4.5E+06	1.2E+06	7.9E+06	2.2E+06	1.6E+07	4.4E+06
100414	Ethylbenzene		C	1.1E+05	2.5E+04	2.2E+05	5.1E+04	3.2E+05	7.3E+04	5.5E+05	1.3E+05	1.1E+06	2.5E+05
75218	Ethylene oxide		C	1.2E+03	6.8E+02	2.4E+03	1.4E+03	3.5E+03	1.9E+03	6.1E+03	3.4E+03	1.2E+04	6.8E+03
97632	Ethylmethacrylate	X	NC	1.6E+05	3.4E+04	3.2E+05	6.8E+04	4.5E+05	9.6E+04	7.9E+05	1.7E+05	1.6E+06	3.4E+05
86737	Fluorene	X	NC	**	**	**	**	**	**	**	**	**	**
110009	Furan	X	NC	1.8E+03	6.3E+02	3.5E+03	1.3E+03	5.0E+03	1.8E+03	8.8E+03	3.1E+03	1.8E+04	6.3E+03
58899	gamma-HCH (Lindane)	X	C	3.3E+02	2.8E+01	6.6E+02	5.5E+01	9.4E+02	7.9E+01	1.6E+03	1.4E+02	3.3E+03	2.8E+02
76448	Heptachlor		C	9.4E+01	6.1E+00	1.9E+02	1.2E+01	2.7E+02	1.8E+01	4.7E+02	3.1E+01	9.4E+02	6.1E+01
87683	Hexachloro-1,3-butadiene		C	5.5E+03	5.2E+02	1.1E+04	1.0E+03	1.6E+04	1.5E+03	2.8E+04	2.6E+03	5.5E+04	5.2E+03
118741	Hexachlorobenzene		C	2.6E+02	2.3E+01	**	**	**	**	**	**	**	**
77474	Hexachlorocyclopentadiene		NC	1.0E+02	9.0E+00	2.0E+02	1.8E+01	2.9E+02	2.6E+01	5.0E+02	4.5E+01	1.0E+03	9.0E+01
67721	Hexachloroethane		C	3.0E+04	3.1E+03	6.1E+04	6.3E+03	8.7E+04	9.0E+03	1.5E+05	1.6E+04	3.0E+05	3.1E+04
110543	Hexane		NC	1.0E+05	2.8E+04	2.0E+05	5.7E+04	2.9E+05	8.1E+04	5.0E+05	1.4E+05	1.0E+06	2.8E+05
74908	Hydrogen cyanide		NC	1.5E+03	1.4E+03	3.0E+03	2.7E+03	4.3E+03	3.9E+03	7.5E+03	6.8E+03	1.5E+04	1.4E+04
78831	Isobutanol	X	NC	5.3E+05	1.7E+05	1.1E+06	3.5E+05	1.5E+06	5.0E+05	2.6E+06	8.7E+05	5.3E+06	1.7E+06
7439976	Mercury (elemental)		NC	1.5E+02	1.8E+01	3.0E+02	3.7E+01	4.3E+02	5.2E+01	7.5E+02	9.1E+01	1.5E+03	1.8E+02
126987	Methacrylonitrile		NC	3.5E+02	1.3E+02	7.0E+02	2.6E+02	1.0E+03	3.6E+02	1.8E+03	6.4E+02	3.5E+03	1.3E+03
72435	Methoxychlor	X	NC	**	**	**	**	**	**	**	**	**	**
79209	Methyl acetate	X	NC	1.8E+06	5.8E+05	3.5E+06	1.2E+06	5.0E+06	1.7E+06	8.8E+06	2.9E+06	**	**
96333	Methyl acrylate	X	NC	5.3E+04	1.5E+04	1.1E+05	3.0E+04	1.5E+05	4.3E+04	2.6E+05	7.5E+04	5.3E+05	1.5E+05
74839	Methyl bromide		NC	2.5E+03	6.4E+02	5.0E+03	1.3E+03	7.1E+03	1.8E+03	1.3E+04	3.2E+03	2.5E+04	6.4E+03
74873	Methyl chloride (chloromethane)		NC	4.5E+04	2.2E+04	9.0E+04	4.4E+04	1.3E+05	6.2E+04	2.3E+05	1.1E+05	4.5E+05	2.2E+05
108872	Methylcyclohexane		NC	1.5E+06	3.7E+05	3.0E+06	7.5E+05	4.3E+06	1.1E+06	7.5E+06	1.9E+06	1.5E+07	3.7E+06
74953	Methylene bromide	X	NC	1.8E+04	2.5E+03	3.5E+04	4.9E+03	5.0E+04	7.0E+03	8.8E+04	1.2E+04	1.8E+05	2.5E+04
75092	Methylene chloride		C	2.6E+05	7.5E+04	5.2E+05	1.5E+05	7.4E+05	2.1E+05	1.3E+06	3.7E+05	2.6E+06	7.5E+05
78933	Methylethylketone (2-butanone)		NC	5.0E+05	1.7E+05	1.0E+06	3.4E+05	1.4E+06	4.8E+05	2.5E+06	8.5E+05	5.0E+06	1.7E+06
108101	Methylisobutylketone		NC	4.0E+04	9.8E+03	8.0E+04	2.0E+04	1.1E+05	2.8E+04	2.0E+05	4.9E+04	4.0E+05	9.8E+04
80626	Methylmethacrylate		NC	3.5E+05	8.6E+04	7.0E+05	1.7E+05	1.0E+06	2.4E+05	1.8E+06	4.3E+05	3.5E+06	8.6E+05
91576	2-Methylnaphthalene	X	NC	3.5E+04	6.0E+03	7.0E+04	1.2E+04	1.0E+05	1.7E+04	1.8E+05	3.0E+04	3.5E+05	6.0E+04
1634044	MTBE		NC	1.5E+06	4.2E+05	3.0E+06	8.3E+05	4.3E+06	1.2E+06	7.5E+06	2.1E+06	1.5E+07	4.2E+06

Table 3a-SG: Question 5 Soil Gas Screening Levels for Scenario-Specific Vapor Attenuation Factors (α) **DRAFT**

Risk = 1 x 10^{-4}

				Target Soil Gas Concentrations for Different Attenuation Factors									
		Compounds with Provisional Toxicity Data Extrapolated	Basis of Target Concentration C=cancer risk	$\alpha = 2x10^{-3}$ $C_{soil\text{-}gas}$		$\alpha = 1x10^{-3}$ $C_{soil\text{-}gas}$		$\alpha = 7x10^{-4}$ $C_{soil\text{-}gas}$		$\alpha = 4x10^{-4}$ $C_{soil\text{-}gas}$		$\alpha = 2x10^{-4}$ $C_{soil\text{-}gas}$	
CAS No.	Chemical	From Oral Sources	NC=noncancer risk	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)
108383	m-Xylene	X	NC	3.5E+06	8.1E+05	7.0E+06	1.6E+06	1.0E+07	2.3E+06	1.8E+07	4.0E+06	3.5E+07	8.1E+06
91203	Naphthalene		NC	1.5E+03	2.9E+02	3.0E+03	5.7E+02	4.3E+03	8.2E+02	7.5E+03	1.4E+03	1.5E+04	2.9E+03
104518	n-Butylbenzene	X	NC	7.0E+04	1.3E+04	1.4E+05	2.6E+04	2.0E+05	3.6E+04	3.5E+05	6.4E+04	7.0E+05	1.3E+05
98953	Nitrobenzene		NC	1.0E+03	2.0E+02	2.0E+03	4.0E+02	2.9E+03	5.7E+02	5.0E+03	9.9E+02	1.0E+04	2.0E+03
79469	2-Nitropropane		C	4.5E+01	1.2E+01	9.0E+01	2.5E+01	1.3E+02	3.5E+01	2.3E+02	6.2E+01	4.5E+02	1.2E+02
924163	N-Nitroso-di-n-butylamine		C	7.6E+01	1.2E+01	1.5E+02	2.4E+01	2.2E+02	3.4E+01	3.8E+02	5.9E+01	7.6E+02	1.2E+02
103651	n-Propylbenzene	X	NC	7.0E+04	1.4E+04	1.4E+05	2.8E+04	2.0E+05	4.1E+04	3.5E+05	7.1E+04	7.0E+05	1.4E+05
88722	o-Nitrotoluene	X	NC	1.8E+04	3.1E+03	3.5E+04	6.2E+03	5.0E+04	8.9E+03	8.8E+04	1.6E+04	1.8E+05	3.1E+04
95476	o-Xylene	X	NC	3.5E+06	8.1E+05	7.0E+06	1.6E+06	1.0E+07	2.3E+06	1.8E+07	4.0E+06	3.5E+07	8.1E+06
106423	p-Xylene	X	NC	3.5E+06	8.1E+05	7.0E+06	1.6E+06	1.0E+07	2.3E+06	1.8E+07	4.0E+06	3.5E+07	8.1E+06
129000	Pyrene	X	NC	**	**	**	**	**	**	**	**	**	**
135988	sec-Butylbenzene	X	NC	7.0E+04	1.3E+04	1.4E+05	2.6E+04	2.0E+05	3.6E+04	3.5E+05	6.4E+04	7.0E+05	1.3E+05
100425	Styrene		NC	5.0E+05	1.2E+05	1.0E+06	2.3E+05	1.4E+06	3.4E+05	2.5E+06	5.9E+05	5.0E+06	1.2E+06
98066	tert-Butylbenzene	X	NC	7.0E+04	1.3E+04	1.4E+05	2.6E+04	2.0E+05	3.6E+04	3.5E+05	6.4E+04	7.0E+05	1.3E+05
630206	1,1,1,2-Tetrachloroethane		C	1.6E+04	2.4E+03	3.3E+04	4.8E+03	4.7E+04	6.8E+03	8.2E+04	1.2E+04	1.6E+05	2.4E+04
79345	1,1,2,2-Tetrachloroethane		C	2.1E+03	3.1E+02	4.2E+03	6.1E+02	6.0E+03	8.7E+02	1.0E+04	1.5E+03	2.1E+04	3.1E+03
127184	Tetrachloroethylene		C	4.1E+04	6.0E+03	8.1E+04	1.2E+04	1.2E+05	1.7E+04	2.0E+05	3.0E+04	4.1E+05	6.0E+04
108883	Toluene		NC	2.0E+05	5.3E+04	4.0E+05	1.1E+05	5.7E+05	1.5E+05	1.0E+06	2.7E+05	2.0E+06	5.3E+05
156605	trans-1,2-Dichloroethylene	X	NC	3.5E+04	8.8E+03	7.0E+04	1.8E+04	1.0E+05	2.5E+04	1.8E+05	4.4E+04	3.5E+05	8.8E+04
76131	1,1,2-Trichloro-1,2,2-trifluoroethane		NC	1.5E+07	2.0E+06	3.0E+07	3.9E+06	4.3E+07	5.6E+06	7.5E+07	9.8E+06	1.5E+08	2.0E+07
120821	1,2,4-Trichlorobenzene		NC	1.0E+05	1.3E+04	2.0E+05	2.7E+04	2.9E+05	3.8E+04	5.0E+05	6.7E+04	1.0E+06	1.3E+05
79005	1,1,2-Trichloroethane		C	7.6E+03	1.4E+03	1.5E+04	2.8E+03	2.2E+04	4.0E+03	3.8E+04	7.0E+03	7.6E+04	1.4E+04
71556	1,1,1-Trichloroethane		NC	1.1E+06	2.0E+05	2.2E+06	4.0E+05	3.1E+06	5.8E+05	5.5E+06	1.0E+06	1.1E+07	2.0E+06
79016	Trichloroethylene ††	X	C	1.1E+03	2.1E+02	2.2E+03	4.1E+02	3.2E+03	5.9E+02	5.5E+03	1.0E+03	1.1E+04	2.1E+03
75694	Trichlorofluoromethane		NC	3.5E+05	6.2E+04	7.0E+05	1.2E+05	1.0E+06	1.8E+05	1.8E+06	3.1E+05	3.5E+06	6.2E+05
96184	1,2,3-Trichloropropane		NC	2.5E+03	4.1E+02	4.9E+03	8.1E+02	7.0E+03	1.2E+03	1.2E+04	2.0E+03	2.5E+04	4.1E+03
95636	1,2,4-Trimethylbenzene		NC	3.0E+03	6.1E+02	6.0E+03	1.2E+03	8.5E+03	1.7E+03	1.5E+04	3.0E+03	3.0E+04	6.1E+03
108678	1,3,5-Trimethylbenzene		NC	3.0E+03	6.1E+02	6.0E+03	1.2E+03	8.5E+03	1.7E+03	1.5E+04	3.0E+03	3.0E+04	6.1E+03
108054	Vinyl acetate		NC	1.0E+05	2.8E+04	2.0E+05	5.7E+04	2.9E+05	8.1E+04	5.0E+05	1.4E+05	1.0E+06	2.8E+05
75014	Vinyl chloride (chloroethene)		C	1.4E+04	5.4E+03	2.8E+04	1.1E+04	4.0E+04	1.5E+04	6.9E+04	2.7E+04	1.4E+05	5.4E+04

* Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete)

** Target soil gas concentration exceeds maximum possible vapor concentration at this soil gas to indoor air attenuation factor (pathway incomplete)

†† The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further. (See Appendix D.)

Table 3b-SG: Question 5 Soil Gas Screening Levels for Scenario-Specific Vapor Attenuation Factors (α) **DRAFT**

Risk = 1 x 10^{-5}

				Target Soil Gas Concentrations for Different Attenuation Factors									
				$\alpha = 2x10^{-3}$ $C_{soil-gas}$		$\alpha = 1x10^{-3}$ $C_{soil-gas}$		$\alpha = 7x10^{-4}$ $C_{soil-gas}$		$\alpha = 4x10^{-4}$ $C_{soil-gas}$		$\alpha = 2x10^{-4}$ $C_{soil-gas}$	
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)
83329	Acenaphthene	X	NC	**	**	**	**	**	**	**	**	**	**
75070	Acetaldehyde		NC	4.5E+03	2.5E+03	9.0E+03	5.0E+03	1.3E+04	7.1E+03	2.2E+04	1.2E+04	4.5E+04	2.5E+04
67641	Acetone	X	NC	1.8E+05	7.4E+04	3.5E+05	1.5E+05	5.0E+05	2.1E+05	8.8E+05	3.7E+05	1.8E+06	7.4E+05
75058	Acetonitrile		NC	3.0E+04	1.8E+04	6.0E+04	3.6E+04	8.6E+04	5.1E+04	1.5E+05	8.9E+04	3.0E+05	1.8E+05
98862	Acetophenone	X	NC	1.8E+05	3.6E+04	3.5E+05	7.1E+04	5.0E+05	1.0E+05	8.8E+05	1.8E+05	1.8E+06	3.6E+05
107028	Acrolein		NC	1.0E+01	4.4E+00	2.0E+01	8.7E+00	2.9E+01	1.2E+01	5.0E+01	2.2E+01	1.0E+02	4.4E+01
107131	Acrylonitrile		C	1.8E+02	8.3E+01	3.6E+02	1.7E+02	5.1E+02	2.4E+02	8.9E+02	4.1E+02	1.8E+03	8.3E+02
309002	Aldrin		C	2.5E+00	1.7E-01	5.0E+00	3.3E-01	7.1E+00	4.8E-01	1.2E+01	8.3E-01	2.5E+01	1.7E+00
319846	alpha-HCH (alpha-BHC)		C	6.8E+00	5.7E-01	1.4E+01	1.1E+00	1.9E+01	1.6E+00	3.4E+01	2.8E+00	6.8E+01	5.7E+00
100527	Benzaldehyde	X	NC	1.8E+05	4.0E+04	3.5E+05	8.1E+04	5.0E+05	1.2E+05	8.8E+05	2.0E+05	1.8E+06	4.0E+05
71432	Benzene		C	1.6E+03	4.9E+02	3.1E+03	9.8E+02	4.5E+03	1.4E+03	7.8E+03	2.4E+03	1.6E+04	4.9E+03
205992	Benzo(b)fluoranthene	X	C	**	**	**	**	**	**	**	**	**	**
100447	Benzylchloride	X	C	2.5E+02	4.8E+01	5.0E+02	9.7E+01	7.2E+02	1.4E+02	1.3E+03	2.4E+02	2.5E+03	4.8E+02
91587	beta-Chloronaphthalene	X	NC	1.4E+05	2.1E+04	**	**	**	**	**	**	**	**
92524	Biphenyl	X	NC	8.8E+04	1.4E+04	**	**	**	**	**	**	**	**
111444	Bis(2-chloroethyl)ether		C	3.7E+01	6.3E+00	7.4E+01	1.3E+01	1.1E+02	1.8E+01	1.8E+02	3.2E+01	3.7E+02	6.3E+01
108601	Bis(2-chloroisopropyl)ether		C	1.2E+03	1.7E+02	2.4E+03	3.5E+02	3.5E+03	5.0E+02	6.1E+03	8.7E+02	1.2E+04	1.7E+03
542881	Bis(chloromethyl)ether		C	2.0E-01	4.2E-02	3.9E-01	8.4E-02	5.6E-01	1.2E-01	9.8E-01	2.1E-01	2.0E+00	4.2E-01
75274	Bromodichloromethane	X	C	6.9E+02	1.0E+02	1.4E+03	2.1E+02	2.0E+03	2.9E+02	3.4E+03	5.1E+02	6.9E+03	1.0E+03
75252	Bromoform		C	1.1E+04	1.1E+03	2.2E+04	2.1E+03	3.2E+04	3.1E+03	5.5E+04	5.4E+03	1.1E+05	1.1E+04
106990	1,3-Butadiene		C	4.3E+01	2.0E+01	8.7E+01	3.9E+01	1.2E+02	5.6E+01	2.2E+02	9.8E+01	4.3E+02	2.0E+02
75150	Carbon disulfide		NC	3.5E+05	1.1E+05	7.0E+05	2.2E+05	1.0E+06	3.2E+05	1.8E+06	5.6E+05	3.5E+06	1.1E+06
56235	Carbon tetrachloride		C	8.1E+02	1.3E+02	1.6E+03	2.6E+02	2.3E+03	3.7E+02	4.1E+03	6.5E+02	8.1E+03	1.3E+03
57749	Chlordane		C	**	**	**	**	**	**	**	**	**	**
126998	2-Chloro-1,3-butadiene (chloroprene)		NC	3.5E+03	9.7E+02	7.0E+03	1.9E+03	1.0E+04	2.8E+03	1.8E+04	4.8E+03	3.5E+04	9.7E+03
108907	Chlorobenzene		NC	3.0E+04	6.5E+03	6.0E+04	1.3E+04	8.5E+04	1.8E+04	1.5E+05	3.2E+04	3.0E+05	6.5E+04
109693	1-Chlorobutane	X	NC	7.0E+05	1.8E+05	1.4E+06	3.7E+05	2.0E+06	5.3E+05	3.5E+06	9.2E+05	7.0E+06	1.8E+06
124481	Chlorodibromomethane	X	C	5.1E+02	6.0E+01	1.0E+03	1.2E+02	1.4E+03	1.7E+02	2.5E+03	3.0E+02	5.1E+03	6.0E+02
75456	Chlorodifluoromethane		NC	**	**	**	**	**	**	**	**	**	**
75003	Chloroethane (ethyl chloride)		NC	5.0E+06	1.9E+06	1.0E+07	3.8E+06	1.4E+07	5.4E+06	2.5E+07	9.5E+06	5.0E+07	1.9E+07
67663	Chloroform		C	5.3E+02	1.1E+02	1.1E+03	2.2E+02	1.5E+03	3.1E+02	2.6E+03	5.4E+02	5.3E+03	1.1E+03
95578	2-Chlorophenol	X	NC	8.8E+03	1.7E+03	1.8E+04	3.3E+03	2.5E+04	4.8E+03	4.4E+04	8.3E+03	8.8E+04	1.7E+04
75296	2-Chloropropane		NC	5.1E+04	1.6E+04	1.0E+05	3.2E+04	1.5E+05	4.5E+04	2.5E+05	7.9E+04	5.1E+05	1.6E+05
218019	Chrysene	X	C	**	**	**	**	**	**	**	**	**	**
156592	cis-1,2-Dichloroethylene	X	NC	1.8E+04	4.4E+03	3.5E+04	8.8E+03	5.0E+04	1.3E+04	8.8E+04	2.2E+04	1.8E+05	4.4E+04
123739	Crotonaldehyde (2-butenal)	X	C	2.2E+01	7.8E+00	4.5E+01	1.6E+01	6.4E+01	2.2E+01	1.1E+02	3.9E+01	2.2E+02	7.8E+01
98828	Cumene		NC	2.0E+05	4.1E+04	4.0E+05	8.1E+04	5.7E+05	1.2E+05	1.0E+06	2.0E+05	2.0E+06	4.1E+05
72559	DDE	X	C	**	**	**	**	**	**	**	**	**	**
132649	Dibenzofuran	X	NC	**	**	**	**	**	**	**	**	**	**
96128	1,2-Dibromo-3-chloropropane		NC	1.0E+02	1.0E+01	2.0E+02	2.1E+01	2.9E+02	3.0E+01	5.0E+02	5.2E+01	1.0E+03	1.0E+02
106934	1,2-Dibromoethane (ethylene dibromide)		C	5.5E+01	7.2E+00	1.1E+02	1.4E+01	1.6E+02	2.1E+01	2.8E+02	3.6E+01	5.5E+02	7.2E+01
541731	1,3-Dichlorobenzene	X	NC	5.3E+04	8.7E+03	1.1E+05	1.7E+04	1.5E+05	2.5E+04	2.6E+05	4.4E+04	5.3E+05	8.7E+04

Table 3b-SG: Question 5 Soil Gas Screening Levels for Scenario-Specific Vapor Attenuation Factors (α) **DRAFT**

Risk = 1 x 10^{-5}

				Target Soil Gas Concentrations for Different Attenuation Factors									
		Compounds with Provisional Toxicity Data Extrapolated	Basis of Target Concentration C=cancer risk	α = 2x10^{-3} $C_{soil\text{-}gas}$		α = 1x10^{-3} $C_{soil\text{-}gas}$		α = 7x10^{-4} $C_{soil\text{-}gas}$		α = 4x10^{-4} $C_{soil\text{-}gas}$		α = 2x10^{-4} $C_{soil\text{-}gas}$	
CAS No.	Chemical	From Oral Sources	NC=noncancer risk	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)
95501	1,2-Dichlorobenzene		NC	1.0E+05	1.7E+04	2.0E+05	3.3E+04	2.9E+05	4.8E+04	5.0E+05	8.3E+04	1.0E+06	1.7E+05
106467	1,4-Dichlorobenzene		NC	4.0E+05	6.7E+04	8.0E+05	1.3E+05	1.1E+06	1.9E+05	2.0E+06	3.3E+05	4.0E+06	6.7E+05
75718	Dichlorodifluoromethane		NC	1.0E+05	2.0E+04	2.0E+05	4.0E+04	2.9E+05	5.8E+04	5.0E+05	1.0E+05	1.0E+06	2.0E+05
75343	1,1-Dichloroethane		NC	2.5E+05	6.2E+04	5.0E+05	1.2E+05	7.1E+05	1.8E+05	1.3E+06	3.1E+05	2.5E+06	6.2E+05
107062	1,2-Dichloroethane		C	4.7E+02	1.2E+02	9.4E+02	2.3E+02	1.3E+03	3.3E+02	2.3E+03	5.8E+02	4.7E+03	1.2E+03
75354	1,1-Dichloroethylene		NC	1.0E+05	2.5E+04	2.0E+05	5.0E+04	2.9E+05	7.2E+04	5.0E+05	1.3E+05	1.0E+06	2.5E+05
78875	1,2-Dichloropropane		NC	2.0E+03	4.3E+02	4.0E+03	8.7E+02	5.7E+03	1.2E+03	1.0E+04	2.2E+03	2.0E+04	4.3E+03
542756	1,3-Dichloropropene		C	3.0E+03	6.7E+02	6.1E+03	1.3E+03	8.7E+03	1.9E+03	1.5E+04	3.4E+03	3.0E+04	6.7E+03
60571	Dieldrin		C	2.6E+00	1.7E-01	5.3E+00	3.4E-01	7.6E+00	4.9E-01	1.3E+01	8.5E-01	2.6E+01	1.7E+00
115297	Endosulfan	X	NC	**	**	**	**	**	**	**	**	**	**
106898	Epichlorohydrin		NC	5.0E+02	1.3E+02	1.0E+03	2.6E+02	1.4E+03	3.8E+02	2.5E+03	6.6E+02	5.0E+03	1.3E+03
60297	Ethyl ether	X	NC	3.5E+05	1.2E+05	7.0E+05	2.3E+05	1.0E+06	3.3E+05	1.8E+06	5.8E+05	3.5E+06	1.2E+06
141786	Ethylacetate	X	NC	1.6E+06	4.4E+05	3.2E+06	8.7E+05	4.5E+06	1.2E+06	7.9E+06	2.2E+06	1.6E+07	4.4E+06
100414	Ethylbenzene		C	1.1E+04	2.5E+03	2.2E+04	5.1E+03	3.2E+04	7.3E+03	5.5E+04	1.3E+04	1.1E+05	2.5E+04
75218	Ethylene oxide		C	1.2E+02	6.8E+01	2.4E+02	1.4E+02	3.5E+02	1.9E+02	6.1E+02	3.4E+02	1.2E+03	6.8E+02
97632	Ethylmethacrylate	X	NC	1.6E+05	3.4E+04	3.2E+05	6.8E+04	4.5E+05	9.6E+04	7.9E+05	1.7E+05	1.6E+06	3.4E+05
86737	Fluorene	X	NC	**	**	**	**	**	**	**	**	**	**
110009	Furan	X	NC	1.8E+03	6.3E+02	3.5E+03	1.3E+03	5.0E+03	1.8E+03	8.8E+03	3.1E+03	1.8E+04	6.3E+03
58899	gamma-HCH (Lindane)	X	C	3.3E+01	2.8E+00	6.6E+01	5.5E+00	9.4E+01	7.9E+00	1.6E+02	1.4E+01	3.3E+02	2.8E+01
76448	Heptachlor		C	9.4E+00	6.1E-01	1.9E+01	1.2E+00	2.7E+01	1.8E+00	4.7E+01	3.1E+00	9.4E+01	6.1E+00
87683	Hexachloro-1,3-butadiene		C	5.5E+02	5.2E+01	1.1E+03	1.0E+02	1.6E+03	1.5E+02	2.8E+03	2.6E+02	5.5E+03	5.2E+02
118741	Hexachlorobenzene		C	2.6E+01	2.3E+00	5.3E+01	4.5E+00	7.6E+01	6.5E+00	1.3E+02	1.1E+01	2.6E+02	2.3E+01
77474	Hexachlorocyclopentadiene		NC	1.0E+02	9.0E+00	2.0E+02	1.8E+01	2.9E+02	2.6E+01	5.0E+02	4.5E+01	1.0E+03	9.0E+01
67721	Hexachloroethane		C	3.0E+03	3.1E+02	6.1E+03	6.3E+02	8.7E+03	9.0E+02	1.5E+04	1.6E+03	3.0E+04	3.1E+03
110543	Hexane		NC	1.0E+05	2.8E+04	2.0E+05	5.7E+04	2.9E+05	8.1E+04	5.0E+05	1.4E+05	1.0E+06	2.8E+05
74908	Hydrogen cyanide		NC	1.5E+03	1.4E+03	3.0E+03	2.7E+03	4.3E+03	3.9E+03	7.5E+03	6.8E+03	1.5E+04	1.4E+04
78831	Isobutanol	X	NC	5.3E+05	1.7E+05	1.1E+06	3.5E+05	1.5E+06	5.0E+05	2.6E+06	8.7E+05	5.3E+06	1.7E+06
7439976	Mercury (elemental)		NC	1.5E+02	1.8E+01	3.0E+02	3.7E+01	4.3E+02	5.2E+01	7.5E+02	9.1E+01	1.5E+03	1.8E+02
126987	Methacrylonitrile		NC	3.5E+02	1.3E+02	7.0E+02	2.6E+02	1.0E+03	3.6E+02	1.8E+03	6.4E+02	3.5E+03	1.3E+03
72435	Methoxychlor	X	NC	**	**	**	**	**	**	**	**	**	**
79209	Methyl acetate	X	NC	1.8E+06	5.8E+05	3.5E+06	1.2E+06	5.0E+06	1.7E+06	8.8E+06	2.9E+06	**	**
96333	Methyl acrylate	X	NC	5.3E+04	1.5E+04	1.1E+05	3.0E+04	1.5E+05	4.3E+04	2.6E+05	7.5E+04	5.3E+05	1.5E+05
74839	Methyl bromide		NC	2.5E+03	6.4E+02	5.0E+03	1.3E+03	7.1E+03	1.8E+03	1.3E+04	3.2E+03	2.5E+04	6.4E+03
74873	Methyl chloride (chloromethane)		C	1.2E+04	5.9E+03	2.4E+04	1.2E+04	3.5E+04	1.7E+04	6.1E+04	2.9E+04	1.2E+05	5.9E+04
108872	Methylcyclohexane		NC	1.5E+06	3.7E+05	3.0E+06	7.5E+05	4.3E+06	1.1E+06	7.5E+06	1.9E+06	1.5E+07	3.7E+06
74953	Methylene bromide	X	NC	1.8E+04	2.5E+03	3.5E+04	4.9E+03	5.0E+04	7.0E+03	8.8E+04	1.2E+04	1.8E+05	2.5E+04
75092	Methylene chloride		C	2.6E+04	7.5E+03	5.2E+04	1.5E+04	7.4E+04	2.1E+04	1.3E+05	3.7E+04	2.6E+05	7.5E+04
78933	Methylethylketone (2-butanone)		NC	5.0E+05	1.7E+05	1.0E+06	3.4E+05	1.4E+06	4.8E+05	2.5E+06	8.5E+05	5.0E+06	1.7E+06
108101	Methylisobutylketone		NC	4.0E+04	9.8E+03	8.0E+04	2.0E+04	1.1E+05	2.8E+04	2.0E+05	4.9E+04	4.0E+05	9.8E+04
80626	Methylmethacrylate		NC	3.5E+05	8.6E+04	7.0E+05	1.7E+05	1.0E+06	2.4E+05	1.8E+06	4.3E+05	3.5E+06	8.6E+05
91576	2-Methylnaphthalene	X	NC	3.5E+04	6.0E+03	7.0E+04	1.2E+04	1.0E+05	1.7E+04	1.8E+05	3.0E+04	3.5E+05	6.0E+04
1634044	MTBE		NC	1.5E+06	4.2E+05	3.0E+06	8.3E+05	4.3E+06	1.2E+06	7.5E+06	2.1E+06	1.5E+07	4.2E+06

Table 3b-SG: Question 5 Soil Gas Screening Levels for Scenario-Specific Vapor Attenuation Factors (α) **DRAFT**

Risk = 1 x 10^{-5}

				Target Soil Gas Concentrations for Different Attenuation Factors									
		Compounds with Provisional Toxicity Data Extrapolated	Basis of Target Concentration C=cancer risk	$\alpha = 2x10^{-3}$ $C_{soil\text{-}gas}$		$\alpha = 1x10^{-3}$ $C_{soil\text{-}gas}$		$\alpha = 7x10^{-4}$ $C_{soil\text{-}gas}$		$\alpha = 4x10^{-4}$ $C_{soil\text{-}gas}$		$\alpha = 2x10^{-4}$ $C_{soil\text{-}gas}$	
CAS No.	Chemical	From Oral Sources	NC=noncancer risk	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)
108383	m-Xylene	X	NC	3.5E+06	8.1E+05	7.0E+06	1.6E+06	1.0E+07	2.3E+06	1.8E+07	4.0E+06	3.5E+07	8.1E+06
91203	Naphthalene		NC	1.5E+03	2.9E+02	3.0E+03	5.7E+02	4.3E+03	8.2E+02	7.5E+03	1.4E+03	1.5E+04	2.9E+03
104518	n-Butylbenzene	X	NC	7.0E+04	1.3E+04	1.4E+05	2.6E+04	2.0E+05	3.6E+04	3.5E+05	6.4E+04	7.0E+05	1.3E+05
98953	Nitrobenzene		NC	1.0E+03	2.0E+02	2.0E+03	4.0E+02	2.9E+03	5.7E+02	5.0E+03	9.9E+02	1.0E+04	2.0E+03
79469	2-Nitropropane		C	4.5E+00	1.2E+00	9.0E+00	2.5E+00	1.3E+01	3.5E+00	2.3E+01	6.2E+00	4.5E+01	1.2E+01
924163	N-Nitroso-di-n-butylamine		C	7.6E+00	1.2E+00	1.5E+01	2.4E+00	2.2E+01	3.4E+00	3.8E+01	5.9E+00	7.6E+01	1.2E+01
103651	n-Propylbenzene	X	NC	7.0E+04	1.4E+04	1.4E+05	2.8E+04	2.0E+05	4.1E+04	3.5E+05	7.1E+04	7.0E+05	1.4E+05
88722	o-Nitrotoluene	X	NC	1.8E+04	3.1E+03	3.5E+04	6.2E+03	5.0E+04	8.9E+03	8.8E+04	1.6E+04	1.8E+05	3.1E+04
95476	o-Xylene	X	NC	3.5E+06	8.1E+05	7.0E+06	1.6E+06	1.0E+07	2.3E+06	1.8E+07	4.0E+06	3.5E+07	8.1E+06
106423	p-Xylene	X	NC	3.5E+06	8.1E+05	7.0E+06	1.6E+06	1.0E+07	2.3E+06	1.8E+07	4.0E+06	3.5E+07	8.1E+06
129000	Pyrene	X	NC	**	**	**	**	**	**	**	**	**	**
135988	sec-Butylbenzene	X	NC	7.0E+04	1.3E+04	1.4E+05	2.6E+04	2.0E+05	3.6E+04	3.5E+05	6.4E+04	7.0E+05	1.3E+05
100425	Styrene		NC	5.0E+05	1.2E+05	1.0E+06	2.3E+05	1.4E+06	3.4E+05	2.5E+06	5.9E+05	5.0E+06	1.2E+06
98066	tert-Butylbenzene	X	NC	7.0E+04	1.3E+04	1.4E+05	2.6E+04	2.0E+05	3.6E+04	3.5E+05	6.4E+04	7.0E+05	1.3E+05
630206	1,1,1,2-Tetrachloroethane		C	1.6E+03	2.4E+02	3.3E+03	4.8E+02	4.7E+03	6.8E+02	8.2E+03	1.2E+03	1.6E+04	2.4E+03
79345	1,1,2,2-Tetrachloroethane		C	2.1E+02	3.1E+01	4.2E+02	6.1E+01	6.0E+02	8.7E+01	1.0E+03	1.5E+02	2.1E+03	3.1E+02
127184	Tetrachloroethylene		C	4.1E+03	6.0E+02	8.1E+03	1.2E+03	1.2E+04	1.7E+03	2.0E+04	3.0E+03	4.1E+04	6.0E+03
108883	Toluene		NC	2.0E+05	5.3E+04	4.0E+05	1.1E+05	5.7E+05	1.5E+05	1.0E+06	2.7E+05	2.0E+06	5.3E+05
156605	trans-1,2-Dichloroethylene	X	NC	3.5E+04	8.8E+03	7.0E+04	1.8E+04	1.0E+05	2.5E+04	1.8E+05	4.4E+04	3.5E+05	8.8E+04
76131	1,1,2-Trichloro-1,2,2-trifluoroethane		NC	1.5E+07	2.0E+06	3.0E+07	3.9E+06	4.3E+07	5.6E+06	7.5E+07	9.8E+06	1.5E+08	2.0E+07
120821	1,2,4-Trichlorobenzene		NC	1.0E+05	1.3E+04	2.0E+05	2.7E+04	2.9E+05	3.8E+04	5.0E+05	6.7E+04	1.0E+06	1.3E+05
79005	1,1,2-Trichloroethane		C	7.6E+02	1.4E+02	1.5E+03	2.8E+02	2.2E+03	4.0E+02	3.8E+03	7.0E+02	7.6E+03	1.4E+03
71556	1,1,1-Trichloroethane		NC	1.1E+06	2.0E+05	2.2E+06	4.0E+05	3.1E+06	5.8E+05	5.5E+06	1.0E+06	1.1E+07	2.0E+06
79016	Trichloroethylene ††	X	C	1.1E+02	2.1E+01	2.2E+02	4.1E+01	3.2E+02	5.9E+01	5.5E+02	1.0E+02	1.1E+03	2.1E+02
75694	Trichlorofluoromethane		NC	3.5E+05	6.2E+04	7.0E+05	1.2E+05	1.0E+06	1.8E+05	1.8E+06	3.1E+05	3.5E+06	6.2E+05
96184	1,2,3-Trichloropropane		NC	2.5E+03	4.1E+02	4.9E+03	8.1E+02	7.0E+03	1.2E+03	1.2E+04	2.0E+03	2.5E+04	4.1E+03
95636	1,2,4-Trimethylbenzene		NC	3.0E+03	6.1E+02	6.0E+03	1.2E+03	8.5E+03	1.7E+03	1.5E+04	3.0E+03	3.0E+04	6.1E+03
108678	1,3,5-Trimethylbenzene		NC	3.0E+03	6.1E+02	6.0E+03	1.2E+03	8.5E+03	1.7E+03	1.5E+04	3.0E+03	3.0E+04	6.1E+03
108054	Vinyl acetate		NC	1.0E+05	2.8E+04	2.0E+05	5.7E+04	2.9E+05	8.1E+04	5.0E+05	1.4E+05	1.0E+06	2.8E+05
75014	Vinyl chloride (chloroethene)		C	1.4E+03	5.4E+02	2.8E+03	1.1E+03	4.0E+03	1.5E+03	6.9E+03	2.7E+03	1.4E+04	5.4E+03

* Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete)

** Target soil gas concentration exceeds maximum possible vapor concentration at this soil gas to indoor air attenuation factor (pathway incomplete)

†† The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further. (See Appendix D.)

Table 3c-SG: Question 5 Soil Gas Screening Levels for Scenario-Specific Vapor Attenuation Factors (α) **DRAFT**

Risk = 1 x 10^{-6}

				Target Soil Gas Concentrations for Different Attenuation Factors									
				$\alpha = 2x10^{-3}$ $C_{soil-gas}$		$\alpha = 1x10^{-3}$ $C_{soil-gas}$		$\alpha = 7x10^{-4}$ $C_{soil-gas}$		$\alpha = 4x10^{-4}$ $C_{soil-gas}$		$\alpha = 2x10^{-4}$ $C_{soil-gas}$	
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)
83329	Acenaphthene	X	NC	**	**	**	**	**	**	**	**	**	**
75070	Acetaldehyde		C	5.5E+02	3.1E+02	1.1E+03	6.1E+02	1.6E+03	8.8E+02	2.8E+03	1.5E+03	5.5E+03	3.1E+03
67641	Acetone	X	NC	1.8E+05	7.4E+04	3.5E+05	1.5E+05	5.0E+05	2.1E+05	8.8E+05	3.7E+05	1.8E+06	7.4E+05
75058	Acetonitrile		NC	3.0E+04	1.8E+04	6.0E+04	3.6E+04	8.6E+04	5.1E+04	1.5E+05	8.9E+04	3.0E+05	1.8E+05
98862	Acetophenone	X	NC	1.8E+05	3.6E+04	3.5E+05	7.1E+04	5.0E+05	1.0E+05	8.8E+05	1.8E+05	1.8E+06	3.6E+05
107028	Acrolein		NC	1.0E+01	4.4E+00	2.0E+01	8.7E+00	2.9E+01	1.2E+01	5.0E+01	2.2E+01	1.0E+02	4.4E+01
107131	Acrylonitrile		C	1.8E+01	8.3E+00	3.6E+01	1.7E+01	5.1E+01	2.4E+01	8.9E+01	4.1E+01	1.8E+02	8.3E+01
309002	Aldrin		C	2.5E-01	1.7E-02	5.0E-01	3.3E-02	7.1E-01	4.8E-02	1.2E+00	8.3E-02	2.5E+00	1.7E-01
319846	alpha-HCH (alpha-BHC)		C	6.8E-01	5.7E-02	1.4E+00	1.1E-01	1.9E+00	1.6E-01	3.4E+00	2.8E-01	6.8E+00	5.7E-01
100527	Benzaldehyde	X	NC	1.8E+05	4.0E+04	3.5E+05	8.1E+04	5.0E+05	1.2E+05	8.8E+05	2.0E+05	1.8E+06	4.0E+05
71432	Benzene		C	1.6E+02	4.9E+01	3.1E+02	9.8E+01	4.5E+02	1.4E+02	7.8E+02	2.4E+02	1.6E+03	4.9E+02
205992	Benzo(b)fluoranthene	X	C	5.8E+00	5.6E-01	**	**	**	**	**	**	**	**
100447	Benzylchloride	X	C	2.5E+01	4.8E+00	5.0E+01	9.7E+00	7.2E+01	1.4E+01	1.3E+02	2.4E+01	2.5E+02	4.8E+01
91587	beta-Chloronaphthalene	X	NC	1.4E+05	2.1E+04	**	**	**	**	**	**	**	**
92524	Biphenyl	X	NC	8.8E+04	1.4E+04	**	**	**	**	**	**	**	**
111444	Bis(2-chloroethyl)ether		C	3.7E+00	6.3E-01	7.4E+00	1.3E+00	1.1E+01	1.8E+00	1.8E+01	3.2E+00	3.7E+01	6.3E+00
108601	Bis(2-chloroisopropyl)ether		C	1.2E+02	1.7E+01	2.4E+02	3.5E+01	3.5E+02	5.0E+01	6.1E+02	8.7E+01	1.2E+03	1.7E+02
542881	Bis(chloromethyl)ether		C	2.0E-02	4.2E-03	3.9E-02	8.4E-03	5.6E-02	1.2E-02	9.8E-02	2.1E-02	2.0E-01	4.2E-02
75274	Bromodichloromethane	X	C	6.9E+01	1.0E+01	1.4E+02	2.1E+01	2.0E+02	2.9E+01	3.4E+02	5.1E+01	6.9E+02	1.0E+02
75252	Bromoform		C	1.1E+03	1.1E+02	2.2E+03	2.1E+02	3.2E+03	3.1E+02	5.5E+03	5.4E+02	1.1E+04	1.1E+03
106990	1,3-Butadiene		C	4.3E+00	2.0E+00	8.7E+00	3.9E+00	1.2E+01	5.6E+00	2.2E+01	9.8E+00	4.3E+01	2.0E+01
75150	Carbon disulfide		NC	3.5E+05	1.1E+05	7.0E+05	2.2E+05	1.0E+06	3.2E+05	1.8E+06	5.6E+05	3.5E+06	1.1E+06
56235	Carbon tetrachloride		C	8.1E+01	1.3E+01	1.6E+02	2.6E+01	2.3E+02	3.7E+01	4.1E+02	6.5E+01	8.1E+02	1.3E+02
57749	Chlordane		C	1.2E+01	7.3E-01	2.4E+01	1.5E+00	3.5E+01	2.1E+00	6.1E+01	3.6E+00	**	**
126998	2-Chloro-1,3-butadiene (chloroprene)		NC	3.5E+03	9.7E+02	7.0E+03	1.9E+03	1.0E+04	2.8E+03	1.8E+04	4.8E+03	3.5E+04	9.7E+03
108907	Chlorobenzene		NC	3.0E+04	6.5E+03	6.0E+04	1.3E+04	8.5E+04	1.8E+04	1.5E+05	3.2E+04	3.0E+05	6.5E+04
109693	1-Chlorobutane	X	NC	7.0E+05	1.8E+05	1.4E+06	3.7E+05	2.0E+06	5.3E+05	3.5E+06	9.2E+05	7.0E+06	1.8E+06
124481	Chlorodibromomethane	X	C	5.1E+01	6.0E+00	1.0E+02	1.2E+01	1.4E+02	1.7E+01	2.5E+02	3.0E+01	5.1E+02	6.0E+01
75456	Chlorodifluoromethane		NC	**	**	**	**	**	**	**	**	**	**
75003	Chloroethane (ethyl chloride)		NC	5.0E+06	1.9E+06	1.0E+07	3.8E+06	1.4E+07	5.4E+06	2.5E+07	9.5E+06	5.0E+07	1.9E+07
67663	Chloroform		C	5.3E+01	1.1E+01	1.1E+02	2.2E+01	1.5E+02	3.1E+01	2.6E+02	5.4E+01	5.3E+02	1.1E+02
95578	2-Chlorophenol	X	NC	8.8E+03	1.7E+03	1.8E+04	3.3E+03	2.5E+04	4.8E+03	4.4E+04	8.3E+03	8.8E+04	1.7E+04
75296	2-Chloropropane		NC	5.1E+04	1.6E+04	1.0E+05	3.2E+04	1.5E+05	4.5E+04	2.5E+05	7.9E+04	5.1E+05	1.6E+05
218019	Chrysene	X	C	**	**	**	**	**	**	**	**	**	**
156592	cis-1,2-Dichloroethylene	X	NC	1.8E+04	4.4E+03	3.5E+04	8.8E+03	5.0E+04	1.3E+04	8.8E+04	2.2E+04	1.8E+05	4.4E+04
123739	Crotonaldehyde (2-butenal)	X	C	2.2E+00	7.8E-01	4.5E+00	1.6E+00	6.4E+00	2.2E+00	1.1E+01	3.9E+00	2.2E+01	7.8E+00
98828	Cumene		NC	2.0E+05	4.1E+04	4.0E+05	8.1E+04	5.7E+05	1.2E+05	1.0E+06	2.0E+05	2.0E+06	4.1E+05
72559	DDE	X	C	1.3E+01	9.6E-01	2.5E+01	1.9E+00	3.6E+01	2.8E+00	6.3E+01	4.8E+00	**	**
132649	Dibenzofuran	X	NC	**	**	**	**	**	**	**	**	**	**
96128	1,2-Dibromo-3-chloropropane		NC	1.0E+02	1.0E+01	2.0E+02	2.1E+01	2.9E+02	3.0E+01	5.0E+02	5.2E+01	1.0E+03	1.0E+02
106934	1,2-Dibromoethane (ethylene dibromide)		C	5.5E+00	7.2E-01	1.1E+01	1.4E+00	1.6E+01	2.1E+00	2.8E+01	3.6E+00	5.5E+01	7.2E+00
541731	1,3-Dichlorobenzene	X	NC	5.3E+04	8.7E+03	1.1E+05	1.7E+04	1.5E+05	2.5E+04	2.6E+05	4.4E+04	5.3E+05	8.7E+04

Table 3c-SG: Question 5 Soil Gas Screening Levels for Scenario-Specific Vapor Attenuation Factors (α) **DRAFT**

Risk = 1 x 10^{-6}

				Target Soil Gas Concentrations for Different Attenuation Factors									
		Compounds with Provisional Toxicity Data Extrapolated	Basis of Target Concentration C=cancer risk	$\alpha = 2x10^{-3}$ $C_{soil\text{-}gas}$		$\alpha = 1x10^{-3}$ $C_{soil\text{-}gas}$		$\alpha = 7x10^{-4}$ $C_{soil\text{-}gas}$		$\alpha = 4x10^{-4}$ $C_{soil\text{-}gas}$		$\alpha = 2x10^{-4}$ $C_{soil\text{-}gas}$	
CAS No.	Chemical	From Oral Sources	NC=noncancer risk	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)
95501	1,2-Dichlorobenzene		NC	1.0E+05	1.7E+04	2.0E+05	3.3E+04	2.9E+05	4.8E+04	5.0E+05	8.3E+04	1.0E+06	1.7E+05
106467	1,4-Dichlorobenzene		NC	4.0E+05	6.7E+04	8.0E+05	1.3E+05	1.1E+06	1.9E+05	2.0E+06	3.3E+05	4.0E+06	6.7E+05
75718	Dichlorodifluoromethane		NC	1.0E+05	2.0E+04	2.0E+05	4.0E+04	2.9E+05	5.8E+04	5.0E+05	1.0E+05	1.0E+06	2.0E+05
75343	1,1-Dichloroethane		NC	2.5E+05	6.2E+04	5.0E+05	1.2E+05	7.1E+05	1.8E+05	1.3E+06	3.1E+05	2.5E+06	6.2E+05
107062	1,2-Dichloroethane		C	4.7E+01	1.2E+01	9.4E+01	2.3E+01	1.3E+02	3.3E+01	2.3E+02	5.8E+01	4.7E+02	1.2E+02
75354	1,1-Dichloroethylene		NC	1.0E+05	2.5E+04	2.0E+05	5.0E+04	2.9E+05	7.2E+04	5.0E+05	1.3E+05	1.0E+06	2.5E+05
78875	1,2-Dichloropropane		NC	2.0E+03	4.3E+02	4.0E+03	8.7E+02	5.7E+03	1.2E+03	1.0E+04	2.2E+03	2.0E+04	4.3E+03
542756	1,3-Dichloropropene		C	3.0E+02	6.7E+01	6.1E+02	1.3E+02	8.7E+02	1.9E+02	1.5E+03	3.4E+02	3.0E+03	6.7E+02
60571	Dieldrin		C	2.6E-01	1.7E-02	5.3E-01	3.4E-02	7.6E-01	4.9E-02	1.3E+00	8.5E-02	2.6E+00	1.7E-01
115297	Endosulfan	X	NC	**	**	**	**	**	**	**	**	**	**
106898	Epichlorohydrin		NC	5.0E+02	1.3E+02	1.0E+03	2.6E+02	1.4E+03	3.8E+02	2.5E+03	6.6E+02	5.0E+03	1.3E+03
60297	Ethyl ether	X	NC	3.5E+05	1.2E+05	7.0E+05	2.3E+05	1.0E+06	3.3E+05	1.8E+06	5.8E+05	3.5E+06	1.2E+06
141786	Ethylacetate	X	NC	1.6E+06	4.4E+05	3.2E+06	8.7E+05	4.5E+06	1.2E+06	7.9E+06	2.2E+06	1.6E+07	4.4E+06
100414	Ethylbenzene		C	1.1E+03	2.5E+02	2.2E+03	5.1E+02	3.2E+03	7.3E+02	5.5E+03	1.3E+03	1.1E+04	2.5E+03
75218	Ethylene oxide		C	1.2E+01	6.8E+00	2.4E+01	1.4E+01	3.5E+01	1.9E+01	6.1E+01	3.4E+01	1.2E+02	6.8E+01
97632	Ethylmethacrylate	X	NC	1.6E+05	3.4E+04	3.2E+05	6.8E+04	4.5E+05	9.6E+04	7.9E+05	1.7E+05	1.6E+06	3.4E+05
86737	Fluorene	X	NC	**	**	**	**	**	**	**	**	**	**
110009	Furan	X	NC	1.8E+03	6.3E+02	3.5E+03	1.3E+03	5.0E+03	1.8E+03	8.8E+03	3.1E+03	1.8E+04	6.3E+03
58899	gamma-HCH (Lindane)	X	C	3.3E+00	2.8E-01	6.6E+00	5.5E-01	9.4E+00	7.9E-01	1.6E+01	1.4E+00	3.3E+01	2.8E+00
76448	Heptachlor		C	9.4E-01	6.1E-02	1.9E+00	1.2E-01	2.7E+00	1.8E-01	4.7E+00	3.1E-01	9.4E+00	6.1E-01
87683	Hexachloro-1,3-butadiene		C	5.5E+01	5.2E+00	1.1E+02	1.0E+01	1.6E+02	1.5E+01	2.8E+02	2.6E+01	5.5E+02	5.2E+01
118741	Hexachlorobenzene		C	2.6E+00	2.3E-01	5.3E+00	4.5E-01	7.6E+00	6.5E-01	1.3E+01	1.1E+00	2.6E+01	2.3E+00
77474	Hexachlorocyclopentadiene		NC	1.0E+02	9.0E+00	2.0E+02	1.8E+01	2.9E+02	2.6E+01	5.0E+02	4.5E+01	1.0E+03	9.0E+01
67721	Hexachloroethane		C	3.0E+02	3.1E+01	6.1E+02	6.3E+01	8.7E+02	9.0E+01	1.5E+03	1.6E+02	3.0E+03	3.1E+02
110543	Hexane		NC	1.0E+05	2.8E+04	2.0E+05	5.7E+04	2.9E+05	8.1E+04	5.0E+05	1.4E+05	1.0E+06	2.8E+05
74908	Hydrogen cyanide		NC	1.5E+03	1.4E+03	3.0E+03	2.7E+03	4.3E+03	3.9E+03	7.5E+03	6.8E+03	1.5E+04	1.4E+04
78831	Isobutanol	X	NC	5.3E+05	1.7E+05	1.1E+06	3.5E+05	1.5E+06	5.0E+05	2.6E+06	8.7E+05	5.3E+06	1.7E+06
7439976	Mercury (elemental)		NC	1.5E+02	1.8E+01	3.0E+02	3.7E+01	4.3E+02	5.2E+01	7.5E+02	9.1E+01	1.5E+03	1.8E+02
126987	Methacrylonitrile		NC	3.5E+02	1.3E+02	7.0E+02	2.6E+02	1.0E+03	3.6E+02	1.8E+03	6.4E+02	3.5E+03	1.3E+03
72435	Methoxychlor	X	NC	**	**	**	**	**	**	**	**	**	**
79209	Methyl acetate	X	NC	1.8E+06	5.8E+05	3.5E+06	1.2E+06	5.0E+06	1.7E+06	8.8E+06	2.9E+06	**	**
96333	Methyl acrylate	X	NC	5.3E+04	1.5E+04	1.1E+05	3.0E+04	1.5E+05	4.3E+04	2.6E+05	7.5E+04	5.3E+05	1.5E+05
74839	Methyl bromide		NC	2.5E+03	6.4E+02	5.0E+03	1.3E+03	7.1E+03	1.8E+03	1.3E+04	3.2E+03	2.5E+04	6.4E+03
74873	Methyl chloride (chloromethane)		C	1.2E+03	5.9E+02	2.4E+03	1.2E+03	3.5E+03	1.7E+03	6.1E+03	2.9E+03	1.2E+04	5.9E+03
108872	Methylcyclohexane		NC	1.5E+06	3.7E+05	3.0E+06	7.5E+05	4.3E+06	1.1E+06	7.5E+06	1.9E+06	1.5E+07	3.7E+06
74953	Methylene bromide	X	NC	1.8E+04	2.5E+03	3.5E+04	4.9E+03	5.0E+04	7.0E+03	8.8E+04	1.2E+04	1.8E+05	2.5E+04
75092	Methylene chloride		C	2.6E+03	7.5E+02	5.2E+03	1.5E+03	7.4E+03	2.1E+03	1.3E+04	3.7E+03	2.6E+04	7.5E+03
78933	Methylethylketone (2-butanone)		NC	5.0E+05	1.7E+05	1.0E+06	3.4E+05	1.4E+06	4.8E+05	2.5E+06	8.5E+05	5.0E+06	1.7E+06
108101	Methylisobutylketone		NC	4.0E+04	9.8E+03	8.0E+04	2.0E+04	1.1E+05	2.8E+04	2.0E+05	4.9E+04	4.0E+05	9.8E+04
80626	Methylmethacrylate		NC	3.5E+05	8.6E+04	7.0E+05	1.7E+05	1.0E+06	2.4E+05	1.8E+06	4.3E+05	3.5E+06	8.6E+05
91576	2-Methylnaphthalene	X	NC	3.5E+04	6.0E+03	7.0E+04	1.2E+04	1.0E+05	1.7E+04	1.8E+05	3.0E+04	3.5E+05	6.0E+04
1634044	MTBE		NC	1.5E+06	4.2E+05	3.0E+06	8.3E+05	4.3E+06	1.2E+06	7.5E+06	2.1E+06	1.5E+07	4.2E+06

Table 3c-SG: Question 5 Soil Gas Screening Levels for Scenario-Specific Vapor Attenuation Factors (α) **DRAFT**

Risk = 1 x 10^{-6}

				Target Soil Gas Concentrations for Different Attenuation Factors									
		Compounds with Provisional Toxicity Data Extrapolated	Basis of Target Concentration C=cancer risk	$\alpha = 2x10^{-3}$ $C_{soil\text{-}gas}$		$\alpha = 1x10^{-3}$ $C_{soil\text{-}gas}$		$\alpha = 7x10^{-4}$ $C_{soil\text{-}gas}$		$\alpha = 4x10^{-4}$ $C_{soil\text{-}gas}$		$\alpha = 2x10^{-4}$ $C_{soil\text{-}gas}$	
CAS No.	Chemical	From Oral Sources	NC=noncancer risk	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)	(ug/m^3)	(ppbv)
108383	m-Xylene	X	NC	3.5E+06	8.1E+05	7.0E+06	1.6E+06	1.0E+07	2.3E+06	1.8E+07	4.0E+06	3.5E+07	8.1E+06
91203	Naphthalene		NC	1.5E+03	2.9E+02	3.0E+03	5.7E+02	4.3E+03	8.2E+02	7.5E+03	1.4E+03	1.5E+04	2.9E+03
104518	n-Butylbenzene	X	NC	7.0E+04	1.3E+04	1.4E+05	2.6E+04	2.0E+05	3.6E+04	3.5E+05	6.4E+04	7.0E+05	1.3E+05
98953	Nitrobenzene		NC	1.0E+03	2.0E+02	2.0E+03	4.0E+02	2.9E+03	5.7E+02	5.0E+03	9.9E+02	1.0E+04	2.0E+03
79469	2-Nitropropane		C	4.5E-01	1.2E-01	9.0E-01	2.5E-01	1.3E+00	3.5E-01	2.3E+00	6.2E-01	4.5E+00	1.2E+00
924163	N-Nitroso-di-n-butylamine		C	7.6E-01	1.2E-01	1.5E+00	2.4E-01	2.2E+00	3.4E-01	3.8E+00	5.9E-01	7.6E+00	1.2E+00
103651	n-Propylbenzene	X	NC	7.0E+04	1.4E+04	1.4E+05	2.8E+04	2.0E+05	4.1E+04	3.5E+05	7.1E+04	7.0E+05	1.4E+05
88722	o-Nitrotoluene	X	NC	1.8E+04	3.1E+03	3.5E+04	6.2E+03	5.0E+04	8.9E+03	8.8E+04	1.6E+04	1.8E+05	3.1E+04
95476	o-Xylene	X	NC	3.5E+06	8.1E+05	7.0E+06	1.6E+06	1.0E+07	2.3E+06	1.8E+07	4.0E+06	3.5E+07	8.1E+06
106423	p-Xylene	X	NC	3.5E+06	8.1E+05	7.0E+06	1.6E+06	1.0E+07	2.3E+06	1.8E+07	4.0E+06	3.5E+07	8.1E+06
129000	Pyrene	X	NC	**	**	**	**	**	**	**	**	**	**
135988	sec-Butylbenzene	X	NC	7.0E+04	1.3E+04	1.4E+05	2.6E+04	2.0E+05	3.6E+04	3.5E+05	6.4E+04	7.0E+05	1.3E+05
100425	Styrene		NC	5.0E+05	1.2E+05	1.0E+06	2.3E+05	1.4E+06	3.4E+05	2.5E+06	5.9E+05	5.0E+06	1.2E+06
98066	tert-Butylbenzene	X	NC	7.0E+04	1.3E+04	1.4E+05	2.6E+04	2.0E+05	3.6E+04	3.5E+05	6.4E+04	7.0E+05	1.3E+05
630206	1,1,1,2-Tetrachloroethane		C	1.6E+02	2.4E+01	3.3E+02	4.8E+01	4.7E+02	6.8E+01	8.2E+02	1.2E+02	1.6E+03	2.4E+02
79345	1,1,2,2-Tetrachloroethane		C	2.1E+01	3.1E+00	4.2E+01	6.1E+00	6.0E+01	8.7E+00	1.0E+02	1.5E+01	2.1E+02	3.1E+01
127184	Tetrachloroethylene		C	4.1E+02	6.0E+01	8.1E+02	1.2E+02	1.2E+03	1.7E+02	2.0E+03	3.0E+02	4.1E+03	6.0E+02
108883	Toluene		NC	2.0E+05	5.3E+04	4.0E+05	1.1E+05	5.7E+05	1.5E+05	1.0E+06	2.7E+05	2.0E+06	5.3E+05
156605	trans-1,2-Dichloroethylene	X	NC	3.5E+04	8.8E+03	7.0E+04	1.8E+04	1.0E+05	2.5E+04	1.8E+05	4.4E+04	3.5E+05	8.8E+04
76131	1,1,2-Trichloro-1,2,2-trifluoroethane		NC	1.5E+07	2.0E+06	3.0E+07	3.9E+06	4.3E+07	5.6E+06	7.5E+07	9.8E+06	1.5E+08	2.0E+07
120821	1,2,4-Trichlorobenzene		NC	1.0E+05	1.3E+04	2.0E+05	2.7E+04	2.9E+05	3.8E+04	5.0E+05	6.7E+04	1.0E+06	1.3E+05
79005	1,1,2-Trichloroethane		C	7.6E+01	1.4E+01	1.5E+02	2.8E+01	2.2E+02	4.0E+01	3.8E+02	7.0E+01	7.6E+02	1.4E+02
71556	1,1,1-Trichloroethane		NC	1.1E+06	2.0E+05	2.2E+06	4.0E+05	3.1E+06	5.8E+05	5.5E+06	1.0E+06	1.1E+07	2.0E+06
79016	Trichloroethylene ††	X	C	1.1E+01	2.1E+00	2.2E+01	4.1E+00	3.2E+01	5.9E+00	5.5E+01	1.0E+01	1.1E+02	2.1E+01
75694	Trichlorofluoromethane		NC	3.5E+05	6.2E+04	7.0E+05	1.2E+05	1.0E+06	1.8E+05	1.8E+06	3.1E+05	3.5E+06	6.2E+05
96184	1,2,3-Trichloropropane		NC	2.5E+03	4.1E+02	4.9E+03	8.1E+02	7.0E+03	1.2E+03	1.2E+04	2.0E+03	2.5E+04	4.1E+03
95636	1,2,4-Trimethylbenzene		NC	3.0E+03	6.1E+02	6.0E+03	1.2E+03	8.5E+03	1.7E+03	1.5E+04	3.0E+03	3.0E+04	6.1E+03
108678	1,3,5-Trimethylbenzene		NC	3.0E+03	6.1E+02	6.0E+03	1.2E+03	8.5E+03	1.7E+03	1.5E+04	3.0E+03	3.0E+04	6.1E+03
108054	Vinyl acetate		NC	1.0E+05	2.8E+04	2.0E+05	5.7E+04	2.9E+05	8.1E+04	5.0E+05	1.4E+05	1.0E+06	2.8E+05
75014	Vinyl chloride (chloroethene)		C	1.4E+02	5.4E+01	2.8E+02	1.1E+02	4.0E+02	1.5E+02	6.9E+02	2.7E+02	1.4E+03	5.4E+02

* Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete)

** Target soil gas concentration exceeds maximum possible vapor concentration at this soil gas to indoor air attenuation factor (pathway incomplete)

†† The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further. (See Appendix D.)

Table 3a - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-4}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
83329	Acenaphthene	X	NC	**	**	**	**	**
75070	Acetaldehyde		NC	4.0E+03	5.6E+03	9.3E+03	1.4E+04	2.8E+04
67641	Acetone	X	NC	3.2E+05	4.4E+05	7.4E+05	1.1E+06	2.2E+06
75058	Acetonitrile		NC	6.1E+04	8.5E+04	1.4E+05	2.1E+05	4.2E+05
98862	Acetophenone	X	NC	1.1E+06	1.6E+06	2.7E+06	4.0E+06	**
107028	Acrolein		NC	5.7E+00	8.0E+00	1.3E+01	2.0E+01	4.0E+01
107131	Acrylonitrile		NC	6.8E+02	9.5E+02	1.6E+03	2.4E+03	4.7E+03
309002	Aldrin		C	1.0E+01	1.4E+01	**	**	**
319846	alpha-HCH (alpha-BHC)		C	4.5E+02	6.2E+02	1.0E+03	1.6E+03	**
100527	Benzaldehyde	X	NC	5.1E+05	7.2E+05	1.2E+06	1.8E+06	**
71432	Benzene		C	2.0E+02	2.7E+02	4.6E+02	6.9E+02	1.4E+03
205992	Benzo(b)fluoranthene	X	C	**	**	**	**	**
100447	Benzylchloride	X	C	4.2E+02	5.9E+02	9.8E+02	1.5E+03	3.0E+03
91587	beta-Chloronaphthalene	X	NC	**	**	**	**	**
92524	Biphenyl	X	NC	**	**	**	**	**
111444	Bis(2-chloroethyl)ether		C	1.4E+03	2.0E+03	3.3E+03	5.0E+03	1.0E+04
108601	Bis(2-chloroisopropyl)ether		C	7.3E+03	1.0E+04	1.7E+04	2.5E+04	5.1E+04
542881	Bis(chloromethyl)ether		C	6.4E-01	9.0E-01	1.5E+00	2.3E+00	4.5E+00
75274	Bromodichloromethane	X	C	3.0E+02	4.2E+02	7.0E+02	1.1E+03	2.1E+03
75252	Bromoform		C	1.2E+00	1.7E+00	2.8E+00	4.2E+00	8.3E+00
106990	1,3-Butadiene		C	4.1E-01	5.8E-01	9.6E-01	1.4E+00	2.9E+00
75150	Carbon disulfide		NC	8.1E+02	1.1E+03	1.9E+03	2.8E+03	5.6E+03
56235	Carbon tetrachloride		C	1.9E+01	2.6E+01	4.3E+01	6.5E+01	1.3E+02
57749	Chlordane		NC	**	**	**	**	**
126998	2-Chloro-1,3-butadiene (chloroprene)		NC	2.0E+01	2.9E+01	4.8E+01	7.1E+01	1.4E+02
108907	Chlorobenzene		NC	5.6E+02	7.9E+02	1.3E+03	2.0E+03	3.9E+03
109693	1-Chlorobutane	X	NC	2.9E+03	4.0E+03	6.7E+03	1.0E+04	2.0E+04
124481	Chlorodibromomethane	X	C	4.5E+02	6.3E+02	1.1E+03	1.6E+03	3.2E+03
75456	Chlorodifluoromethane		NC	**	**	**	**	**
75003	Chloroethane (ethyl chloride)		NC	4.0E+04	5.5E+04	9.2E+04	1.4E+05	2.8E+05
67663	Chloroform		C	1.0E+02	1.4E+02	2.3E+02	3.5E+02	7.0E+02
95578	2-Chlorophenol	X	NC	1.6E+03	2.2E+03	3.6E+03	5.5E+03	1.1E+04
75296	2-Chloropropane		NC	2.4E+02	3.4E+02	5.7E+02	8.6E+02	1.7E+03

Table 3a - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-4}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
218019	Chrysene	X	*	*	*	*	*	*
156592	cis-1,2-Dichloroethylene	X	NC	3.0E+02	4.2E+02	7.0E+02	1.0E+03	2.1E+03
123739	Crotonaldehyde (2-butenal)	X	C	8.0E+02	1.1E+03	1.9E+03	2.8E+03	5.6E+03
98828	Cumene		NC	1.2E+01	1.7E+01	2.8E+01	4.2E+01	8.4E+01
72559	DDE	X	C	**	**	**	**	**
132649	Dibenzofuran	X	NC	**	**	**	**	**
96128	1,2-Dibromo-3-chloropropane		NC	4.8E+01	6.7E+01	1.1E+02	1.7E+02	3.3E+02
106934	1,2-Dibromoethane (ethylene dibromide)		NC	9.4E+00	1.3E+01	2.2E+01	3.3E+01	6.6E+01
541731	1,3-Dichlorobenzene	X	NC	1.2E+03	1.7E+03	2.8E+03	4.1E+03	8.3E+03
95501	1,2-Dichlorobenzene		NC	3.7E+03	5.1E+03	8.6E+03	1.3E+04	2.6E+04
106467	1,4-Dichlorobenzene		NC	1.2E+04	1.6E+04	2.7E+04	4.1E+04	**
75718	Dichlorodifluoromethane		NC	2.0E+01	2.9E+01	4.8E+01	7.1E+01	1.4E+02
75343	1,1-Dichloroethane		NC	3.1E+03	4.4E+03	7.3E+03	1.1E+04	2.2E+04
107062	1,2-Dichloroethane		C	3.3E+02	4.7E+02	7.8E+02	1.2E+03	2.3E+03
75354	1,1-Dichloroethylene		NC	2.7E+02	3.7E+02	6.2E+02	9.4E+02	1.9E+03
78875	1,2-Dichloropropane		NC	5.0E+01	7.0E+01	1.2E+02	1.7E+02	3.5E+02
542756	1,3-Dichloropropene		NC	3.9E+01	5.5E+01	9.2E+01	1.4E+02	2.8E+02
60571	Dieldrin		C	1.2E+02	1.7E+02	**	**	**
115297	Endosulfan	X	NC	**	**	**	**	**
106898	Epichlorohydrin		NC	1.1E+03	1.6E+03	2.7E+03	4.0E+03	8.0E+03
60297	Ethyl ether	X	NC	7.4E+02	1.0E+03	1.7E+03	2.6E+03	5.2E+03
141786	Ethylacetate	X	NC	8.0E+05	1.1E+06	1.9E+06	2.8E+06	5.6E+06
100414	Ethylbenzene		C	9.8E+02	1.4E+03	2.3E+03	3.4E+03	6.9E+03
75218	Ethylene oxide		C	1.5E+02	2.1E+02	3.6E+02	5.4E+02	1.1E+03
97632	Ethylmethacrylate	X	NC	1.3E+04	1.8E+04	3.0E+04	4.6E+04	9.1E+04
86737	Fluorene	X	NC	**	**	**	**	**
110009	Furan	X	NC	2.3E+01	3.2E+01	5.3E+01	7.9E+01	1.6E+02
58899	gamma-HCH (Lindane)	X	C	1.6E+03	2.3E+03	3.8E+03	5.7E+03	**
76448	Heptachlor		C	4.0E-01 †	4.0E-01 †	4.0E-01 †	4.0E-01 †	4.0E-01 †
87683	Hexachloro-1,3-butadiene		C	4.7E+01	6.6E+01	1.1E+02	1.7E+02	3.3E+02
118741	Hexachlorobenzene		C	**	**	**	**	**
77474	Hexachlorocyclopentadiene		NC	5.0E+01 †	5.0E+01 †	5.0E+01 †	5.0E+01 †	5.0E+01 †
67721	Hexachloroethane		C	5.5E+02	7.6E+02	1.3E+03	1.9E+03	3.8E+03

Table 3a - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-4}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
110543	Hexane		NC	4.2E+00	5.9E+00	9.8E+00	1.5E+01	2.9E+01
74908	Hydrogen cyanide		NC	7.9E+02	1.1E+03	1.8E+03	2.8E+03	5.5E+03
78831	Isobutanol	X	NC	3.1E+06	4.4E+06	7.3E+06	1.1E+07	2.2E+07
7439976	Mercury (elemental)		NC	9.7E-01	1.4E+00	2.3E+00	3.4E+00	6.8E+00
126987	Methacrylonitrile		NC	9.9E+01	1.4E+02	2.3E+02	3.5E+02	6.9E+02
72435	Methoxychlor	X	NC	**	**	**	**	**
79209	Methyl acetate	X	NC	1.0E+06	1.4E+06	**	**	**
96333	Methyl acrylate	X	NC	2.0E+04	2.7E+04	4.6E+04	6.8E+04	1.4E+05
74839	Methyl bromide		NC	2.8E+01	3.9E+01	6.5E+01	9.8E+01	2.0E+02
74873	Methyl chloride (chloromethane)		NC	3.6E+02	5.0E+02	8.3E+02	1.2E+03	2.5E+03
108872	Methylcyclohexane		NC	1.0E+03	1.4E+03	2.4E+03	3.6E+03	7.1E+03
74953	Methylene bromide	X	NC	1.4E+03	2.0E+03	3.3E+03	5.0E+03	9.9E+03
75092	Methylene chloride		C	8.3E+03	1.2E+04	1.9E+04	2.9E+04	5.8E+04
78933	Methylethylketone (2-butanone)		NC	6.2E+05	8.7E+05	1.5E+06	2.2E+06	4.4E+06
108101	Methylisobutylketone		NC	2.0E+04	2.8E+04	4.7E+04	7.1E+04	1.4E+05
80626	Methylmethacrylate		NC	7.3E+04	1.0E+05	1.7E+05	2.5E+05	5.1E+05
91576	2-Methylnaphthalene	X	NC	4.7E+03	6.6E+03	1.1E+04	1.7E+04	**
1634044	MTBE		NC	1.7E+05	2.3E+05	3.9E+05	5.9E+05	1.2E+06
108383	m-Xylene	X	NC	3.3E+04	4.7E+04	7.8E+04	1.2E+05	**
91203	Naphthalene		NC	2.2E+02	3.0E+02	5.1E+02	7.6E+02	1.5E+03
104518	n-Butylbenzene	X	NC	3.7E+02	5.2E+02	8.7E+02	1.3E+03	**
98953	Nitrobenzene		NC	2.9E+03	4.1E+03	6.8E+03	1.0E+04	2.0E+04
79469	2-Nitropropane		C	2.6E+01	3.6E+01	6.0E+01	9.0E+01	1.8E+02
924163	N-Nitroso-di-n-butylamine		C	1.7E+01	2.4E+01	3.9E+01	5.9E+01	1.2E+02
103651	n-Propylbenzene	X	NC	4.6E+02	6.4E+02	1.1E+03	1.6E+03	3.2E+03
88722	o-Nitrotoluene	X	NC	9.8E+04	1.4E+05	2.3E+05	3.4E+05	**
95476	o-Xylene	X	NC	4.7E+04	6.6E+04	1.1E+05	1.6E+05	**
106423	p-Xylene	X	NC	3.2E+04	4.5E+04	7.4E+04	1.1E+05	**
129000	Pyrene	X	NC	**	**	**	**	**
135988	sec-Butylbenzene	X	NC	3.5E+02	4.9E+02	8.2E+02	1.2E+03	2.5E+03
100425	Styrene		NC	1.3E+04	1.8E+04	3.0E+04	4.4E+04	8.9E+04
98066	tert-Butylbenzene	X	NC	4.1E+02	5.8E+02	9.6E+02	1.4E+03	2.9E+03
630206	1,1,1,2-Tetrachloroethane		C	4.7E+02	6.6E+02	1.1E+03	1.7E+03	3.3E+03

Table 3a - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-4}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
79345	1,1,2,2-Tetrachloroethane		C	4.2E+02	5.9E+02	9.9E+02	1.5E+03	3.0E+03
127184	Tetrachloroethylene		C	1.5E+02	2.2E+02	3.6E+02	5.4E+02	1.1E+03
108883	Toluene		NC	2.1E+03	2.9E+03	4.9E+03	7.4E+03	1.5E+04
156605	trans-1,2-Dichloroethylene	X	NC	2.6E+02	3.6E+02	6.1E+02	9.1E+02	1.8E+03
76131	1,1,2-Trichloro-1,2,2-trifluoroethane		NC	2.2E+03	3.1E+03	5.1E+03	7.7E+03	1.5E+04
120821	1,2,4-Trichlorobenzene		NC	4.9E+03	6.9E+03	1.1E+04	1.7E+04	3.4E+04
79005	1,1,2-Trichloroethane		C	5.8E+02	8.1E+02	1.4E+03	2.0E+03	4.1E+03
71556	1,1,1-Trichloroethane		NC	4.5E+03	6.3E+03	1.0E+04	1.6E+04	3.1E+04
79016	Trichloroethylene ††	X	C	7.5E+00	1.1E+01	1.8E+01	2.6E+01	5.3E+01
75694	Trichlorofluoromethane		NC	2.5E+02	3.5E+02	5.9E+02	8.8E+02	1.8E+03
96184	1,2,3-Trichloropropane		NC	4.2E+02	5.9E+02	9.8E+02	1.5E+03	2.9E+03
95636	1,2,4-Trimethylbenzene		NC	3.4E+01	4.7E+01	7.9E+01	1.2E+02	2.4E+02
108678	1,3,5-Trimethylbenzene		NC	3.5E+01	4.9E+01	8.2E+01	1.2E+02	2.5E+02
108054	Vinyl acetate		NC	1.4E+04	1.9E+04	3.2E+04	4.8E+04	9.6E+04
75014	Vinyl chloride (chloroethene)		C	3.6E+01	5.0E+01	8.3E+01	1.3E+02	2.5E+02

* Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete)

** Target soil gas concentration exceeds maximum possible vapor concentration at this soil gas to indoor air attenuation factor (pathway incomplete)

† The target groundwater concentrations is the MCL. (The MCL for chloroform is the MCL for total Trihalomethanes. The MCL listed for m-Xylene, o-Xylene, and p-Xylene is the MCL for total Xylenes.

†† The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further. (See Appendix D.)

Table 3b - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-5}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
83329	Acenaphthene	X	NC	**	**	**	**	**
75070	Acetaldehyde		NC	4.0E+03	5.6E+03	9.3E+03	1.4E+04	2.8E+04
67641	Acetone	X	NC	3.2E+05	4.4E+05	7.4E+05	1.1E+06	2.2E+06
75058	Acetonitrile		NC	6.1E+04	8.5E+04	1.4E+05	2.1E+05	4.2E+05
98862	Acetophenone	X	NC	1.1E+06	1.6E+06	2.7E+06	4.0E+06	**
107028	Acrolein		NC	5.7E+00	8.0E+00	1.3E+01	2.0E+01	4.0E+01
107131	Acrylonitrile		C	1.2E+02	1.7E+02	2.8E+02	4.2E+02	8.5E+02
309002	Aldrin		C	1.0E+00	1.4E+00	2.4E+00	3.6E+00	7.1E+00
319846	alpha-HCH (alpha-BHC)		C	4.5E+01	6.2E+01	1.0E+02	1.6E+02	3.1E+02
100527	Benzaldehyde	X	NC	5.1E+05	7.2E+05	1.2E+06	1.8E+06	**
71432	Benzene		C	2.0E+01	2.7E+01	4.6E+01	6.9E+01	1.4E+02
205992	Benzo(b)fluoranthene	X	C	**	**	**	**	**
100447	Benzylchloride	X	C	4.2E+01	5.9E+01	9.8E+01	1.5E+02	3.0E+02
91587	beta-Chloronaphthalene	X	NC	**	**	**	**	**
92524	Biphenyl	X	NC	**	**	**	**	**
111444	Bis(2-chloroethyl)ether		C	1.4E+02	2.0E+02	3.3E+02	5.0E+02	1.0E+03
108601	Bis(2-chloroisopropyl)ether		C	7.3E+02	1.0E+03	1.7E+03	2.5E+03	5.1E+03
542881	Bis(chloromethyl)ether		C	6.4E-02	9.0E-02	1.5E-01	2.3E-01	4.5E-01
75274	Bromodichloromethane	X	C	3.0E+01	4.2E+01	7.0E+01	1.1E+02	2.1E+02
75252	Bromoform		C	1.2E-01	1.7E-01	2.8E-01	4.2E-01	8.3E-01
106990	1,3-Butadiene		C	4.1E-02	5.8E-02	9.6E-02	1.4E-01	2.9E-01
75150	Carbon disulfide		NC	8.1E+02	1.1E+03	1.9E+03	2.8E+03	5.6E+03
56235	Carbon tetrachloride		C	5.0E+00 †	5.0E+00 †	5.0E+00 †	6.5E+00	1.3E+01
57749	Chlordane		C	**	**	**	**	**
126998	2-Chloro-1,3-butadiene (chloroprene)		NC	2.0E+01	2.9E+01	4.8E+01	7.1E+01	1.4E+02
108907	Chlorobenzene		NC	5.6E+02	7.9E+02	1.3E+03	2.0E+03	3.9E+03
109693	1-Chlorobutane	X	NC	2.9E+03	4.0E+03	6.7E+03	1.0E+04	2.0E+04
124481	Chlorodibromomethane	X	C	4.5E+01	6.3E+01	1.1E+02	1.6E+02	3.2E+02
75456	Chlorodifluoromethane		NC	**	**	**	**	**
75003	Chloroethane (ethyl chloride)		NC	4.0E+04	5.5E+04	9.2E+04	1.4E+05	2.8E+05
67663	Chloroform		C	8.0E+01 †	8.0E+01 †	8.0E+01 †	8.0E+01 †	8.0E+01 †
95578	2-Chlorophenol	X	NC	1.6E+03	2.2E+03	3.6E+03	5.5E+03	1.1E+04
75296	2-Chloropropane		NC	2.4E+02	3.4E+02	5.7E+02	8.6E+02	1.7E+03

Table 3b - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-5}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
218019	Chrysene	X	C	**	**	**	**	**
156592	cis-1,2-Dichloroethylene	X	NC	3.0E+02	4.2E+02	7.0E+02	1.0E+03	2.1E+03
123739	Crotonaldehyde (2-butenal)	X	C	8.0E+01	1.1E+02	1.9E+02	2.8E+02	5.6E+02
98828	Cumene		NC	1.2E+01	1.7E+01	2.8E+01	4.2E+01	8.4E+01
72559	DDE	X	C	**	**	**	**	**
132649	Dibenzofuran	X	NC	**	**	**	**	**
96128	1,2-Dibromo-3-chloropropane		NC	4.8E+01	6.7E+01	1.1E+02	1.7E+02	3.3E+02
106934	1,2-Dibromoethane (ethylene dibromide)		C	5.2E+00	7.3E+00	1.2E+01	1.8E+01	3.6E+01
541731	1,3-Dichlorobenzene	X	NC	1.2E+03	1.7E+03	2.8E+03	4.1E+03	8.3E+03
95501	1,2-Dichlorobenzene		NC	3.7E+03	5.1E+03	8.6E+03	1.3E+04	2.6E+04
106467	1,4-Dichlorobenzene		NC	1.2E+04	1.6E+04	2.7E+04	4.1E+04	**
75718	Dichlorodifluoromethane		NC	2.0E+01	2.9E+01	4.8E+01	7.1E+01	1.4E+02
75343	1,1-Dichloroethane		NC	3.1E+03	4.4E+03	7.3E+03	1.1E+04	2.2E+04
107062	1,2-Dichloroethane		C	3.3E+01	4.7E+01	7.8E+01	1.2E+02	2.3E+02
75354	1,1-Dichloroethylene		NC	2.7E+02	3.7E+02	6.2E+02	9.4E+02	1.9E+03
78875	1,2-Dichloropropane		NC	5.0E+01	7.0E+01	1.2E+02	1.7E+02	3.5E+02
542756	1,3-Dichloropropene		C	1.2E+01	1.7E+01	2.8E+01	4.2E+01	8.4E+01
60571	Dieldrin		C	1.2E+01	1.7E+01	2.9E+01	4.3E+01	8.6E+01
115297	Endosulfan	X	NC	**	**	**	**	**
106898	Epichlorohydrin		NC	1.1E+03	1.6E+03	2.7E+03	4.0E+03	8.0E+03
60297	Ethyl ether	X	NC	7.4E+02	1.0E+03	1.7E+03	2.6E+03	5.2E+03
141786	Ethylacetate	X	NC	8.0E+05	1.1E+06	1.9E+06	2.8E+06	5.6E+06
100414	Ethylbenzene		C	7.0E+02 †	7.0E+02 †	7.0E+02 †	7.0E+02 †	7.0E+02 †
75218	Ethylene oxide		C	1.5E+01	2.1E+01	3.6E+01	5.4E+01	1.1E+02
97632	Ethylmethacrylate	X	NC	1.3E+04	1.8E+04	3.0E+04	4.6E+04	9.1E+04
86737	Fluorene	X	NC	**	**	**	**	**
110009	Furan	X	NC	2.3E+01	3.2E+01	5.3E+01	7.9E+01	1.6E+02
58899	gamma-HCH (Lindane)	X	C	1.6E+02	2.3E+02	3.8E+02	5.7E+02	1.1E+03
76448	Heptachlor		C	4.0E-01 †	4.0E-01 †	4.0E-01 †	4.0E-01 †	4.0E-01 †
87683	Hexachloro-1,3-butadiene		C	4.7E+00	6.6E+00	1.1E+01	1.7E+01	3.3E+01
118741	Hexachlorobenzene		C	1.4E+00	2.0E+00	3.3E+00	4.9E+00	**
77474	Hexachlorocyclopentadiene		NC	5.0E+01 †	5.0E+01 †	5.0E+01 †	5.0E+01 †	5.0E+01 †
67721	Hexachloroethane		C	5.5E+01	7.6E+01	1.3E+02	1.9E+02	3.8E+02

Table 3b - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-5}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
110543	Hexane		NC	4.2E+00	5.9E+00	9.8E+00	1.5E+01	2.9E+01
74908	Hydrogen cyanide		NC	7.9E+02	1.1E+03	1.8E+03	2.8E+03	5.5E+03
78831	Isobutanol	X	NC	3.1E+06	4.4E+06	7.3E+06	1.1E+07	2.2E+07
7439976	Mercury (elemental)		NC	9.7E-01	1.4E+00	2.3E+00	3.4E+00	6.8E+00
126987	Methacrylonitrile		NC	9.9E+01	1.4E+02	2.3E+02	3.5E+02	6.9E+02
72435	Methoxychlor	X	NC	**	**	**	**	**
79209	Methyl acetate	X	NC	1.0E+06	1.4E+06	**	**	**
96333	Methyl acrylate	X	NC	2.0E+04	2.7E+04	4.6E+04	6.8E+04	1.4E+05
74839	Methyl bromide		NC	2.8E+01	3.9E+01	6.5E+01	9.8E+01	2.0E+02
74873	Methyl chloride (chloromethane)		C	9.6E+01	1.3E+02	2.2E+02	3.4E+02	6.7E+02
108872	Methylcyclohexane		NC	1.0E+03	1.4E+03	2.4E+03	3.6E+03	7.1E+03
74953	Methylene bromide	X	NC	1.4E+03	2.0E+03	3.3E+03	5.0E+03	9.9E+03
75092	Methylene chloride		C	8.3E+02	1.2E+03	1.9E+03	2.9E+03	5.8E+03
78933	Methylethylketone (2-butanone)		NC	6.2E+05	8.7E+05	1.5E+06	2.2E+06	4.4E+06
108101	Methylisobutylketone		NC	2.0E+04	2.8E+04	4.7E+04	7.1E+04	1.4E+05
80626	Methylmethacrylate		NC	7.3E+04	1.0E+05	1.7E+05	2.5E+05	5.1E+05
91576	2-Methylnaphthalene	X	NC	4.7E+03	6.6E+03	1.1E+04	1.7E+04	**
1634044	MTBE		NC	1.7E+05	2.3E+05	3.9E+05	5.9E+05	1.2E+06
108383	m-Xylene	X	NC	3.3E+04	4.7E+04	7.8E+04	1.2E+05	**
91203	Naphthalene		NC	2.2E+02	3.0E+02	5.1E+02	7.6E+02	1.5E+03
104518	n-Butylbenzene	X	NC	3.7E+02	5.2E+02	8.7E+02	1.3E+03	**
98953	Nitrobenzene		NC	2.9E+03	4.1E+03	6.8E+03	1.0E+04	2.0E+04
79469	2-Nitropropane		C	2.6E+00	3.6E+00	6.0E+00	9.0E+00	1.8E+01
924163	N-Nitroso-di-n-butylamine		C	1.7E+00	2.4E+00	3.9E+00	5.9E+00	1.2E+01
103651	n-Propylbenzene	X	NC	4.6E+02	6.4E+02	1.1E+03	1.6E+03	3.2E+03
88722	o-Nitrotoluene	X	NC	9.8E+04	1.4E+05	2.3E+05	3.4E+05	**
95476	o-Xylene	X	NC	4.7E+04	6.6E+04	1.1E+05	1.6E+05	**
106423	p-Xylene	X	NC	3.2E+04	4.5E+04	7.4E+04	1.1E+05	**
129000	Pyrene	X	NC	**	**	**	**	**
135988	sec-Butylbenzene	X	NC	3.5E+02	4.9E+02	8.2E+02	1.2E+03	2.5E+03
100425	Styrene		NC	1.3E+04	1.8E+04	3.0E+04	4.4E+04	8.9E+04
98066	tert-Butylbenzene	X	NC	4.1E+02	5.8E+02	9.6E+02	1.4E+03	2.9E+03
630206	1,1,1,2-Tetrachloroethane		C	4.7E+01	6.6E+01	1.1E+02	1.7E+02	3.3E+02

Table 3b - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-5}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
79345	1,1,2,2-Tetrachloroethane		C	4.2E+01	5.9E+01	9.9E+01	1.5E+02	3.0E+02
127184	Tetrachloroethylene		C	1.5E+01	2.2E+01	3.6E+01	5.4E+01	1.1E+02
108883	Toluene		NC	2.1E+03	2.9E+03	4.9E+03	7.4E+03	1.5E+04
156605	trans-1,2-Dichloroethylene	X	NC	2.6E+02	3.6E+02	6.1E+02	9.1E+02	1.8E+03
76131	1,1,2-Trichloro-1,2,2-trifluoroethane		NC	2.2E+03	3.1E+03	5.1E+03	7.7E+03	1.5E+04
120821	1,2,4-Trichlorobenzene		NC	4.9E+03	6.9E+03	1.1E+04	1.7E+04	3.4E+04
79005	1,1,2-Trichloroethane		C	5.8E+01	8.1E+01	1.4E+02	2.0E+02	4.1E+02
71556	1,1,1-Trichloroethane		NC	4.5E+03	6.3E+03	1.0E+04	1.6E+04	3.1E+04
79016	Trichloroethylene ††	X	C	5.0E+00 †	5.0E+00 †	5.0E+00 †	5.0E+00 †	5.3E+00
75694	Trichlorofluoromethane		NC	2.5E+02	3.5E+02	5.9E+02	8.8E+02	1.8E+03
96184	1,2,3-Trichloropropane		NC	4.2E+02	5.9E+02	9.8E+02	1.5E+03	2.9E+03
95636	1,2,4-Trimethylbenzene		NC	3.4E+01	4.7E+01	7.9E+01	1.2E+02	2.4E+02
108678	1,3,5-Trimethylbenzene		NC	3.5E+01	4.9E+01	8.2E+01	1.2E+02	2.5E+02
108054	Vinyl acetate		NC	1.4E+04	1.9E+04	3.2E+04	4.8E+04	9.6E+04
75014	Vinyl chloride (chloroethene)		C	3.6E+00	5.0E+00	8.3E+00	1.3E+01	2.5E+01

* Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete)

** Target soil gas concentration exceeds maximum possible vapor concentration at this soil gas to indoor air attenuation factor (pathway incomplete)

† The target groundwater concentrations is the MCL. (The MCL for chloroform is the MCL for total Trihalomethanes. The MCL listed for m-Xylene, o-Xylene, and p-Xylene is the MCL for total Xylenes.

†† The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further. (See Appendix D.)

Table 3c - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-6}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
83329	Acenaphthene	X	NC	**	**	**	**	**
75070	Acetaldehyde		C	4.9E+02	6.9E+02	1.1E+03	1.7E+03	3.4E+03
67641	Acetone	X	NC	3.2E+05	4.4E+05	7.4E+05	1.1E+06	2.2E+06
75058	Acetonitrile		NC	6.1E+04	8.5E+04	1.4E+05	2.1E+05	4.2E+05
98862	Acetophenone	X	NC	1.1E+06	1.6E+06	2.7E+06	4.0E+06	**
107028	Acrolein		NC	5.7E+00	8.0E+00	1.3E+01	2.0E+01	4.0E+01
107131	Acrylonitrile		C	1.2E+01	1.7E+01	2.8E+01	4.2E+01	8.5E+01
309002	Aldrin		C	1.0E-01	1.4E-01	2.4E-01	3.6E-01	7.1E-01
319846	alpha-HCH (alpha-BHC)		C	4.5E+00	6.2E+00	1.0E+01	1.6E+01	3.1E+01
100527	Benzaldehyde	X	NC	5.1E+05	7.2E+05	1.2E+06	1.8E+06	**
71432	Benzene		C	5.0E+00 †	5.0E+00 †	5.0E+00 †	6.9E+00	1.4E+01
205992	Benzo(b)fluoranthene	X	C	**	**	**	**	**
100447	Benzylchloride	X	C	4.2E+00	5.9E+00	9.8E+00	1.5E+01	3.0E+01
91587	beta-Chloronaphthalene	X	NC	**	**	**	**	**
92524	Biphenyl	X	NC	**	**	**	**	**
111444	Bis(2-chloroethyl)ether		C	1.4E+01	2.0E+01	3.3E+01	5.0E+01	1.0E+02
108601	Bis(2-chloroisopropyl)ether		C	7.3E+01	1.0E+02	1.7E+02	2.5E+02	5.1E+02
542881	Bis(chloromethyl)ether		C	6.4E-03	9.0E-03	1.5E-02	2.3E-02	4.5E-02
75274	Bromodichloromethane	X	C	3.0E+00	4.2E+00	7.0E+00	1.1E+01	2.1E+01
75252	Bromoform		C	1.2E-02	1.7E-02	2.8E-02	4.2E-02	8.3E-02
106990	1,3-Butadiene		C	4.1E-03	5.8E-03	9.6E-03	1.4E-02	2.9E-02
75150	Carbon disulfide		NC	8.1E+02	1.1E+03	1.9E+03	2.8E+03	5.6E+03
56235	Carbon tetrachloride		C	5.0E+00 †	5.0E+00 †	5.0E+00 †	5.0E+00 †	5.0E+00 †
57749	Chlordane		C	1.7E+01	2.4E+01	4.1E+01	**	**
126998	2-Chloro-1,3-butadiene (chloroprene)		NC	2.0E+01	2.9E+01	4.8E+01	7.1E+01	1.4E+02
108907	Chlorobenzene		NC	5.6E+02	7.9E+02	1.3E+03	2.0E+03	3.9E+03
109693	1-Chlorobutane	X	NC	2.9E+03	4.0E+03	6.7E+03	1.0E+04	2.0E+04
124481	Chlorodibromomethane	X	C	4.5E+00	6.3E+00	1.1E+01	1.6E+01	3.2E+01
75456	Chlorodifluoromethane		NC	**	**	**	**	**
75003	Chloroethane (ethyl chloride)		NC	4.0E+04	5.5E+04	9.2E+04	1.4E+05	2.8E+05
67663	Chloroform		C	8.0E+01 †	8.0E+01 †	8.0E+01 †	8.0E+01 †	8.0E+01 †
95578	2-Chlorophenol	X	NC	1.6E+03	2.2E+03	3.6E+03	5.5E+03	1.1E+04
75296	2-Chloropropane		NC	2.4E+02	3.4E+02	5.7E+02	8.6E+02	1.7E+03

Table 3c - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-6}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
218019	Chrysene	X	C	**	**	**	**	**
156592	cis-1,2-Dichloroethylene	X	NC	3.0E+02	4.2E+02	7.0E+02	1.0E+03	2.1E+03
123739	Crotonaldehyde (2-butenal)	X	C	8.0E+00	1.1E+01	1.9E+01	2.8E+01	5.6E+01
98828	Cumene		NC	1.2E+01	1.7E+01	2.8E+01	4.2E+01	8.4E+01
72559	DDE	X	C	4.2E+01	5.8E+01	9.7E+01	**	**
132649	Dibenzofuran	X	NC	**	**	**	**	**
96128	1,2-Dibromo-3-chloropropane		NC	4.8E+01	6.7E+01	1.1E+02	1.7E+02	3.3E+02
106934	1,2-Dibromoethane (ethylene dibromide)		C	5.2E-01	7.3E-01	1.2E+00	1.8E+00	3.6E+00
541731	1,3-Dichlorobenzene	X	NC	1.2E+03	1.7E+03	2.8E+03	4.1E+03	8.3E+03
95501	1,2-Dichlorobenzene		NC	3.7E+03	5.1E+03	8.6E+03	1.3E+04	2.6E+04
106467	1,4-Dichlorobenzene		NC	1.2E+04	1.6E+04	2.7E+04	4.1E+04	**
75718	Dichlorodifluoromethane		NC	2.0E+01	2.9E+01	4.8E+01	7.1E+01	1.4E+02
75343	1,1-Dichloroethane		NC	3.1E+03	4.4E+03	7.3E+03	1.1E+04	2.2E+04
107062	1,2-Dichloroethane		C	5.0E+00 †	5.0E+00 †	7.8E+00	1.2E+01	2.3E+01
75354	1,1-Dichloroethylene		NC	2.7E+02	3.7E+02	6.2E+02	9.4E+02	1.9E+03
78875	1,2-Dichloropropane		NC	5.0E+01	7.0E+01	1.2E+02	1.7E+02	3.5E+02
542756	1,3-Dichloropropene		C	1.2E+00	1.7E+00	2.8E+00	4.2E+00	8.4E+00
60571	Dieldrin		C	1.2E+00	1.7E+00	2.9E+00	4.3E+00	8.6E+00
115297	Endosulfan	X	NC	**	**	**	**	**
106898	Epichlorohydrin		NC	1.1E+03	1.6E+03	2.7E+03	4.0E+03	8.0E+03
60297	Ethyl ether	X	NC	7.4E+02	1.0E+03	1.7E+03	2.6E+03	5.2E+03
141786	Ethylacetate	X	NC	8.0E+05	1.1E+06	1.9E+06	2.8E+06	5.6E+06
100414	Ethylbenzene		C	7.0E+02 †	7.0E+02 †	7.0E+02 †	7.0E+02 †	7.0E+02 †
75218	Ethylene oxide		C	1.5E+00	2.1E+00	3.6E+00	5.4E+00	1.1E+01
97632	Ethylmethacrylate	X	NC	1.3E+04	1.8E+04	3.0E+04	4.6E+04	9.1E+04
86737	Fluorene	X	NC	**	**	**	**	**
110009	Furan	X	NC	2.3E+01	3.2E+01	5.3E+01	7.9E+01	1.6E+02
58899	gamma-HCH (Lindane)	X	C	1.6E+01	2.3E+01	3.8E+01	5.7E+01	1.1E+02
76448	Heptachlor		C	4.0E-01 †	4.0E-01 †	4.0E-01 †	4.0E-01 †	4.0E-01 †
87683	Hexachloro-1,3-butadiene		C	4.7E-01	6.6E-01	1.1E+00	1.7E+00	3.3E+00
118741	Hexachlorobenzene		C	1.0E+00 †	1.0E+00 †	1.0E+00 †	1.0E+00 †	1.0E+00 †
77474	Hexachlorocyclopentadiene		NC	5.0E+01 †	5.0E+01 †	5.0E+01 †	5.0E+01 †	5.0E+01 †
67721	Hexachloroethane		C	5.5E+00	7.6E+00	1.3E+01	1.9E+01	3.8E+01

Table 3c - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-6}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
110543	Hexane		NC	4.2E+00	5.9E+00	9.8E+00	1.5E+01	2.9E+01
74908	Hydrogen cyanide		NC	7.9E+02	1.1E+03	1.8E+03	2.8E+03	5.5E+03
78831	Isobutanol	X	NC	3.1E+06	4.4E+06	7.3E+06	1.1E+07	2.2E+07
7439976	Mercury (elemental)		NC	9.7E-01	1.4E+00	2.3E+00	3.4E+00	6.8E+00
126987	Methacrylonitrile		NC	9.9E+01	1.4E+02	2.3E+02	3.5E+02	6.9E+02
72435	Methoxychlor	X	NC	**	**	**	**	**
79209	Methyl acetate	X	NC	1.0E+06	1.4E+06	**	**	**
96333	Methyl acrylate	X	NC	2.0E+04	2.7E+04	4.6E+04	6.8E+04	1.4E+05
74839	Methyl bromide		NC	2.8E+01	3.9E+01	6.5E+01	9.8E+01	2.0E+02
74873	Methyl chloride (chloromethane)		C	9.6E+00	1.3E+01	2.2E+01	3.4E+01	6.7E+01
108872	Methylcyclohexane		NC	1.0E+03	1.4E+03	2.4E+03	3.6E+03	7.1E+03
74953	Methylene bromide	X	NC	1.4E+03	2.0E+03	3.3E+03	5.0E+03	9.9E+03
75092	Methylene chloride		C	8.3E+01	1.2E+02	1.9E+02	2.9E+02	5.8E+02
78933	Methylethylketone (2-butanone)		NC	6.2E+05	8.7E+05	1.5E+06	2.2E+06	4.4E+06
108101	Methylisobutylketone		NC	2.0E+04	2.8E+04	4.7E+04	7.1E+04	1.4E+05
80626	Methylmethacrylate		NC	7.3E+04	1.0E+05	1.7E+05	2.5E+05	5.1E+05
91576	2-Methylnaphthalene	X	NC	4.7E+03	6.6E+03	1.1E+04	1.7E+04	**
1634044	MTBE		NC	1.7E+05	2.3E+05	3.9E+05	5.9E+05	1.2E+06
108383	m-Xylene	X	NC	3.3E+04	4.7E+04	7.8E+04	1.2E+05	**
91203	Naphthalene		NC	2.2E+02	3.0E+02	5.1E+02	7.6E+02	1.5E+03
104518	n-Butylbenzene	X	NC	3.7E+02	5.2E+02	8.7E+02	1.3E+03	**
98953	Nitrobenzene		NC	2.9E+03	4.1E+03	6.8E+03	1.0E+04	2.0E+04
79469	2-Nitropropane		C	2.6E-01	3.6E-01	6.0E-01	9.0E-01	1.8E+00
924163	N-Nitroso-di-n-butylamine		C	1.7E-01	2.4E-01	3.9E-01	5.9E-01	1.2E+00
103651	n-Propylbenzene	X	NC	4.6E+02	6.4E+02	1.1E+03	1.6E+03	3.2E+03
88722	o-Nitrotoluene	X	NC	9.8E+04	1.4E+05	2.3E+05	3.4E+05	**
95476	o-Xylene	X	NC	4.7E+04	6.6E+04	1.1E+05	1.6E+05	**
106423	p-Xylene	X	NC	3.2E+04	4.5E+04	7.4E+04	1.1E+05	**
129000	Pyrene	X	NC	**	**	**	**	**
135988	sec-Butylbenzene	X	NC	3.5E+02	4.9E+02	8.2E+02	1.2E+03	2.5E+03
100425	Styrene		NC	1.3E+04	1.8E+04	3.0E+04	4.4E+04	8.9E+04
98066	tert-Butylbenzene	X	NC	4.1E+02	5.8E+02	9.6E+02	1.4E+03	2.9E+03
630206	1,1,1,2-Tetrachloroethane		C	4.7E+00	6.6E+00	1.1E+01	1.7E+01	3.3E+01

Table 3c - GW: Question 5 Groundwater Screening Levels for Scenario-Specific Vapor Attenuation Factors (α)
Risk = 1 x 10^{-6}

				Target Groundwater Concentrations at Different Attenuation Factors				
CAS No.	Chemical	Compounds with Provisional Toxicity Data Extrapolated From Oral Sources	Basis of Target Concentration C=cancer risk NC=noncancer risk	$\alpha = 7x10^{-4}$ C_{gw} (ug/L)	$\alpha = 5x10^{-4}$ C_{gw} (ug/L)	$\alpha = 3x10^{-4}$ C_{gw} (ug/L)	$\alpha = 2x10^{-4}$ C_{gw} (ug/L)	$\alpha = 1x10^{-4}$ C_{gw} (ug/L)
79345	1,1,2,2-Tetrachloroethane		C	4.2E+00	5.9E+00	9.9E+00	1.5E+01	3.0E+01
127184	Tetrachloroethylene		C	5.0E+00 †	5.0E+00 †	5.0E+00 †	5.4E+00	1.1E+01
108883	Toluene		NC	2.1E+03	2.9E+03	4.9E+03	7.4E+03	1.5E+04
156605	trans-1,2-Dichloroethylene	X	NC	2.6E+02	3.6E+02	6.1E+02	9.1E+02	1.8E+03
76131	1,1,2-Trichloro-1,2,2-trifluoroethane		NC	2.2E+03	3.1E+03	5.1E+03	7.7E+03	1.5E+04
120821	1,2,4-Trichlorobenzene		NC	4.9E+03	6.9E+03	1.1E+04	1.7E+04	3.4E+04
79005	1,1,2-Trichloroethane		C	5.8E+00	8.1E+00	1.4E+01	2.0E+01	4.1E+01
71556	1,1,1-Trichloroethane		NC	4.5E+03	6.3E+03	1.0E+04	1.6E+04	3.1E+04
79016	Trichloroethylene ††	X	C	5.0E+00 †	5.0E+00 †	5.0E+00 †	5.0E+00 †	5.0E+00 †
75694	Trichlorofluoromethane		NC	2.5E+02	3.5E+02	5.9E+02	8.8E+02	1.8E+03
96184	1,2,3-Trichloropropane		NC	4.2E+02	5.9E+02	9.8E+02	1.5E+03	2.9E+03
95636	1,2,4-Trimethylbenzene		NC	3.4E+01	4.7E+01	7.9E+01	1.2E+02	2.4E+02
108678	1,3,5-Trimethylbenzene		NC	3.5E+01	4.9E+01	8.2E+01	1.2E+02	2.5E+02
108054	Vinyl acetate		NC	1.4E+04	1.9E+04	3.2E+04	4.8E+04	9.6E+04
75014	Vinyl chloride (chloroethene)		C	2.0E+00 †	2.0E+00 †	2.0E+00 †	2.0E+00 †	2.5E+00

* Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete)

** Target soil gas concentration exceeds maximum possible vapor concentration at this soil gas to indoor air attenuation factor (pathway incomplete)

† The target groundwater concentrations is the MCL. (The MCL for chloroform is the MCL for total Trihalomethanes. The MCL listed for m-Xylene, o-Xylene, and p-Xylene is the MCL for total Xylenes.

†† The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further. (See Appendix D.)

APPENDIX A

DATA QUALITY ASSURANCE CONSIDERATIONS

The assessment of information to determine if there is a problem associated with the migration of volatile compounds from the groundwater will require the collection and assessment of environmental data and possibly the use of modeling as part of the assessment. As the guidance indicates, decisions to screen out sites after the first tier of screening from further analysis should be based either upon definitive measurement data or upon multiple lines of converging information. The ability to measure contamination levels in different media and to characterize the variability associated with sampling are key considerations.

OSWER expects that site-specific projects assess the impact of groundwater contaminants on indoor VOCs will be addressed by an approved Quality Assurance Project Plan (QAPP). This appendix is intended to provide a few recommendations on developing a QAPP, which need to follow EPA Requirements for Quality Assurance Project Plans (QA/R-5).

> *Recommendation 1: Using the Conceptual Site Model, develop the project plan and quality assurance project plan through a process that involves all key players and share these materials with interested parties in draft form so that potential study weaknesses can be addressed early.*

The collection and assessment of data, or the use of a model for the assessment of the data, warrants the development of a Quality Assurance Project Plan as part of a systematic planning process (EPA, 2000a,b, 2001). The EPA Region 1 guidance on the Quality Assurance Project Plan may be a useful reference that can aid site managers (EPA, 1999).

Data Quality Objectives (DQOs) play a central role in the systematic planning process as they help to ensure that the data collected will be of sufficient quality to support their intended use. Data Quality Objectives will generally be addressed within the Quality Assurance Project Plan and are typically a critical element in the planning for much of the work that EPA undertakes. The Agency guidance for DQOs, *Guidance for the Data Quality Objectives Process (G-4)*, provides useful information to implement DQOs (EPA, 2000c).

Table A-1 summarizes the steps in the DQO process, the purpose of each step, and provides some examples of how plans could be structured.

Table A-2 summarizes the sensitivity/detection limits of a variety of currently available methods for the analysis of VOCs along with estimated cost information. Table A-2 has been prepared to summarize some information that can serve as a general guide but should be updated as individual projects are undertaken.

The determination of the analytic and sampling methods to use, the number of samples, location of samples, and timing is a challenging task that will be related to a number of factors, including the values for screening and risk that will use the monitored results. These sampling issues can be addressed, at least in part, by employing software that has been designed to optimize sampling so that confidence in results will be maximized. Visual Sample Plan (VSP)[http://dqo.pnl.gov/vsp/] has been developed to provide statistical solutions to sampling design, mathematical and statistical algorithms, and a user-friendly visual interface, while answering the following two important questions in sample planning:

- How many samples are needed?

  The algorithms involved in determining the number of samples needed can be quite involved and intimidating to the non-expert. VSP aids in the calculation of the number of samples often needed for various scenarios at different costs.

- Where should the samples be taken?

  Sample placement based on professional judgment is prone to bias. VSP provides the alternative of random or gridded sampling locations overlaid on the site map.

References

EPA, 1999. ***EPA New England Compendium of Quality Assurance Project Plan Requirements and Guidance***. EPA, Region 1, Boston, MA. (http://www.epa.gov/NE/measure/qappcompendium.pdf).

EPA, 2000a. ***EPA Order 5360.1.A2, Policy and Program Requirements for the Mandatory Agency-wide Quality System***. EPA, Washington, D.C. (http://www.epa.gov/quality/qs-docs/5360-1.pdf).

EPA, 2000b. ***EPA Quality Manual for Environmental Programs.*** EPA, Washington, D.C. (http://www.epa.gov/quality/qs-docs/5360.pdf).

EPA, 2000c. ***Guidance for the Data Quality Objectives Process (G-4).*** EPA, Washington, D.C. (http://www.epa.gov/quality/qs-docs/g4-final.pdf)

EPA, 2001. ***EPA Requirements for QA Project Plans (QA/R-5)***. EPA, Washington, D.C. (http://www.epa.gov/quality/qs-docs/r5-final.pdf) and (http://www.epa.gov/QUALITY/qapps.html)

Visual Sample Plan (VSP)[http://dqo.pnl.gov/vsp/]

Table A-1. Example of Steps in the DQO Process using Q5©) of guidance

DQO Step	Purpose of the DQO Step	Example Application
1. State the Problem	Summarize the problem that will require new environmental data (the monitoring hypothesis) and modeling (if modeling is to be used).	Do measured or reasonably estimated groundwater concentrations exceed the target media-specific concentrations given in Table 2 (from the main body of the guidance)?
2. Identify the Decision	Identify the decision that requires new data/analysis to address the problem.	The decisions will be whether available information is sufficient to screen the site from further study.
3. Identify the Inputs to the Decision	Identify the information needed to support the decision and specify that inputs will require new information.	Ground water monitoring data will be compared with the screening values provided in guidance along with information to determine what comparisons would be most appropriate (e.g., soil type, screening wells at water table).
4. Define the Boundaries of the Study	Specify the spatial and temporal aspects of the environmental media or endpoints that the data must represent to support the decision.	The boundaries of the study will be defined by the extent to which indoor air contamination can be associated with site-related contamination. Groundwater contamination closest to the residential units would be of greatest relevance but other contamination may pose a risk to residential units in the future.

DQO Step	Purpose of the DQO Step	Example Application
5. Develop a Decision Rule	Develop a logical "if..then" statement that defines the conditions that will inform the decision maker to choose among alternative decisions.	For example, "If any measured VOC concentration in groundwater is above the action level for groundwater screening in Question 5c, then further assessment (including soil gas concentrations, and possibly indoor air concentrations, depending on the magnitude of the concentrations) should be performed as appropriate.
6. Specify Tolerable Limits on Decision Errors	Specify acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainly in the analysis.	Decision errors could result from failing to appreciate uncertainty in sampling, analysis or performing analyses. Decision performance goals may be useful in managing uncertainty. The use of a computer program, such as *Visual Sample Plan* (VSP) can aid in understanding and managing uncertainties associated with sampling and analysis.[1]
7. Optimize the Design for Obtaining Data	Identify the most resource-effective sampling and analysis design for generating the information needed to satisfy the DQOs.	Again, using a tool like VSP may prove very useful in understanding and managing uncertainty in this study. See discussion of VSP.

[1]VSP is a computer program that is useful for optimizing sampling efforts so that the greatest value in confidence of information can be collected for an expenditure of resources.

Table A-2. VOC Analytical Methods, their Detection Limits and Estimated Costs
(compiled July 2002)

Media	Analytical Method / Reference	Description	Average Practical Detection Limits	Analyte List	Estimated Analytical Costs
Water	**OSW - SW 846 Method 8260C** http://www.epa.gov/epaoswer/hazwaste/test/main.htm	Purge and trap GC/MS	5 ug/L	1	$ 100
Water	**OW Drinking Water Method 524.2** http://www.epa.gov/safewater/methods/methods.html	Purge and trap GC/MS	0.5 ug/L	2	$ 90
Water	**OERR/AOC SOW OLM04.2** http://www.epa.gov/superfund/programs/clp/olm42.htm	Purge and trap GC/MS	10 ug/L	3	$ 130
Water	**OERR/AOC SOW OLC03.2** http://www.epa.gov/superfund/programs/clp/olc32.htm	Purge and trap GC/MS	0.5 ug/L	4	$ 100
Soil	**OSW - SW 846 Method 8260C** http://www.epa.gov/epaoswer/hazwaste/test/main.htm	Purge and trap GC/MS	5 ug/kg	1	$ 100
Soil	**OERR/AOC SOW OLM04.2** http://www.epa.gov/superfund/programs/clp/olm42.htm	Purge and trap GC/MS	10 ug/kg	3	$130
Air	**OSW SW846 Method 5041** http://www.epa.gov/epaoswer/hazwaste/test/pdfs/5041a.pdf	Sorbent tubes/Thermal Desporption	0.1 ug/m3	5	$100
Air	**NIOSH Method 1003** Chlorinated VOCs http://www.cdc.gov/niosh/nmam/pdfs/1003.pdf	Charcoal Tubes / GC	0.01mg/L	6	$ 50
Air	**NIOSH Method 1501** http://www.cdc.gov/niosh/nmam/pdfs/1501.pdf	Charcoal Tubes/ GC	0.001 mg/L	7	$ 50

Air	**OAR TO-15** http://www.epa.gov/ttnamti1/airtox.html	Canisters/GC/MS	0.2-0.5 ug/m3 Scan Method 0.02 SIM Method	8	$ 250
Air	**OAR TO-17** http://www.epa.gov/ttnamti1/airtox.html	Sorbent Tubes/GC/MS	0.2-0.5 ug/m3	8	?
Air	**ASTM Method D-1945**	(GC/TCD/FID) .	Reporting Limit = 10 ppmv, O_2 and N_2 = 1000 (0.1%) ppmv, CH_4 = 1 ppmv.	Atmospheric gases plus C_1-C_6 hydrocarbon speciation	
Air	**ASTM Method D-1946** (GC/TCD/FID)	Atmospheric gases		O_2, N_2, CO, CO_2, CH_4, ethane, ethylene	?
Air	**Method TO-5 HPLC** http://www.epa.gov/ttnamti1/airtox.html	Selected aldehydes and ketones collected via dinitrophenylhydrazine (DNPH) midget impinger.	0.05 ug	-	?
Air	**Method TO-11 HPLC** http://www.epa.gov/ttnamti1/airtox.html	Selected aldehydes and ketones collected on a dinitrophenylhydrazine (DNPH) coated Sep-Pak cartridge	0.05 ug.	-	?

VOC Methods Analyte Lists

List 1 Office of Solid Waste SW 846 Method 8260 C	
Acetone	Ethanol
Acetonitrile	Ethyl acetate
Acrolein (Propenal)	Ethylbenzene
Acrylonitrile	Ethylene oxide
Allyl alcohol	Ethyl methacrylate
Allyl chloride	Hexachlorobutadiene
Benzene	Hexachloroethane
Benzyl chloride	2-Hexanone
Bis(2-chloroethyl)sulfide	2-Hydroxypropionitrile
Bromoacetone	Iodomethane
Bromochloromethane	Isobutyl alcohol
Bromodichloromethane	Isopropylbenzene
Bromoform	Malononitrile
Bromomethane	Methacrylonitrile
n-Butanol	Methanol
2-Butanone (MEK)	Methylene chloride
t-Butyl alcohol	Methyl methacrylate
Carbon disulfide	4-Methyl-2-pentanone (MIBK)
Carbon tetrachloride	Naphthalene
Chloral hydrate	Bromobenzene
Chlorobenzene	1,3-Dichloropropane
Chlorodibromomethane	n-Butylbenzene
Chloroethane	2,2-Dichloropropane
2-Chloroethanol	sec-Butylbenzene
2-Chloroethyl vinyl ether	1,1-Dichloropropene
Chloroform	tert-Butylbenzene
Chloromethane	p-Isopropyltoluene
Chloroprene	Chloroacetonitrile
3-Chloropropionitrile	Methyl acrylate
Crotonaldehyde	1-Chlorobutane
1,2-Dibromo-3-chloropropane	Methyl-t-butyl ether
1,2-Dibromoethane	1-Chlorohexane
Dibromomethane	Pentafluorobenzene
1,2-Dichlorobenzene	2-Chlorotoluene
1,3-Dichlorobenzene	n-Propylbenzene
1,4-Dichlorobenzene	4-Chlorotoluene
cis-1,4-Dichloro-2-butene	1,2,3-Trichlorobenzene
trans-1,4-Dichloro-2-butene	Dibromofluoromethane
Dichlorodifluoromethane	1,2,4-Trimethylbenzene
1,1-Dichloroethane	cis-1,2-Dichloroethene
1,2-Dichloroethane	1,3,5-trimethylbenzene
1,1-Dichloroethene	
trans-1,2-Dichloroethene	
1,2-Dichloropropane	
1,3-Dichloro-2-propanol	
cis-1,3-Dichloropropene	
trans-1,3-Dichloropropene	
1,2,3,4-Diepoxybutane	
Diethyl ether	
1,4-Dioxane	
Epichlorohydrin	

VOC Methods Analyte Lists (cont.)

List 2 EPA Office of Water Method 524.2	List 3 OERR (Superfund) CLP Statement of Work OLM04.2
Chloroform	1,1-Dichloroethane
Bromodichloromethane	1,1-Dichloroethene
Bromoform	1,1,1-Trichloroethane
Chlorodibromomethane	1,1,2-Trichloro-
Bromobenzene	1,1,2-Trichloroethane
Bromochloromethane	1,1,2,2-Tetrachloroethane
Bromomethane	1,2-Dibromo-3-chloropropane
n-Butylbenzene	1,2-Dibromoethane
tert-Butylbenzene	1,2-Dichlorobenzene
Chloroethane	1,2-Dichloroethane
Chloromethane	1,2-Dichloropropane
o-Chlorotoluene	1,2,2-trifluoroethane
p-Chlorotoluene	1,2,4-Trichlorobenzene
Dibromomethane	1,3-Dichlorobenzene
m-Dichlorobenzene	1,4-Dichlorobenzene
Dichlorodifluoromethane	2-Butanone [78-93-3]
1,1-Dichloroethane	2-Hexanone
1,3-Dichloropropane	4-Methyl-2-pentanone
2,2-Dichloropropane	Acetone
1,1-Dichloropropene	Benzene
1,3-Dichloropropene	Bromodichloromethane
Fluorotrichloromethane	Bromoform
Hexachlorobutadiene	Bromomethane
Isopropylbenzene	Carbon Disulfide
p-Isopropyltoluene	Carbon Tetrachloride [56-23-5]
Naphthalene	Chlorobenzene
n-Propylbenzene	Chloroethane
1,1,2,2-Tetrachloroethane	Chloroform [67-66-3]
1,1,1,2-Tetrachloroethane	Chloromethane
1,2,3-Trichlorobenzene	cis-1,2-Dichloroethene
1,2,3-Trichloropropane	cis-1,3-Dichloropropene
1,2,4-Trimethylbenzene	Cyclohexane [110-82-7]
1,3,5 -Trimethylbenzene	Dibromochloromethane
	Dichlorodifluoromethane
	Ethylbenzene
	Isopropylbenzene
	Methyl tert-Butyl Ether
	Methyl Acetate
	Methylcyclohexane
	Methylene Chloride
	Styrene
	Tetrachloroethene
	Toluene
	trans-1,2-Dichloroethene
	trans-1,3-Dichloropropene
	Trichloroethene
	Trichlorofluoromethane
	Vinyl Chloride
	Xylenes (total)

VOC Methods Analyte Lists (cont.)

List 4 OERR (Superfund) CLP Statement of Work OLC03.2	List 5 Office of Solid Waste SW 846 Method 5041
1,1-Dichloroethane	Acetone
1,1-Dichloroethene	Acrylonitrile
1,1,1-Trichloroethane	Benzene
1,1,2-Trichloro-1,2,2-trifluoroethane	Bromodichloromethane
1,1,2-Trichloroethane	Bromoform
1,1,2,2-Tetrachloroethane	Bromomethane
1,2-Dibromo-3-chloropropane	Carbon disulfide
1,2-Dibromoethane	Carbon tetrachloride
1,2-Dichlorobenzene	Chlorobenzene
1,2-Dichloroethane	Chlorodibromomethane
1,2-Dichloropropane	Chloroethane
1,2,3-Trichlorobenzene	Chloroform
1,2,4-Trichlorobenzene	Chloromethane
1,3-Dichlorobenzene	Dibromomethane
1,4-Dichlorobenzene	1,1-Dichloroethane
2-Butanone	1,2-Dichloroethane
2-Hexanone	1,1-Dichloroethene
4-Methyl-2-pentanone	trans-1,2-Dichloroethene
Acetone	1,2-Dichloropropane
Benzene	cis-1,3-Dichloropropene
Bromochloromethane	trans-1,3-Dichloropropene
Bromodichloromethane	Ethylbenzene
Bromoform	Iodomethane
Bromomethane	Methylene chloride
Carbon Disulfide	Styrene
Carbon Tetrachloride	1,1,2,2-Tetrachloroethane
Chlorobenzene	Tetrachloroethene
Chloroethane	Toluene
Chloroform	1,1,1-Trichloroethane
Chloromethane	1,1,2-Trichloroethane
cis-1,2-Dichloroethene	Trichloroethene
cis-1,3-Dichloropropene	Trichlorofluoromethane
Cyclohexane	1,2,3-Trichloropropane
Dibromochloromethane	Vinyl chloride
Dichlorodifluoromethane	Xylenes
Ethylbenzene	
Isopropylbenzene	
Methyl Acetate	
Methyl tert-Butyl Ether	
Methylcyclohexane	
Methylene Chloride	
Styrene	
Tetrachloroethene	
Toluene	
trans-1,2-Dichloroethene	
trans-1,3-Dichloropropene	
Trichloroethene	
Trichlorofluoromethane	
Vinyl Chloride	
Xylenes (total)	

VOC Methods Analyte Lists (cont.)

List 6 NIOSH Method 1003	List 7 NIOSH Method 1501
Benzyl chloride	1-tert-butyl-4-methylbenzene
Bromoform	a-methylstyrene
Carbon tetrachlorideab	benzene
Chlorobenzene	cumene
Chlorobromomethane	dimethylbenzene (p-xylene) (meta)
Chloroform	ethylbenzene
o-Dichlorobenzene	isopropenylbenzene
p-Dichlorobenzene	isopropylbenzene
1,1-Dichloroethane	methylbenzene
1,2-Dichloroethylene	methylstyrene
Ethylene dichloride	methylvinylbenzene (ortho)
Hexachloroethane	naphthalene
1,1,1-trichloroethane	p-tert-butyltoluene
Tetrachloroethylene	styrene
1,1,2-Trichloroethane	toluene
1,2,3-Trichloropropane	vinylbenzene
	xylene

VOC Methods Analyte Lists (cont.)

List 8 EPA Office of Air and Radiation TO-15 & TO-17	
1,1-Dimethylhydrazine;	
1,1,2-Trichloroethane;	Ethylene dichloride (1,2-dichloroethane);
1,1,2,2-Tetrachloroethane;	Ethylene oxide;
1,2-Dibromo-3-chloropropane;	Ethyleneimine (aziridine);
1,2-Epoxybutane (1,2-butylene oxide);	Ethylidene dichloride (1,1-dichloroethane);
1,2-Propyleneimine (2-methylazindine);	Formaldehyde;
1,2,4-Trichlorobenzene;	Hexachlorobutadiene;
1,3-Butadiene;	Hexachloroethane;
1,3-Dichloropropene;	Hexane;
1,3-Propane sultone;	Isophorone;
1,4-Dichlorobenzene (p-);	m-Xylene;
1,4-Dioxane (1,4 Diethylene oxide);	Methanol;
2-Nitropropane;	Methyl methacrylate;
2,2,4-Trimethyl pentane;	Methyl isobutyl ketone (hexone);
Acetaldehyde (ethanal);	Methyl chloride (chloromethane);
Acetonitrile (cyanomethane);	Methyl bromide (bromomethane);
Acetophenone;	Methyl ethyl ketone (2-butanone);
Acrolein (2-propenal);	Methyl isocyanate;
Acrylamide;	Methyl iodide (iodomethane);
Acrylic acid;	Methyl chloroform (1,1,1 trichloroethane);
Acrylonitrile (2-propenenitrile);	Methyl tert-butyl ether;
Allyl chloride (3-chloropropene);	Methylene chloride;
Aniline (aminobenzene);	Methylhydrazine;
Benzene;	N-Nitrosodimethylamine;
Benzyl chloride (a-chlorotoluene);	N-Nitrosomorpholine;
Beta-Propiolactone;	N-Nitrso-N-methylurea;
Bis(2-Chloroethyl)ether;	Nitrobenzene;
Bis(chloromethyl) ether;	N,N-Dimethylaniline;
Bromoform (tribromomethane);	N,N-Dimethylformamide;
Carbon tetrachloride;	o-Cresol;
Carbon disulfide;	o-Xylene;
Carbonyl sulfide;	p-Xylene;
Catechol (o-hydroxyphenol);	Phenol;
Chloroacetic acid;	Phosgene;
Chlorobenzene;	Propionaldehyde;
Chloroform;	Propylene dichloride (1,2-dichloropropane);
Chloromethyl methyl ether;	Propylene oxide;
Chloroprene (2-chloro-1,3-butadiene);	Styrene oxide;
Cresylic acid (cresol isomer mixture);	Styrene;
Cumene (isopropylbenzene);	Tetrachloroethylene;
Diazomethane;	Toluene;
Diethyl sulfate;	Trichloethylene;
Dimethyl sulfate;	Triethylamine;
Dimethylcarbamyl chloride;	Vinyl acetate;
Epichlorohydrin (l-chloro-2,3-epoxy propane);	Vinyl bromide (bromoethene);
Ethyl acrylate;	Vinyl chloride (chloroethene);
Ethyl carbamate (urethane);	Vinylidene chloride (1,1-dichloroethylene);
Ethyl chloride (chloroethane);	Xylenes (isomer & mixtures);
Ethylbenzene;	
Ethylene dibromide (1,2-dibromoethane);	

APPENDIX B

DEVELOPMENT OF A CONCEPTUAL SITE MODEL (CSM) FOR ASSESSMENT OF THE VAPOR INTRUSION PATHWAY

1. Introduction

A conceptual site model (CSM) is a simplified version (picture and/or description) of a complex real-world system. A CSM is not an analytical or mathematical computer model (although a detailed CSM may serve as a foundation for such models). The goal for developing a CSM in the assessment of the vapor intrusion pathway is to assemble a comprehensive (as possible) three-dimensional "picture" based on available reliable data describing the sources of the contamination, the release/transport mechanisms, the possible subsurface pathways, and the potential receptors, as well as historical uses of the site, cleanup concerns expressed by the community, and future land use plans. All the important features relevant to characterization of a site should be included in a CSM and any irrelevant ones excluded. The CSM should present both a narrative and a visual representation of the actual or predicted relationships between receptors (humans and/or ecological entities) and the contaminants at the site, as well as reflect any relevant background levels.

Development of a CSM is an important first step in planning and scoping any site assessment designed to determine the potential impacts of contamination on public health and the environment. In documenting current site conditions, a CSM should be supported by maps, cross sections and site diagrams, and the narrative description should clearly distinguish what aspects are known or determined and what assumptions have been made in its development. The CSM should provide all interested parties a conceptual understanding of the potential for exposure to any hazardous contaminants at a site. As such, it serves as an essential tool to aid management decisions associated with the site and also serves as a valuable communication tool both internally with the "site team" and externally with the community.

A well-defined, detailed CSM will facilitate the identification of additional data needs and development of appropriate Data Quality Objectives (DQOs) in planning any sample collection/analyses to support the site risk assessment. It can also provide useful information for prompt development of a strategy for early response actions if the vapor intrusion pathway is considered to be complete and may pose an imminent potential risk to public health.

Because the CSM is likely to evolve over the course of the site assessment process, it should be considered dynamic in nature. Integration of newly developed information is an iterative process that can occur throughout the early stages of the site assessment process. This should include stakeholder input from persons who are knowledgeable about the community and activities which may have generated the contaminants or affected their movement. As additional data become available during implementation of the site assessment DQO process, the CSM should be updated. Such updates could also suggest iterative refinement of the DQO process (optimization step), since changes in the CSM may lead to identification of additional data or

information not previously recognized as needed. As a fundamental site assessment tool, the CSM warrants prompt updating and distribution to interested parties during the site assessment process.

2. Collecting Existing Site Data

The following general types of information are important for preparing a CSM:

- site maps, sample location maps, aerial photos
- historical site activity, chronology of land use, populations information
- State soil surveys
- published data on local and regional climate, soils, and hydrogeology
- any previous site studies and actions (e.g. Preliminary Assessment/Site Investigation)
- an overview of the nature and extent of the contamination

The CSM developed should identify, in as comprehensive a manner as possible, all potential or suspected sources of contamination (soil, groundwater, soil gas, etc.); the types and concentrations of contamination detected at the site; all potential subsurface pathways, including preferential pathways; and the media and buildings associated with each pathway cleanup. Additional considerations that may be important to include in developing an optimal CSM for use in management decisions are presented below.

3. Additional Considerations for CSM Development for the Vapor Intrusion Pathway

- sensitive populations, including but not limited to:
  - the elderly
  - pregnant or nursing women
  - infants
  - children
  - people suffering from chronic illnesses

- people exposed to particularly high levels of contaminants

- circumstances where a disadvantaged population is exposed (Environmental Justice situation)

- significant contamination sources
  - NAPLs
  - very shallow contaminated groundwater or soil

- vapor transport pathways (see Figure B-1)
  - diffusion upwards
  - lateral vapor transport
  - preferential vapor pathways such as fractured sediments or utility features

- potential non-site related sources of contaminants
  - ambient (outdoor) air sources
  - indoor air emission sources

- building construction quality
  - foundation type (basement, slab on grade, crawlspace)
  - foundation integrity

- building use
  - open windows (etc.)

4. Organizing Existing Site Data for Inclusion in a CSM

The ***Conceptual Site Model Summary*** presented in Attachment A of the ***Soil Screening Guidance: User's Guide*** contains four detailed forms for compiling site data useful in developing a CSM for soil screening purposes. These CSM Summary forms systematically organize the site data according to general site information, soil contaminant source characteristics, exposure pathways and receptors. ***Planning Table 1*** presented in the ***Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual, Part D - Standardized Planning, Reporting, and Review of Superfund Risk Assessments*** may be used in a similar manner to prepare/supplement the CSM. ***Planning Table 1*** is intended to accompany the CSM and present the possible receptors, exposure routes, and exposure pathways, as well as the rationale for selection or exclusion of each potential exposure pathway. The exposure pathways that were examined and excluded from analysis and the exposure pathways that will be evaluated qualitatively or quantitatively in the site risk assessment are clearly reflected when ***Planning Table 1*** is used. Either of these systematic site information organizing formats that are useful for CSM development can also be used to communicate risk information about the site to interested parties outside EPA. The systematic and comprehensive approach encouraged by compilation of data and information in these standard formats, like other steps in the site risk assessment process, may suggest further refinement of the CSM.

- **Constructing Conceptual Site Model Diagrams**

An example of a complete CSM including diagrams prepared for soil screening purposes can be found in ***Attachment A*** of the ***Soil Screening Guidance: User's Guide.*** A software application that can generate CSM diagrams and reflect relevant site data has been developed (DOE). The ***Site Conceptual Exposure Model Builder*** can be found on the internet.
(URL = http://tis-nt.eh.doe.gov/oepa/programs/scem.cfm)

- **Additional Resources for CSM Development Guidance**

(1) The following provide more specific guidance for developing a CSM for cleanup programs:

Soil Screening Guidance: User's Guide. **Part 2.1 and Attachment A**; EPA-540-R-96-018. Office of Emergency and Remedial Response/EPA. July 1996.

Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites Office of Emergency and Remedial Response/EPA

Risk Assessment Guidance for Superfund (RAGS): Volume I - Human Health Evaluation Manual, Part D - (Standardized Planning, Reporting, and Review of Superfund Risk Assessments), Final December 2001. Pub. # - 9285.7-47; *Chapter 2 - Risk Considerations in Project Scoping*; EPA - Office of Emergency and Remedial Response.

Site Conceptual Exposure Model Builder - User Manual - for PC (Windows version) application to assist in preparing a site model; U.S. Dept of Energy, RCRA/CERCLA Division; July 1997.

Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. EPA 540-G-89-004. Office of Emergency and Remedial Response/EPA . 1989.

Expedited Site Assessment Tools for Underground Storage Tank Sites: A Guide for Regulators. Chapter 2. EPA 510-B-97-001; Office of Underground Storage Tanks/EPA; March 1997.

(2) Selected risk assessment guidance and related documents that contain discussions concerning necessary problem formulation, and planning and scoping prior to conducting a risk assessment can provide some additional perspective to consider in preparation of a Conceptual Site Model.

Quality Assurance Guidance for Conducting Brownfields Site Assessments, EPA 540-R-98-038; OSWER 9230.0-83P; PB98-963307; September 1998.

Guidelines for Ecological Risk Assessment, EPA 630-R-95-002F, Federal Register Vol 63, pp.26846-26924; May 14, 1998.

Framework for Cumulative Risk Assessment - External Review Draft, EPA 630-P-02-001A; Risk Assessment Forum; April 23, 2002.

Risk Characterization Handbook, EPA 100-B-00-002, December 2000.

Guidance For The Data Quality Objectives Process - EPA QA/G-4; EPA-600-R-96-055; September 1994.

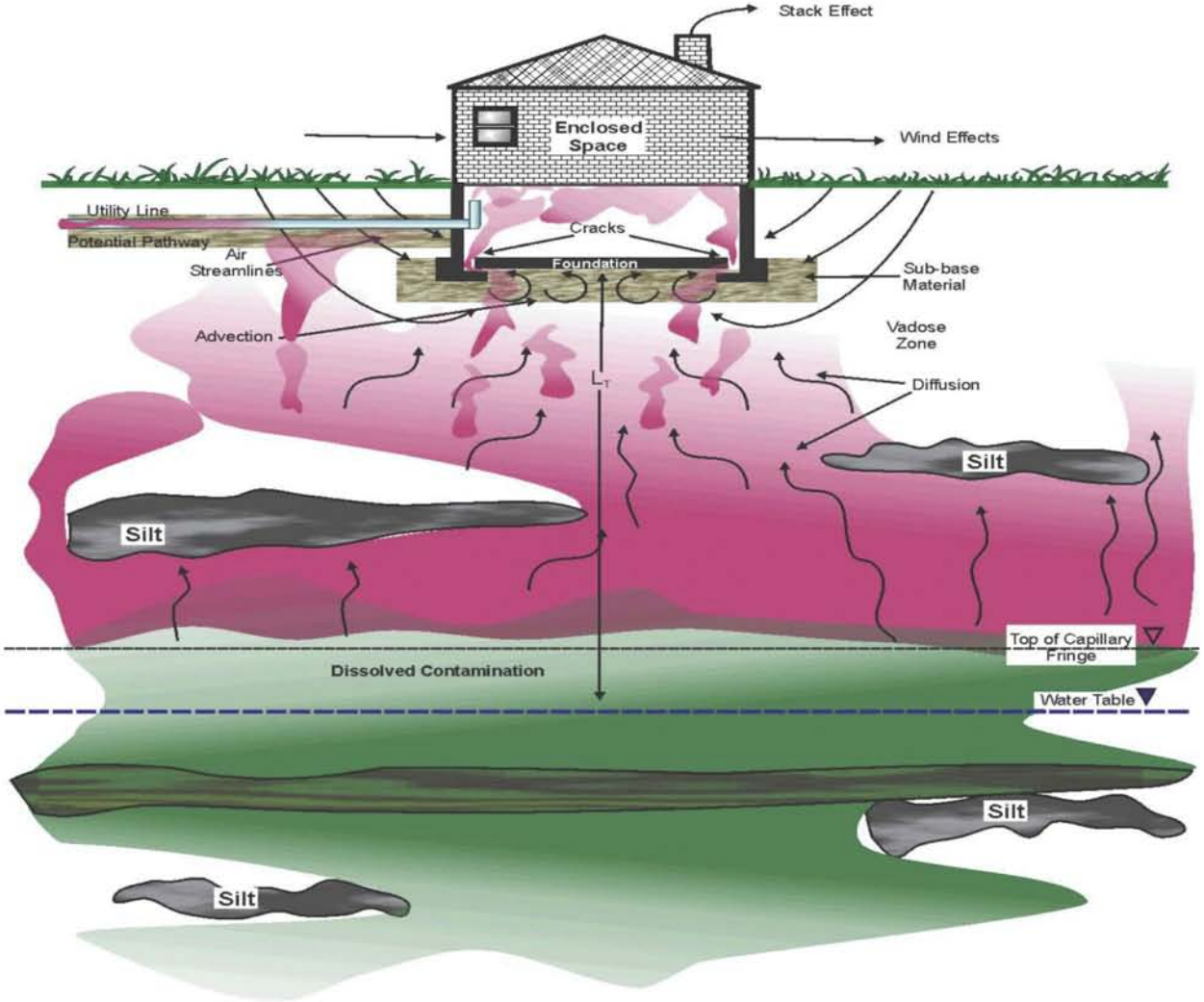
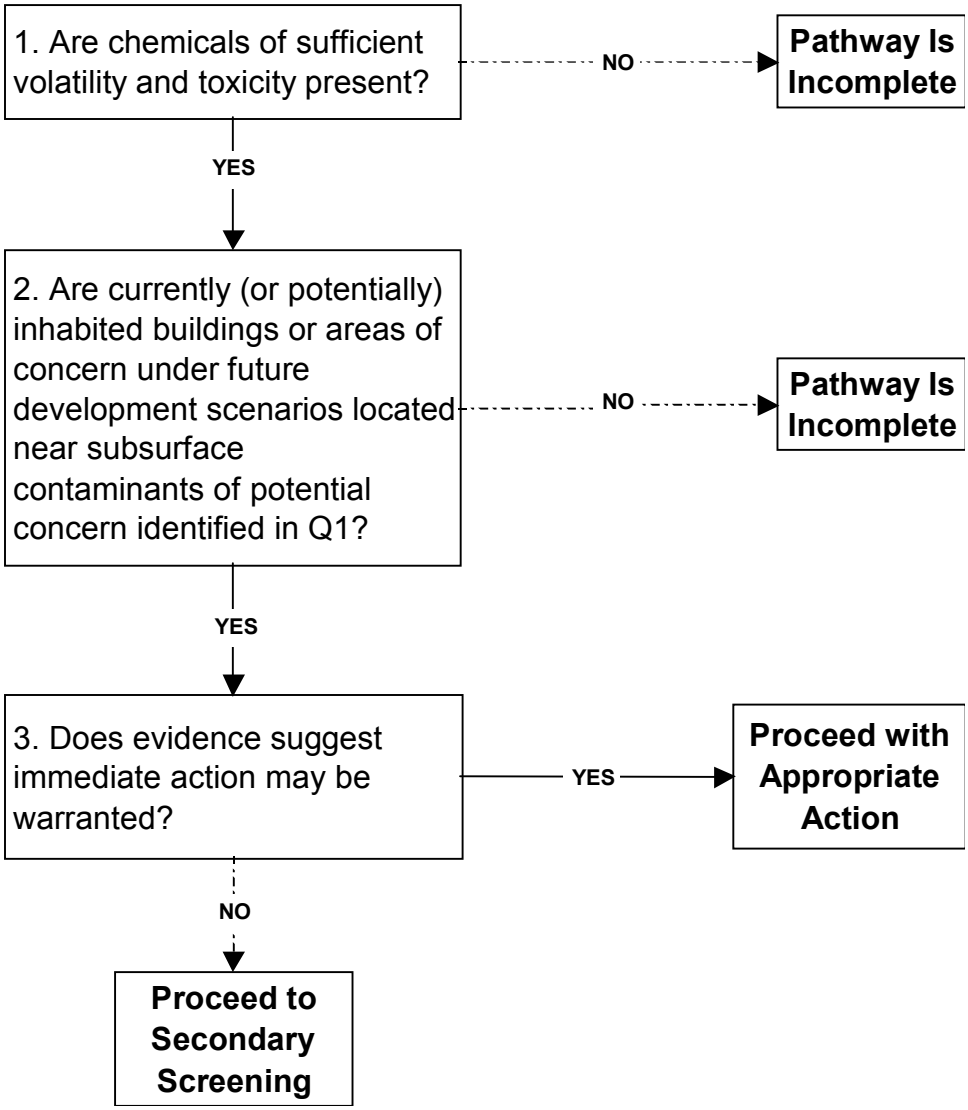


Figure B-1. Example of Conceptual Site Model cross section diagram illustrating potential subsurface vapor intrusion pathways

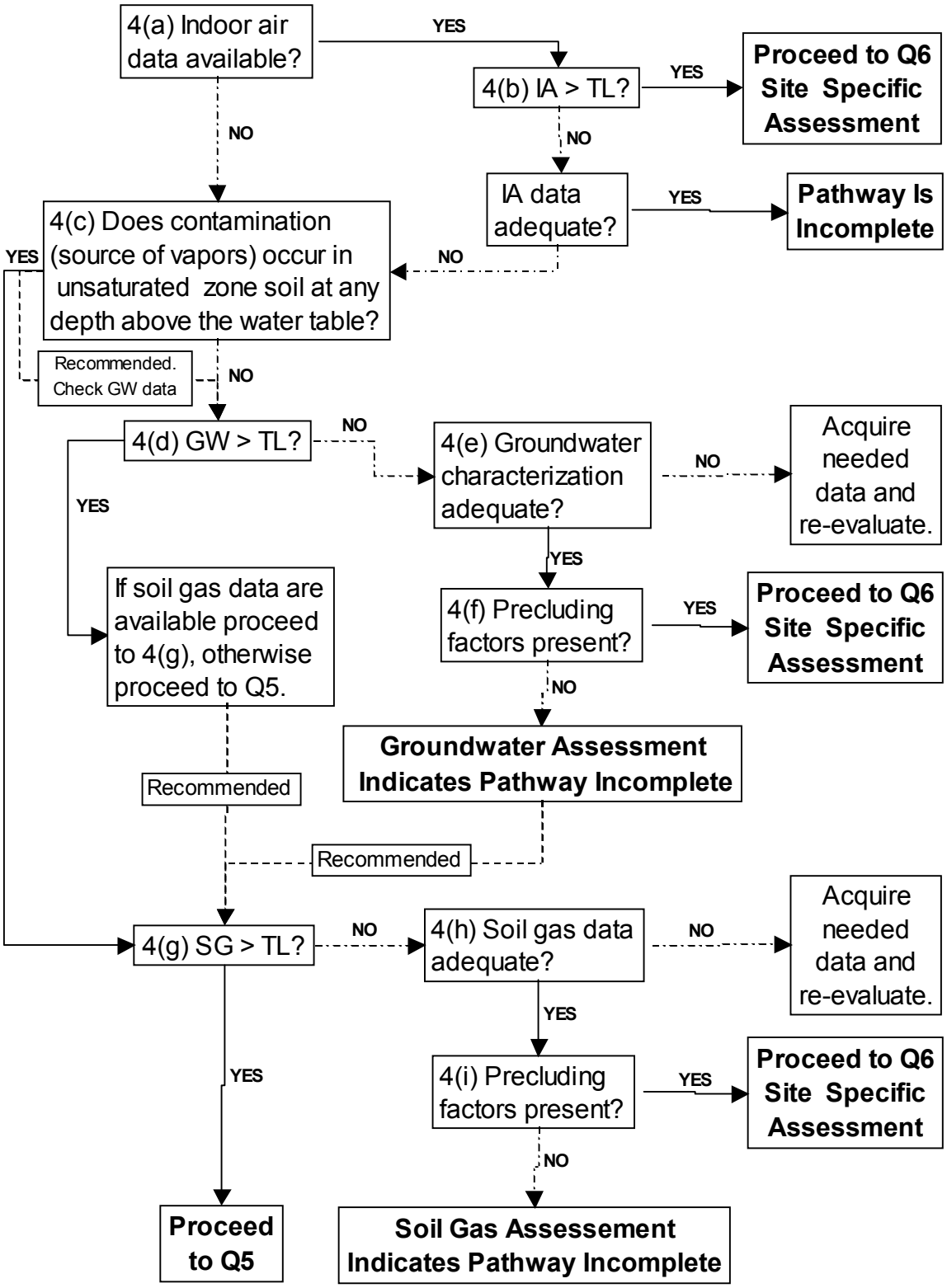
APPENDIX C

DETAILED FLOW DIAGRAMS OF THE EVALUATION APPROACH USED IN THE GUIDANCE

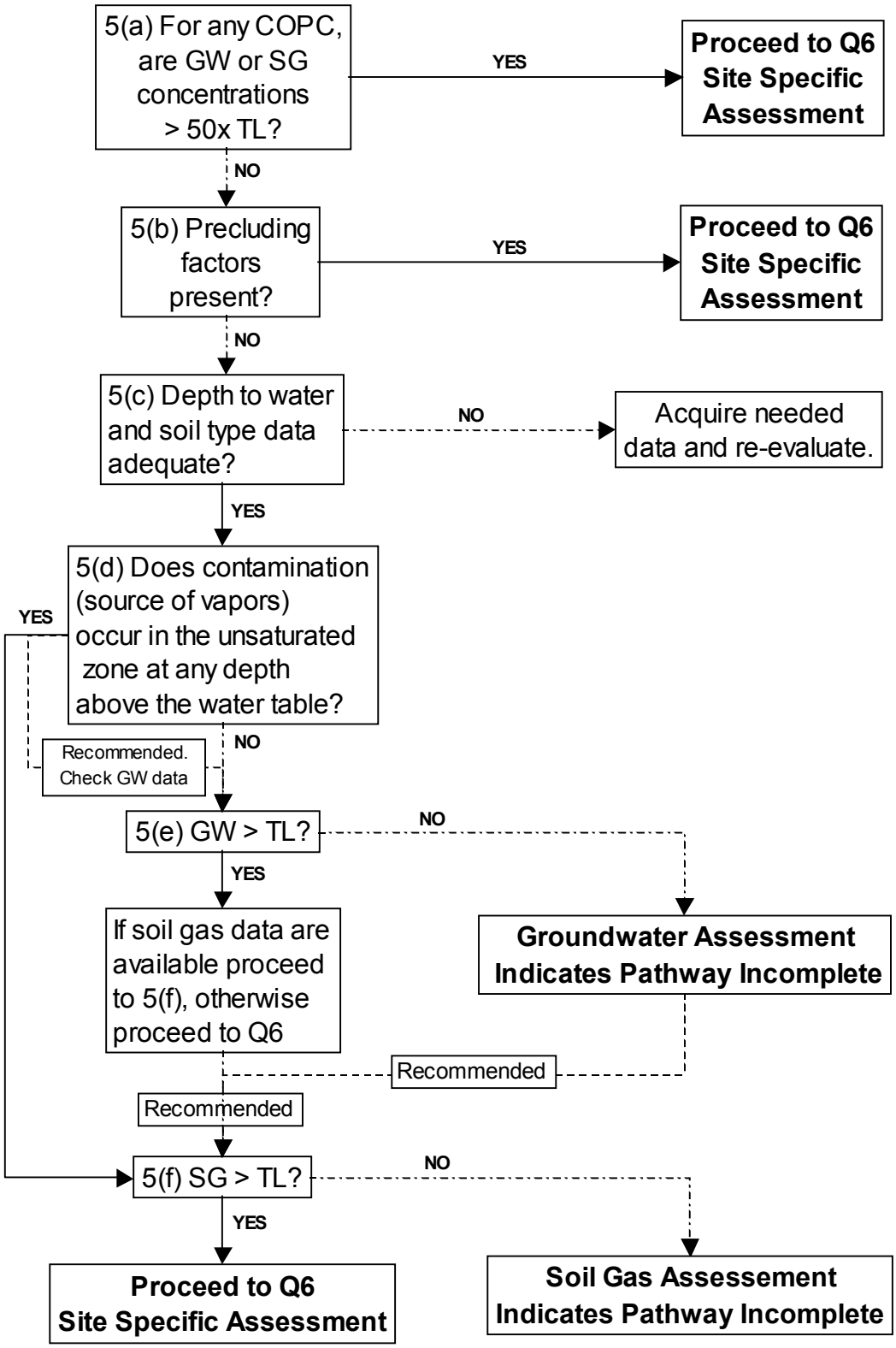
PRIMARY SCREENING



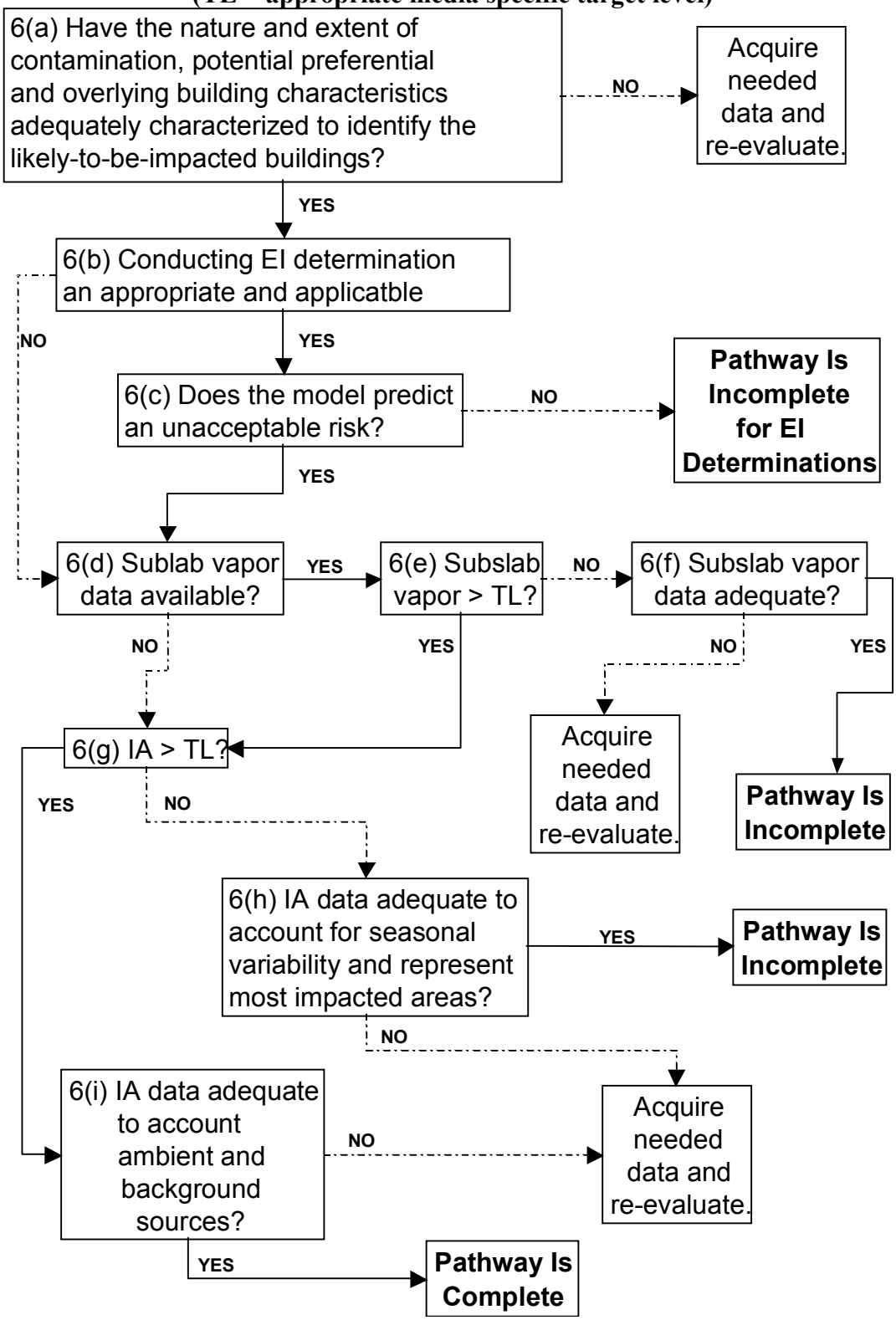
SECONDARY SCREENING
Question 4 – Generic Screening
(TL = appropriate media specific target level)



SECONDARY SCREENING
Question 5 – Semi-Site Specific Screening
(TL = appropriate media specific target level)



SITE SPECIFIC SCREENING
Question 6
(TL = appropriate media specific target level)



APPENDIX D

DEVELOPMENT OF TABLES 1, 2, AND 3

1. Introduction

This appendix describes the data and calculations used to develop Tables 1, 2, and 3 in the guidance. Table 1 lists chemicals that may be present at hazardous waste sites and indicates whether, in our judgment, they are of sufficient toxicity and volatility to result in a potentially unacceptable indoor inhalation risk. Tables 2 and 3 provide generally recommended target concentrations for contaminants in indoor air, groundwater, and soil gas. For non-carcinogens, these values are based on the appropriate reference concentration, and for carcinogens, they are calculated using a method consistent with the approach in EPA's *Supplemental Guidance for Developing Soil Screening Levels* (EPA, to be published). Only chemicals that are, in our judgment, sufficiently volatile and toxic to pose an inhalation risk are included in Tables 2 and 3. The approach described here also can be used, as appropriate, to evaluate chemicals not listed in the tables.

2. Description of Tables 1, 2 and 3

Table 1 lists the chemicals that may be found at hazardous waste sites and indicates whether, in our judgment, they are sufficiently toxic and volatile to result in a potentially unacceptable indoor inhalation risk. It also provides a column for checking off the chemicals found or reasonably suspected to be present in the subsurface at a site. Under this approach, a chemical is considered sufficiently toxic if the vapor concentration of the pure component (see Section 4 below) poses an incremental lifetime cancer risk greater than 10^{-6} or results in a non-cancer hazard index greater than one (see Section 5 below). A chemical is considered sufficiently volatile if its Henry's Law Constant is 1×10^{-5} atm-m^3/mol or greater (US EPA, 1991). In our judgement, if a chemical does not meet both of these criteria, it need not be further considered as part of the evaluation.

Table 2 provides generic soil gas and groundwater screening concentrations corresponding to risk-based concentrations for indoor air in residential settings calculated using the methodology described in Section 5 below. Blank columns are included to allow the user to enter measured or reasonably estimated concentrations specific to a site. The target soil gas and groundwater concentrations are calculated using generic vapor intrusion attenuation factors (see Appendix F) as described in Sections 6 and 7 below.

Table 3 provides soil gas and groundwater screening concentrations for a select set of attenuation factors. Guidance for selecting the appropriate attenuation factor to use is given in Question 5. As with Table 2, the target soil gas and groundwater concentrations are calculated using the approach described in Sections 6 and 7 below and correspond to risk-based concentrations for indoor air in residential settings calculated using the methodology described in Section 5 below.

The target concentrations in Tables 2 and 3 are screening levels. They are not intended to be used as clean-up levels nor are they intended to supercede existing criteria of the lead regulatory authority. The lead regulatory authority for a site may determine that criteria other than those provided herein are appropriate for the specific site or area. Thus, we recommend that the user's initial first step should involve consultation with their lead regulatory authority to identify the most appropriate criteria to use.

3. Data Sources

Chemical Property Data - The source of chemical data used to calculate the values in Tables 1, 2, and 3 is primarily EPA's Superfund Chemical Data Matrix (SCDM) database. EPA's WATER9 database was used for chemicals not included in the SCDM database.

Toxicity Values - EPA's Integrated Risk Information System (IRIS) is the generally preferred source of carcinogenic unit risks and non-carcinogenic reference concentrations (RfCs) for inhalation exposure.[1] The following two sources were consulted, in order of preference, when IRIS values were not available: provisional toxicity values recommended by EPA's National Center for Environmental Assessment (NCEA) and EPA's Health Effects Assessment Summary Tables (HEAST). If no inhalation toxicity data could be obtained from IRIS, NCEA, or HEAST, we derived extrapolated unit risks and/or RfCs using toxicity data for oral exposure (cancer slope factors and/or reference doses, respectively) from these same sources utilizing the same preference order.[2] Target concentrations that were calculated using these extrapolated toxicity values are clearly indicated in Tables 2 and 3. Note that for most compounds, extrapolation from oral data introduces considerable uncertainty into the resulting inhalation value. Values obtained from inhalation studies or from pharmacokinetic modeling applied to oral doses will be less uncertain than those calculated using the equations below.

EPA's Integrated Risk Information System (IRIS) currently does not include carcinogenicity data for TCE, a volatile contaminant frequently encountered at hazardous waste sites. The original carcinogenicity assessment for TCE, which was based on a health risk assessment conducted in the late 1980's, was withdrawn from IRIS in 1994. The Superfund Technical Support Center has continued to recommend use of the cancer slope factor from the withdrawn assessment, until a reassessment of the carcinogenicity of TCE is completed. In 2001, the Agency published a draft of the TCE toxicity assessment for public comment.[3] In this guidance, we have calculated TCE target concentrations using a cancer slope factor identified in that document, which is available on the National Center for Environmental Assessment (NCEA) web site. We selected this slope factor because it is based on state-of-the-art methodology. However, because this document is still undergoing review, the slope factor and the target concentrations calculated for TCE are subject to change and should be considered "provisional" values.

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[1] U.S. EPA. 2002. Integrated Risk Information System (IRIS). http://www.epa.gov/iriswebp/iris/index.html. November.

[2] The oral-to-inhalation extrapolations assume an adult inhalation rate (IR) of 20 m^3/day and an adult body weight (BW) of 70 kg. Unit risks (URs) were extrapolated from cancer slope factors (CSFs) using the following equation:

$$UR\ (:g/m^3)^{-1} = CSF\ (mg/kg/d)^{-1} * IR\ (m^3/d) * (1/BW)\ (kg^{-1}) * (10^{-3}\ mg/:g)$$

Reference concentrations (RfCs) were extrapolated from reference doses (RfDs) using the following equation:

$$RfC\ (mg/m^3) = RfD\ (mg/kg/d) * (1/IR)\ (m3/d)^{-1} * BW\ (kg)$$

[3] US EPA, Trichloroethylene Health Risk Assessment: Synthesis and Characterization - External Review Draft, Office of Research and Development, EPA/600/P-01/002A, August, 2001.

Table D-1 summarizes the toxicity values used in this guidance document, along with their sources. The table also indicates which unit risks and RfCs have been extrapolated from oral toxicity values and whether the indoor air target concentration is based on an oral extrapolated toxicity value. Please note that toxicity databases such as IRIS are routinely updated as new information becomes available; this table is current as of November 2002. Users of this guidance are strongly encouraged to research the latest toxicity values for contaminants of interest from the sources noted above. In the next year, IRIS reassessments are expected for several contaminants commonly found in subsurface contamination whose inhalation toxicity values today are based upon extrapolation.

4. Maximum Pure Component Vapor Concentration

The maximum possible vapor concentration is that corresponding to the pure chemical at the temperature of interest. In this case, all calculations were performed at the reference temperature of 25C using the equation:

$$C_{max,vp} = S * H * 10^3 \ : g/mg * 10^3 \ L/m^3$$

where

$C_{max,vp}$ = maximum pure component vapor concentration at 25C [: g/m^3],
S = pure component solubility at 25C [mg/L], and
H = dimensionless Henry's Law Constant at 25C [(mg/L – vapor)/(mg/L – H_2O)].

To determine if a chemical is sufficiently toxic to potentially pose an unacceptable inhalation risk, the calculated pure component vapor concentrations were compared to target indoor air concentrations corresponding to an incremental lifetime cancer risk greater than 10^{-6} or a non-cancer hazard index greater than one.

5. Target Indoor Air Concentration to Satisfy Both the Prescribed Cancer Risk Level and the Target Hazard Index.

The target breathing zone indoor air concentrations in Tables 1, 2, and 3 are risk-based screening levels for ambient air. The indoor air concentrations for non-carcinogens are set at the appropriate reference concentration, and the concentrations for carcinogens are calculated following an approach consistent with EPA's *Supplemental Guidance for Developing Soil Screening Levels* (EPA, to be published). The toxicity values on which the calculations are based are listed in Table D-1, which also shows the source of the toxicity data. Separate carcinogenic and non-carcinogenic target concentrations were calculated for each compound when both unit risks and reference concentrations were available. When inhalation toxicity values were not available, unit risks and/or reference concentrations were extrapolated from oral slope factors and/or reference doses, respectively. For carcinogens, target indoor air concentrations were based on an adult residential exposure scenario and assume exposure of an individual for 350 days per year over a period of 30 years. For non-carcinogens, target indoor air concentrations are set at the corresponding reference concentration. An inhalation rate of 20 m^3/day and a body weight of 70 kg are assumed and have been factored into the inhalation unit risk and reference concentration toxicity values.

For carcinogens,

C_{cancer} (: g/m^3) = [(TCR * AT_c)/(EF * ED * URF)]

For non-carcinogens,

$C_{non\text{-}cancer}$ (: g/m^3) = (THQ * RfC * 1000 : g/mg)

where

C_{cancer}	=	target indoor air concentration, carcinogen, (: g/m^3)
$C_{non\text{-}cancer}$	=	target indoor air concentration, non-carcinogen, (: g/m^3)
TCR	=	target cancer risk (*e.g.*, 1.0 x 10^{-5})
THQ	=	target hazard quotient (*e.g.*, 1.0)
URF	=	unit risk factor (: g/m^3)$^{-1}$
RfC	=	reference concentration (mg/m^3)
AT_c	=	averaging time, carcinogens (25,550 days)
EF	=	exposure frequency (350 days/year)
ED	=	exposure duration (30 years)

For most compounds, the more stringent of the cancer- and non-cancer-based contaminant concentrations is chosen as the target indoor air concentration that satisfies both the prescribed cancer risk level and the target hazard quotient.

$C_{target,ia}$ = MIN(C_{cancer}, $C_{non\text{-}cancer}$)

However, we generally prefer to base the target concentration on non-extrapolated toxicity values wherever possible. Therefore, for compounds with one inhalation-based toxicity value and one oral-extrapolated value, the screening level based on the non-extrapolated toxicity value is chosen as the target indoor air concentration.[4]

For ease in application of the tables, the indoor air concentrations are given in units of : g/m^3 as well as ppbv. The conversion from ppbv to : g/m^3 is:

C [ppbv] = C [: g/m^3] * 10^9 [ppb/atm] * 10^{-3} [m^3/L] * R * T/(MW * 10^6 [: g/g])

where

[4] The target indoor air concentration for trichloroethylene is the lone exception. The target concentration is based on a carcinogenic unit risk extrapolated from an upper bound oral cancer slope factor of 4x10^{-1} per mg/kg/d cited in NCEA's draft risk assessment for trichloroethylene (US EPA, 2001). However, as noted in that document, available evidence from toxicological studies suggests similar carcinogenic effects from both the oral and inhalation routes of exposure. The existence of this evidence gives greater weight to the extrapolated unit risk, and given that the unit risk produces a lower target concentration than the non-extrapolated RfC, we used the unit risk-based value as the target indoor air concentration for trichloroethylene. (As noted earlier, the trichloroethylene risk assessment is still under review. As a result, the cancer slope factor and extrapolated unit risk values for trichloroethylene are subject to change.)

R = gas constant (0.0821 L-atm/mole-K),
T = absolute temperature (298 K), and
MW = molecular weight (g/mole).

The calculated target indoor air concentrations are listed in Tables 2 and 3 along with a column indicating whether cancer or non-cancer risks drive the target concentration. A separate column indicates whether risks are calculated using provisional, oral-extrapolated toxicity values (i.e., inhalation values extrapolated from oral CSFs or RfDs) (see Table D-1).

6. Target Soil Gas Concentration Corresponding to Target Indoor Air Concentration

The target soil gas concentration corresponding to a chemical's target indoor air concentration was calculated by dividing the indoor air concentration by an appropriate attenuation factor (see Questions 4 and 5 in the guidance and Appendix F). The attenuation factor represents the factor by which subsurface vapor concentrations migrating into indoor air spaces are reduced due to diffusive, advective, and/or other attenuating mechanisms. The attenuation factor can be empirically determined or calculated using an appropriate vapor intrusion model. Once the appropriate attenuation factor was determined, the target soil concentration was calculated as:

$C_{soil\text{-}gas}$ [: g/m^3] = $C_{target,ia}$ [: g/m^3] / α

or

$C_{soil\text{-}gas}$ [ppbv] = $C_{target,ia}$ [ppbv] / α

where

$C_{soil\text{-}gas}$ = target soil gas concentration [: g/m3] and
α = attenuation factor (ratio of indoor air concentration to source vapor concentration)

If $C_{target,ia}$ exceeds the maximum possible pure chemical vapor concentration, the designation "*" is entered in the table. If $C_{soil\text{-}gas}$ exceeds the maximum possible pure chemical vapor concentration at 25C, but $C_{target,ia}$ does not, then "**" is entered in the table.

7. Target Groundwater Concentration Corresponding to Target Indoor Air Concentration

The target groundwater concentration corresponding to a chemical's target indoor air concentration is calculated by dividing the target indoor air concentration by an appropriate attenuation factor (see Questions 4 and 5 in the guidance and Appendix F) and then converting the vapor concentration to an equivalent groundwater concentration assuming equilibrium between the aqueous and vapor phases at the water table. Diffusion resistances across the capillary fringe are assumed to be accounted for in the value of α. The equilibrium partitioning is assumed to obey Henry's Law so that:

C_{gw} [: g/L] = $C_{target,ia}$ [: g/m^3] * 10^{-3} m^3/L * 1/H *1/α

where

C_{gw} = target groundwater concentration,
α = attenuation factor (ratio of indoor air concentration to source vapor concentration).
H = dimensionless Henry's Law Constant at 25C [(mg/L – vapor)/(mg/L – H_2O)].

If $C_{target,ia}$ exceeds the maximum possible pure chemical vapor concentration, the designation "*" is entered in the table. If C_{gw} exceeds the aqueous solubility of the pure chemical, but $C_{target,ia}$ does not, then "**" is entered in the table

If the calculated groundwater target concentration is less than the Maximum Contaminant Level (MCL) for the compound, the target concentration is set at the MCL. Target concentrations set at the MCL are indicated in Tables 2 and 3 by this symbol ("†").

8. References

US EPA, 1991, Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual, Part B.

IRIS - Integrated Risk Information System - US EPA Office of Research and Development - National Center for Environmental Assessment. [http://www.epa.gov/iriswebp/iris/index.html] November 2002.

US EPA, Supplemental Guidance for Developing Soil Screening Levels, Office of Emergency and Remedial Response, OSWER 9355.4-24 (EPA, to be published).

US EPA, Trichloroethylene Health Risk Assessment: Synthesis and Characterization - External Review Draft, Office of Research and Development, EPA/600/P-01/002A, August 2001.

Table D-1

Toxicological Values Used to Calculate Target Concentrations in Indoor Air, Soil Gas, and Groundwater

CASN	Chemical	Unit Risk Factor (URF) (: g/m^3)$^{-1}$	URF Source	Is URF Extrapolated From Oral Value?	Reference Concentration (RfC) (mg/m^3)	RfC Source	Is RfC Extrapolated From Oral Value?	Is Indoor Air Target Concentration Based on Extrapolated Value?
83329	Acenaphthene	NA	NA		2.1E-01	I	yes	yes
75070	Acetaldehyde	2.2E-06	I	no	9.0E-03	I	no	no
67641	Acetone	NA	NA		3.5E-01	I	yes	yes
75058	Acetonitrile	NA	NA		6.0E-02	I	no	no
98862	Acetophenone	NA	NA		3.5E-01	I	yes	yes
107028	Acrolein	NA	NA		2.0E-05	I	no	no
107131	Acrylonitrile	6.8E-05	I	no	2.0E-03	I	no	no
309002	Aldrin	4.9E-03	I	no	1.1E-04	I	yes	no
319846	alpha-HCH (alpha-BHC)	1.8E-03	I	no	NA	NA		no
62533	Aniline	1.6E-06	I		1.0E-03	I	no	no
120127	Anthracene	NA	NA		1.1E+00	I	yes	yes
56553	Benz(a)anthracene	2.1E-04	E	yes	NA	NA		yes
100527	Benzaldehyde	NA	NA		3.5E-01	I	yes	yes
71432	Benzene	7.8E-06	I	no	NA	NA		no
50328	Benzo(a)pyrene	1.5E-01	I	yes	NA	NA		yes
205992	Benzo(b)fluoranthene	2.1E-04	E	yes	NA	NA		yes
207089	Benzo(k)fluoranthene	2.1E-05	E	yes	NA	NA		yes
65850	Benzoic Acid	NA	NA		1.4E+01	I	yes	yes
100516	Benzyl alcohol	NA	NA		1.1E+00	H	yes	yes
100447	Benzylchloride	4.9E-05	I	yes	NA	NA		yes

Table D-1

Toxicological Values Used to Calculate Target Concentrations in Indoor Air, Soil Gas, and Groundwater

CASN	Chemical	Unit Risk Factor (URF) (: g/m^3)$^{-1}$	URF Source	Is URF Extrapolated From Oral Value?	Reference Concentration (RfC) (mg/m^3)	RfC Source	Is RfC Extrapolated From Oral Value?	Is Indoor Air Target Concentration Based on Extrapolated Value?
91587	beta-Chloronaphthalene	NA	NA		2.8E-01	I	yes	yes
319857	beta-HCH (beta-BHC)	5.3E-04	I	no	NA	NA		no
92524	Biphenyl	NA	NA		1.8E-01	I	yes	yes
111444	Bis(2-chloroethyl)ether	3.3E-04	I	no	NA	NA		no
108601	Bis(2-chloroisopropyl)ether	1.0E-05	H	no	1.4E-01	I	yes	no
117817	Bis(2-ethylhexyl)phthalate	NA	NA		7.0E-02	I	yes	yes
542881	Bis(chloromethyl)ether	6.2E-02	I	no	NA	NA		no
75274	Bromodichloromethane	1.8E-05	I	yes	7.0E-02	I	yes	yes
75252	Bromoform	1.1E-06	I	no	7.0E-02	I	yes	no
106990	1,3-Butadiene	2.8E-04	I	no	NA	NA		no
71363	Butanol	NA	NA		3.5E-01	I	yes	yes
85687	Butyl benzyl phthalate	NA	NA		7.0E-01	I	yes	yes
86748	Carbazole	5.7E-06	H	yes	NA	NA		yes
75150	Carbon disulfide	NA	NA		7.0E-01	I	no	no
56235	Carbon tetrachloride	1.5E-05	I	no	NA	NA		no
57749	Chlordane	1.0E-04	I	no	7.0E-04	I	no	no
126998	2-Chloro-1,3-butadiene (chloroprene)	NA	NA		7.0E-03	H	no	no
108907	Chlorobenzene	NA	NA		6.0E-02	E	no	no
109693	1-Chlorobutane	NA	NA		1.4E+00	H	yes	yes

Table D-1

Toxicological Values Used to Calculate Target Concentrations in Indoor Air, Soil Gas, and Groundwater

CASN	Chemical	Unit Risk Factor (URF) (: g/m^3)$^{-1}$	URF Source	Is URF Extrapolated From Oral Value?	Reference Concentration (RfC) (mg/m^3)	RfC Source	Is RfC Extrapolated From Oral Value?	Is Indoor Air Target Concentration Based on Extrapolated Value?
124481	Chlorodibromomethane	2.4E-05	I	yes	7.0E-02	I	yes	yes
75456	Chlorodifluoromethane	NA	NA		5.0E+01	I	no	no
75003	Chloroethane (ethyl chloride)	8.3E-07	E	yes	1.0E+01	I	no	no
67663	Chloroform	2.3E-05	I	no	NA	NA		no
95578	2-Chlorophenol	NA	NA		1.8E-02	I	yes	yes
75296	2-Chloropropane	NA	NA		1.0E-01	H	no	no
218019	Chrysene	2.1E-06	E	yes	NA	NA		yes
156592	cis-1,2-Dichloroethylene	NA	NA		3.5E-02	H	yes	yes
123739	Crotonaldehyde (2-butenal)	5.4E-04	H	yes	NA	NA		yes
98828	Cumene	NA	NA		4.0E-01	I	no	no
72548	DDD	6.9E-05	I	yes	NA	NA		yes
72559	DDE	9.7E-05	I	yes	NA	NA		yes
50293	DDT	9.7E-05	I	no	1.8E-03	I	yes	no
53703	Dibenz(a,h)anthracene	2.1E-03	E	yes	NA	NA		yes
132649	Dibenzofuran	NA	NA		1.4E-02	E	yes	yes
96128	1,2-Dibromo-3-chloropropane	6.9E-07	H	no	2.0E-04	I	no	no
106934	1,2-Dibromoethane (ethylene dibromide)	2.2E-04	I	no	2.0E-04	H	no	no
541731	1,3-Dichlorobenzene	NA	NA		1.1E-01	E	yes	yes
95501	1,2-Dichlorobenzene	NA	NA		2.0E-01	H	no	no

Table D-1

Toxicological Values Used to Calculate Target Concentrations in Indoor Air, Soil Gas, and Groundwater

CASN	Chemical	Unit Risk Factor (URF) (: g/m^3)$^{-1}$	URF Source	Is URF Extrapolated From Oral Value?	Reference Concentration (RfC) (mg/m^3)	RfC Source	Is RfC Extrapolated From Oral Value?	Is Indoor Air Target Concentration Based on Extrapolated Value?
106467	1,4-Dichlorobenzene	NA	NA		8.0E-01	I	no	no
91941	3,3-Dichlorobenzidine	1.3E-04	I	yes	NA	NA		yes
75718	Dichlorodifluoromethane	NA	NA		2.0E-01	H	no	no
75343	1,1-Dichloroethane	NA	NA		5.0E-01	H	no	no
107062	1,2-Dichloroethane	2.6E-05	I	no	NA	NA		no
75354	1,1-Dichloroethylene	NA	NA		2.0E-01	E	no	no
120832	2,4-Dichlorophenol	NA	NA		1.1E-02	I	yes	yes
78875	1,2-Dichloropropane	1.9E-05	H	yes	4.0E-03	I	no	no
542756	1,3-Dichloropropene	4.0E-06	I	no	2.0E-02	I	no	no
60571	Dieldrin	4.6E-03	I	no	1.8E-04	I	yes	no
84662	Diethylphthalate	NA	NA		2.8E+00	I	yes	yes
105679	2,4-Dimethylphenol	NA	NA		7.0E-02	I	yes	yes
131113	Dimethylphthalate	NA	NA		NA	NA		
84742	Di-n-butyl phthalate	NA	NA		3.5E-01	I	yes	yes
534521	4,6-Dinitro-2-methylphenol (4,6-dinitro-o-cresol)	NA	NA		3.5E-03	E	yes	yes
51285	2,4-Dinitrophenol	NA	NA		7.0E-03	I	yes	yes
121142	2,4-Dinitrotoluene	1.9E-04	I	yes	7.0E-03	I	yes	yes
606202	2,6-Dinitrotoluene	1.9E-04	I	yes	3.5E-03	H	yes	yes

Table D-1

Toxicological Values Used to Calculate Target Concentrations in Indoor Air, Soil Gas, and Groundwater

CASN	Chemical	Unit Risk Factor (URF) (: g/m^3)$^{-1}$	URF Source	Is URF Extrapolated From Oral Value?	Reference Concentration (RfC) (mg/m^3)	RfC Source	Is RfC Extrapolated From Oral Value?	Is Indoor Air Target Concentration Based on Extrapolated Value?
117840	Di-n-octyl phthalate	NA	NA		7.0E-02	H	yes	yes
115297	Endosulfan	NA	NA		2.1E-02	I	yes	yes
72208	Endrin	NA	NA		1.1E-03	I	yes	yes
106898	Epichlorohydrin	1.2E-06	I	no	1.0E-03	I	no	no
60297	Ethyl ether	NA	NA		7.0E-01	I	yes	yes
141786	Ethylacetate	NA	NA		3.2E+00	I	yes	yes
100414	Ethylbenzene	1.1E-06	E	no	1.0E+00	I	no	no
75218	Ethylene oxide	1.0E-04	H	no	NA	NA		no
97632	Ethylmethacrylate	NA	NA		3.2E-01	H	yes	yes
206440	Fluoranthene	NA	NA		1.4E-01	I	yes	yes
86737	Fluorene	NA	NA		1.4E-01	I	yes	yes
110009	Furan	NA	NA		3.5E-03	I	yes	yes
58899	gamma-HCH (Lindane)	3.7E-04	H	yes	1.1E-03	I	yes	yes
76448	Heptachlor	1.3E-03	I	no	1.8E-03	I	yes	no
1024573	Heptachlor epoxide	2.6E-03	I	no	4.6E-05	I	yes	no
87683	Hexachloro-1,3-butadiene	2.2E-05	I	no	7.0E-04	H	yes	no
118741	Hexachlorobenzene	4.6E-04	I	no	2.8E-03	I	yes	no
77474	Hexachlorocyclopentadiene	NA	NA		2.0E-04	I	no	no
67721	Hexachloroethane	4.0E-06	I	no	3.5E-03	I	yes	no

Table D-1

Toxicological Values Used to Calculate Target Concentrations in Indoor Air, Soil Gas, and Groundwater

CASN	Chemical	Unit Risk Factor (URF) (: g/m^3)$^{-1}$	URF Source	Is URF Extrapolated From Oral Value?	Reference Concentration (RfC) (mg/m^3)	RfC Source	Is RfC Extrapolated From Oral Value?	Is Indoor Air Target Concentration Based on Extrapolated Value?
110543	Hexane	NA	NA		2.0E-01	I	no	no
74908	Hydrogen cyanide	NA	NA		3.0E-03	I	no	no
193395	Indeno(1,2,3-cd)pyrene	2.1E-04	E	yes	NA	NA		yes
78831	Isobutanol	NA	NA		1.1E+00	I	yes	yes
78591	Isophorone	2.7E-07	I	yes	7.0E-01	I	yes	yes
7439976	Mercury (elemental)	NA	NA		3.0E-04	I	no	no
126987	Methacrylonitrile	NA	NA		7.0E-04	A	no	no
72435	Methoxychlor	NA	NA		1.8E-02	I	yes	yes
79209	Methyl acetate	NA	NA		3.5E+00	H	yes	yes
96333	Methyl acrylate	NA	NA		1.1E-01	A	yes	yes
74839	Methyl bromide	NA	NA		5.0E-03	I	no	no
74873	Methyl chloride (chloromethane)	1.0E-06	E	no	9.0E-02	I	no	no
108872	Methylcyclohexane	NA	NA		3.0E+00	H	no	no
74953	Methylene bromide	NA	NA		3.5E-02	A	yes	yes
75092	Methylene chloride	4.7E-07	I	no	3.0E+00	H	no	no
78933	Methylethylketone (2-butanone)	NA	NA		1.0E+00	I	no	no
108101	Methylisobutylketone (4-methyl-2-pentanone)	NA	NA		8.0E-02	H	no	no
80626	Methylmethacrylate	NA	NA		7.0E-01	I	no	no

Table D-1

Toxicological Values Used to Calculate Target Concentrations in Indoor Air, Soil Gas, and Groundwater

CASN	Chemical	Unit Risk Factor (URF) (: g/m^3)$^{-1}$	URF Source	Is URF Extrapolated From Oral Value?	Reference Concentration (RfC) (mg/m^3)	RfC Source	Is RfC Extrapolated From Oral Value?	Is Indoor Air Target Concentration Based on Extrapolated Value?
91576	2-Methylnaphthalene	NA	NA		7.0E-02	E	yes	yes
108394	3-Methylphenol (m-cresol)	NA	NA		1.8E-01	I	yes	yes
95487	2-Methylphenol (o-cresol)	NA	NA		1.8E-01	I	yes	yes
106455	4-Methylphenol (p-cresol)	NA	NA		1.8E-02	H	yes	yes
99081	m-Nitrotoluene	NA	NA		7.0E-02	E	yes	yes
1634044	MTBE	NA	NA		3.0E+00	I	no	no
108383	m-Xylene	NA	NA		7.0E+00	H	yes	yes
91203	Naphthalene	NA	NA		3.0E-03	I	no	no
104518	n-Butylbenzene	NA	NA		1.4E-01	E	yes	yes
98953	Nitrobenzene	NA	NA		2.0E-03	H	no	no
100027	4-Nitrophenol	NA	NA		2.8E-02	E	yes	yes
79469	2-Nitropropane	2.7E-03	H	no	2.0E-02	I	no	no
924163	N-Nitroso-di-n-butylamine	1.6E-03	I	no	NA	NA		no
621647	N-Nitrosodi-n-propylamine	2.0E-03	I	yes	NA	NA		yes
86306	N-Nitrosodiphenylamine	1.4E-06	I	yes	NA	NA		yes
103651	n-Propylbenzene	NA	NA		1.4E-01	E	yes	yes
88722	o-Nitrotoluene	NA	NA		3.5E-02	H	yes	yes
95476	o-Xylene	NA	NA		7.0E+00	H	yes	yes
106478	p-Chloroaniline	NA	NA		1.4E-02	I	yes	yes

Table D-1

Toxicological Values Used to Calculate Target Concentrations in Indoor Air, Soil Gas, and Groundwater

CASN	Chemical	Unit Risk Factor (URF) (: g/m^3)$^{-1}$	URF Source	Is URF Extrapolated From Oral Value?	Reference Concentration (RfC) (mg/m^3)	RfC Source	Is RfC Extrapolated From Oral Value?	Is Indoor Air Target Concentration Based on Extrapolated Value?
87865	Pentachlorophenol	3.4E-05	I	yes	1.1E-01	I	yes	yes
108952	Phenol	NA	NA		2.1E+00	I	yes	yes
99990	p-Nitrotoluene	NA	NA		3.5E-02	H	yes	yes
106423	p-Xylene	NA	NA		7.0E+00	I	yes	yes
129000	Pyrene	NA	NA		1.1E-01	I	yes	yes
110861	Pyridine	NA	NA		3.5E-03	I	yes	yes
135988	sec-Butylbenzene	NA	NA		1.4E-01	E	yes	yes
100425	Styrene	NA	NA		1.0E+00	I	no	no
98066	tert-Butylbenzene	NA	NA		1.4E-01	E	yes	yes
630206	1,1,1,2-Tetrachloroethane	7.4E-06	I	no	1.1E-01	I	yes	no
79345	1,1,2,2-Tetrachloroethane	5.8E-05	I	no	2.1E-01	E	yes	no
127184	Tetrachloroethylene	3.0E-06	E	no	NA	NA		no
108883	Toluene	NA	NA		4.0E-01	I	no	no
8001352	Toxaphene	3.2E-04	I	no	NA	NA		no
156605	trans-1,2-Dichloroethylene	NA	NA		7.0E-02	I	yes	yes
76131	1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA		3.0E+01	H	no	no
120821	1,2,4-Trichlorobenzene	NA	NA		2.0E-01	H	no	no
79005	1,1,2-Trichloroethane	1.6E-05	I	no	1.4E-02	I	yes	no
71556	1,1,1-Trichloroethane	NA	NA		2.2E+00	E	no	no

Table D-1

Toxicological Values Used to Calculate Target Concentrations in Indoor Air, Soil Gas, and Groundwater

CASN	Chemical	Unit Risk Factor (URF) (: g/m^3)$^{-1}$	URF Source	Is URF Extrapolated From Oral Value?	Reference Concentration (RfC) (mg/m^3)	RfC Source	Is RfC Extrapolated From Oral Value?	Is Indoor Air Target Concentration Based on Extrapolated Value?
79016	Trichloroethylene *	1.1E-04	E	yes	4.0E-02	E	no	yes
75694	Trichlorofluoromethane	NA	NA		7.0E-01	A	no	no
95954	2,4,5-Trichlorophenol	NA	NA		3.5E-01	I	yes	yes
88062	2,4,6-Trichlorophenol	3.1E-06	I	no	NA	NA		no
96184	1,2,3-Trichloropropane	5.7E-04	E	yes	4.9E-03	E	no	no
95636	1,2,4-Trimethylbenzene	NA	NA		6.0E-03	E	no	no
108678	1,3,5-Trimethylbenzene	NA	NA		6.0E-03	E	no	no
108054	Vinyl acetate	NA	NA		2.00E-01	I	no	no
75014	Vinyl chloride (chloroethene)	8.80E-06	I	no	1.00E-01	I	no	no

Sources:
Hierarchy is as follows:
I = IRIS
E = EPA-NCEA provisional value
H = HEAST
A = HEAST Alternative

Notes:
If no inhalation data were available, toxicity data were extrapolated from oral studies.
Data are current as of November 2002.

* The target concentration for trichloroethylene is based on the upper bound cancer slope factor identified in EPA's draft risk assessment for trichloroethylene (US EPA, 2001). The slope factor is based on state-of-the-art methodology, however the TCE assessment is still undergoing review. As a result, the slope factor and the target concentration values for TCE may be revised further.

APPENDIX E – RELEVANT METHODS AND TECHNIQUES

I. Introduction

This appendix provides information on sampling and analysis methodologies that can be used to help evaluate vapor intrusion into indoor air. It should be noted that not all of these methods were developed specifically for this purpose. The Office of Research and Development (ORD) is evaluating the available methods to determine their applicability, and when methods have low reliability (e.g., sub-slab sampling), developing new protocols.

The technical references provided in this appendix originate from a variety of sources including non-EPA documents which may provide regional and state site managers, as well as the regulated community, useful technical information. However, such non-EPA documents do not replace current EPA or OSWER guidance or policies.

II. Site Characterization

Characterization of a site involves the collection of data and the development of a conceptual site model (See Appendix B) to assist in making decisions on the risks posed by contaminants to critical receptors. A variety of data may be employed in the process, and the data should be assessed for their quality and usefulness in making critical decisions on the risks posed by a site. Different media may be sampled with a variety of methods and may be analyzed in a variety of ways. We recommend that experts from appropriate disciplines be assembled at an early stage to develop objectives for the site investigation and to develop a sampling and analytical plan meeting data quality objectives (DQOs).

The Office of Research and Development's National Exposure Research Laboratory (NERL) has prepared a Compact Disk (CD) entitled "Site Characterization Library, Volume 1, Release 2.5," which contains more than 20,000 pages and 84 documents of guidance for the characterization of sites that can be searched, read, and printed (EPA/600/C-02/002). The documents are readable using Adobe Acrobat software. Twenty-five software programs are also included. The CD may be obtained from the National Center for Environmental Publications (NCEP). The CD identifies the following ASTM standards for site characterization:

D 5314	Guide for Soil Gas Monitoring in the Vadose Zone
D 4696	Guide for Pore-Liquid Sampling from the Vadose Zone
D 3404	Guide to Measuring Matric Potential in the Vadose Zone Using Tensiometers
D 4944	Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester Methods

D 3017 Test Method for Water Content of Soil and Rock In-Place by the Nuclear Method (Shallow Depth)

D 5220 Test Method for Water Content of Soil and Rock In-Place by Neutron Depth Probe Method

D 6031 Test Method for Logging In Situ Moisture Content and Density of Soil and Rock by the Nuclear Method in Horizontal, Slanted and Vertical Access Tubes

Other relevant ASTM methods include:

D 6235 Standard Practice for Expedited Site Characterization of Vadose Zone and Around Water Contamination at Hazardous Waste Contaminated Sites

D 5730 Guide for Site Characterization for Environmental Purposes with Emphasis on Soil, Rock, the Vadose Zone, and Groundwater

III. Groundwater Sampling and Analysis for VOCs

Prior to using groundwater data for evaluating the vapor intrusion pathway, we recommend that you establish that LNAPL is not floating on the groundwater, as the VOCs can partition directly from the pure product to the vapor phase rather than from the dissolved phase. This can be indicated by analytical results from water samples taken at the water table having values higher than the theoretical solubility for the specific LNAPL compounds present.

If possible, we recommend that groundwater samples be collected from wells screened at or across the top of the water table. This point of collection is necessary to be consistent with the derivation of the target groundwater criteria in Table 2, which assumes equilibrium partitioning between the aqueous and vapor phases and uses Henry's Law Constant to calculate source vapor concentrations corresponding to groundwater concentrations. It should be recognized that samples from groundwater monitoring wells maybe a blend of groundwater from different levels across the screened interval. This may result in either under- or over-estimation of the groundwater contaminant concentration at the top of the aquifer. For example, at site locations where concentrations are highest near the water table, the in-well blending will provide data with a negative bias (concentrations lower than representative). This may occur at locations where LNAPL is found near the water table, where recharge rates are low, or sites where there is an interface-zone plume (a fluctuating water table facilitates interactions between a vapor plume and the shallow groundwater). At other sites, shallow groundwater may have relatively low concentrations, and in-well blending will provide data with a positive bias (concentrations higher than representative). Examples include sites with a high rate of recharge from above, which can create a layer of shallow groundwater with little or no contamination that acts as a barrier to volatilization of vapors from deeper groundwater. [For more information, see Fitzpatrick, N. A., Fitzgerald, J. J. 1996. "An Evaluation of Vapor Intrusion Into Buildings Through a Study of Field Data," *Proceedings of the 11th Annual Conference on Contaminated Soils,* University of Massachusetts at Amherst.]

Confidence in the groundwater data can be increased through the use of a narrowly screened interval across the water table, the use of low flow sampling procedures to minimize mixing, or a variety of other depth-discrete sampling protocols. Methods of sampling such as direct push using a Geoprobe or cone penetrometers should concentrate on the upper few feet of the ground water.

There are numerous ASTM standards for groundwater sampling. Assuming wells already exist for sampling VOCs, the following standards are recommended:

D 5980	Standard Guide for Selection and Documentation of Existing Wells for Use in Environmental Site Characterization and Monitoring
D 6634	Standard Guide for the Selection of Purging and Sampling Devices for Ground-Water Monitoring Wells
D 5903	Guide for Planning and Preparing a Ground-Water Sampling Event
D 6452	Guide for Purging Methods for Wells Used for Ground-Water Quality Investigations
D 4448	Standard Guide for Sampling Ground-Water Monitoring Wells
D 6771	Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations
D 6564	Standard Guide for Field Filtration of Ground Water Samples
D 6517	Standard Guide for Field Preservation of Ground Water Samples
D 3694	Practices for Preparation of Sample Containers and for Preservation of Organic Constituents
D 6089	Guide for Documenting a Ground-Water Sampling Event

The following ASTM standards are useful if a monitoring system is not already in place:

D 5612	Standard Guide for Quality Planning and Field Implementation of a Water Quality Measurement Program
D 5730	Standard Guide for Site Characterization for Environmental Purposes with Emphasis on Soil, Rock, the Vadose Zone and Ground Water
D 6286	Standard Guide for Selection of Drilling Methods for Environmental Site Characterization

D 6001 Standard Guide for Direct-Push Water Sampling for Geoenvironmental Investigations

D 5092 Standard Practice for Design and Installation of Ground-Water Monitoring Wells in Aquifers

D 5521 Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers

Other Related ASTM Standards:

D 6312 Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs

D 5241 Standard Practice for Micro-Extraction of Water for Analysis of Volatile and Semi-Volatile Organic Compounds in Water

D 5314 Standard Guide for Soil Gas Monitoring in the Vadose Zone

D 4696 Standard Guide for Pore-Liquid Sampling from the Vadose Zone

IV. Indoor Air Sampling and Analysis

Indoor air sampling and analysis provide the most direct estimate of inhalation exposures. However, source attribution for the many compounds typically present in indoor air can be challenging. Constituents of indoor air can originate from indoor emission sources, from ambient (outdoor) air contributions, as well as from possible vapor intrusion of contaminated groundwater. Each of these sources can introduce concentrations of volatile chemicals to the indoor environment sufficient to pose an unacceptable health risk. In addition, concentrations of compounds found in indoor air are often subject to temporal and spatial variations, which may complicate estimates of exposure. If source attribution is pursued, then we recommend that the various potential sources contributing to the total concentration of a compound be identified. This is typically very challenging and may involve a series of measurements, or actions, whose purpose is to isolate the individual source contributions. Before conducting an indoor air sampling plan, we recommend consideration be made to other management options, such as proactive exposure controls, which may be cost competitive. Appendix A provides guidance in executing the DQO process for planning an indoor air-monitoring program.

Prior to indoor air sampling, we recommend conducting an inspection of the residence and an occupant survey to adequately identify the presence of any possible indoor air emission sources of (or occupant activities that could generate) target VOCs in the dwelling (see Appendices H & I). An indoor air quality survey has several components, and we recommend that it be consistent with data quality protocols appropriate for risk assessment (see Risks Assessment Guidance for Superfund Part B http://www.epa.gov/superfund/program/risk/ragsb/index.htm or EPA/540/R-

92/003). The Massachusetts Department of Environmental Protection (MA DEP) has prepared an *Indoor Air Sampling and Evaluation Guide (April 2002)* which is available at the following URL: http://www.state.ma.us/dep/ors/files/indair.pdf.

Many aspects of the protocols used for ambient air can also be applied to indoor air sampling (e.g., EPA TO-15 and TO-17 methods). Specially treated stainless steel evacuated canisters or adsorbent tubes are appropriate for sampling and we recommend that they be combined with an analytical method capable of obtaining the detection limits identified in the DQO process. To facilitate a reliable comparison of analytical results, a standard condition for sampling is recommended. Some guidance in establishing a standard monitoring condition is given in the following paragraphs.

We recommend that sampling units be placed within the normal breathing zone, 2 to 5 feet above the floor, in the lowest inhabited area. It is generally advisable to collect at least one 24-hour sample in both the probable place of highest concentration (e.g., basement) and in the main living area. Two or more sampling events at each location are desirable. Typically, we recommend that the house be closed (windows and doors shut) 12 to 24 hours before the measurements begin and the use of appliances that induce large pressure differences (e.g. exhaust fans, clothes dryers, operating fireplaces) be avoided during this time. Additionally, we recommend avoiding sampling locations adjacent to windows and air supplies.

We recommend gas sampling that will be used for direct assessment of vapor intrusion meet or exceed requirements for demonstrating method acceptability as specified in EPA Methods TO-15 (canister-based sample collection) and TO-17 (sorbent tube-based sample collection) or appropriately modified to achieve a lower method detection limit (MDL) corresponding to a given life-time risk level. Note: To achieve detection at or below the published 10^{-5} to 10^{-6} risk levels for many target compounds, the MDLs for TO-15 or TO-17, in our judgment, must be considerably below 0.5 ppbv.

To achieve TO-15 and TO-17 method acceptability, we recommend that a sampling and analysis protocol meet the recommended performance criteria for an enhanced method detection limit, replicate precision, and audit accuracy at compound concentrations corresponding to the 10^{-5} or 10^{-6} risk levels, and special attention be paid to quality control measures. Sufficiently low sample container blanks, analytical system blanks, analytical interferences, etc., are all implied in the ability to meet the technical acceptance criteria.

To ensure reliable measurements are obtained, we recommend that multiple simultaneous samples (more than one canister or sorbent tube) be taken for every sampling event and from the same inlet so that variability in nominally identical samples can be documented. Also, we recommend that knowledge of the performance of the analytical system be demonstrated, including blank response, the MDLs, calibration of the target compounds at or near the sample concentration range, and the likelihood of interferences. These are common sense considerations that are covered in TO-15 and TO-17, but call for special attention at the low concentration levels being considered.

Note: At this point in the development of the best approach to sorbent tube sampling (TO-17), reduction of co-collected water on the sorbent tubes is sometimes important to achieve a linear analytical response such as with ion trap mass spectrometers. Therefore, we recommend that preliminary experiments be performed to document the effect of different water vapor levels on analytical performance. Also, the interaction of target compounds with reactive compounds, e.g. ozone, depends on the extent to which the reactive compounds exist in the indoor air and the reaction rates. Until this specific problem with sampling is addressed, we recommend that the ozone concentration be determined at every sampling event. Also, an interaction of ozone with adsorbed compounds can destroy the compound. Certain target compounds have been tested for this (see McClenny, W.A., Oliver, K.D., Jacumin, H.H., Jr., and Daughtrey, E.H., Jr., 2002, Ambient volatile organic compound (VOC) monitoring using solid adsorbants - recent U.S. EPA developments, JEM 4(5) 695 – 705).

Recommended publications:

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, EPA/625/R-96/010b

- Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). pp.15-1 through 15-62

- Method TO-17, Determination of Volatile Organic Compounds in Ambient Air using Active Sampling on Sorbent Tubes. pp. 17-1 through 17-49

- Compendium of Methods for the Determination of Air Pollutants in Indoor Air, EPA/600/4-90-010

V. Soil Gas Sampling

Soil gas sampling and analysis results tend to be more reliable at locations and depths where high contaminant concentrations are present and where the soils are relatively permeable. Reliability of the results tends to be lower in lower permeability settings and when sampling shallow soil gas. In both cases, leakage of atmospheric air into the samples is a valid concern. Consequently, it is recommended that samples collected at depths less than 5 feet below ground surface (bgs) not be used for this analysis, unless they are collected immediately below the building foundation several feet in from the edge (e.g., subslab samples). Reliability of soil gas sampling can be assessed by: a) measuring a vertical profile and inspecting to see if measured concentrations decrease with increasing distance from the vapor source, and b) checking to see if vapor concentrations correlate qualitatively and quantitatively with available groundwater concentration data. For example, with groundwater sources the highest soil gas concentrations should correlate with the highest groundwater concentrations, and vapor concentrations collected immediately above groundwater should not exceed the value calculated using Henry's Law. Parallel analysis of oxygen, carbon dioxide, and nitrogen in soil gas samples can often be used to help assess the reliability of a given sample result. Reliability is typically improved by using

fixed probes and by ensuring that leakage of atmospheric air into the samples is avoided during purging or sampling. To avoid dilution of the sampling region, we recommend using the minimum purge volume deemed adequate to flush the sampling system. With respect to the spatial distribution of sampling points, close proximity to the building(s) of concern is generally preferred; however, it may be possible to reasonably estimate concentrations based on data from soil gas samples collected about a larger area. Additionally, as vapors are likely to migrate upward preferentially through the coarsest and driest material, we recommend soil gas samples be collected from the most permeable zones in the vadose zone underlying the inhabited buildings. Concentrations should be lower in the high permeability zones than the low permeability zones.

The velocity at which soil gas should be sampled is influenced by the soil permeability, and the volume of sample taken will determine the zone of soil that is sampled. The effects of low- versus high-velocity and micro- versus macro-volume soil gas sampling techniques are currently being evaluated.

Measurement of VOCs in the Subslab Soil Gas

Subslab sampling may entail drilling a series (e.g., 3 to 5) of small diameter (e.g., 9/16") holes in the foundation of a residential building. It may be advantageous to install flush mounted stainless steel or brass vapor probes in contaminant free cement. We recommend sampling be performed using EPA Method TO-15 or TO-17.

The preferred measurement location is in the central portion of the slab, well away from the edges where dilution is more likely to occur. We recommend the hole be plugged with a material such as tape or pliable caulk (VOC free) immediately after drilling the hole to minimize the disturbance of the sub slab concentrations. When drilling the hole, care should be taken not to puncture the surface of soil underneath. In cases where there is aggregate soil underneath the foundation, this care may not be important, but if the soil has a slightly compacted layer on top with a slight subsidence under the slab this compacted layer may actually provide some resistance to the entry of soil gas from underneath. In this case, a subslab sample can be collected by slowly pulling a volume of gas from the void of the subsidence. This initial measurement may be representative of the soil gas typically entering the house. After the subslab with undisturbed soil has been sampled, it may be instructive to penetrate the surface of the soil and resample. We recommend the subslab samples be collected at several locations to obtain representative values. It is important to not disturb the subslab region by applying excessive pressures that might induce dilution of vapors in this region. Significant pressures might result from excessive slamming of doors, or from appliances such as: exhaust fans, clothes dryers, downdraft grills, ceiling or roof mounted attic fans, or certain combinations of open windows on a windy day. If the subslab region is disturbed, it may require many hours to return to a steady state condition.

Additional points to consider before drilling into the foundation are whether or not the home has an existing vapor barrier, or is a tension slab. In either case, alternative sampling methods may be preferable.

Measurement of VOC's in soil gas using slam bar methods

Slam bar methods have been widely used to measure contaminants in soil gas. The results of these measurements have been highly variable. Because this technique is frequently used for relatively shallow sampling, it is, in our judgment, prone to errors from dilution by surface air. This is especially true when the hole is punched or drilled with one instrument that is then replaced by a measurement probe (sometime of smaller diameter). We recommend great care be taken to ensure that leakage air does not enter the sample. Only the volume of air sufficient to flush the probe and sampling line should be extracted before collecting the sample. The larger the purge/sample volume, the larger the subsurface area of influence; if the contamination is contained within non-preferential flow paths or small discrete locations, a large purge/sample volume will dilute the concentration of contaminants.

Measurement of VOC's in soil gas using push probe methods

This approach seems to be emerging as a powerful tool for conducting soil gas measurements. OSWER is working with ORD and will update this section on the EPA/OSWER website as further refinements of these methods are developed.

Recommend publications:

Soil Vapor Extraction Technology: Reference Handbook - Soil Vapor Extraction Technology: Reference Handbook March 1990. Environmental Protection Agency, Risk Reduction Engineering Lab. EPA/540/2-91/003

VI. Soil Sampling and Analysis

Soil sampling and analysis is not recommended for assessing whether or not the vapor intrusion pathway is complete. This is because the uncertainties associated with soil partitioning calculations, as well as the uncertainties associated with soil sampling and soil chemical analyses for volatile organic chemicals, are so great that, that in our judgment, use of soil concentrations for assessment of this pathway is not technically defensible. Thus, soil concentration criteria were not derived and the use of soil criteria is not encouraged in this guidance. Soil concentration data might, however, be used in a qualitative sense for delineation of sources provided the soil samples are preserved immediately upon collection with methanol. For example, high soil concentrations (e.g. >1000 mg/kg TPH) would definitely indicate impacted soils; unfortunately, the converse is not always true and we recommend that non-detect analytical results not be interpreted to conclude the absence of a vapor source.

VII. Other Issues

We recommend that detection limits be considered when choosing which media to sample and how to interpret the results. The properties of some chemicals and the biases in the analytical methods may be such that the sensitivity of detection is higher in one medium than another. For

example, a high Henry's constant (H>1) chemical might be detectable in soil gas when the concentration in groundwater falls below the detection limit (e.g., vinyl chloride).

We recommend that transformation products also be considered when selecting the chemicals of concern. For example, 1,1,1-trichloroethane (111TCA) may be abiotically converted to 1,1-dichloroethene (11DCE) in groundwater, so that we recommend looking for both chemicals at 111TCA spill sites.

APPENDIX F

EMPIRICAL ATTENUATION FACTORS AND RELIABILITY ASSESSMENT

1. Introduction

The empirical attenuation factors used in this guidance were derived through review of data from sites with paired indoor air and soil gas and/or groundwater concentrations. These data have been compiled into a database with the structure and elements illustrated in Figure F-1.

The database contains information from 15 sites (CO - 5 Sites; CA - 1 Site; CT – 1 Site; MA – 7 Sites; and MI – 1 Site). Fifteen VOCs are represented: BTEX, Chloroform, 1,1-Dichloroethane, 1,2-Dichloroethane, 1,1-Dichloroethylene, cis-1,2-Dichloroethylene, trans-1,2-Dichloroethylene, Tetrachloroethylene, 1,1,1- Trichloroethane, 1,1,2-Trichloroethane, Trichloroethylene and Vinyl chloride. The result is a database with 274 total residence and chemical combinations, 35 of which represent BTEX compounds and the remaining 239 represent chlorinated hydrocarbons. Groundwater data are available for the entire set of residence and chemical combinations. Soil gas data are available only for 40 of the residence and chemical combinations.

The information in the database was used to calculate groundwater-to-indoor air and soil gas-to-indoor air attenuation factors for each of the chemicals measured at each of the residences monitored. The distributions of these calculated attenuation factors were used to define a conservative empirical attenuation factor for each medium, as described in Sections 2, 3, and 4 below.

An assessment was performed using the same database to determine the reliability of the selected attenuation factors for screening in residences with indoor air concentrations exceeding the target levels corresponding to a cancer risk of 10^{-6} and 10^{-5}. The reliability assessment was performed by determining the number of false negative and false positives corresponding to the selected attenuation factor using the guidelines described in Section 6 below.

2. Calculation of Attenuation Factors

The attenuation factor represents the ratio of the indoor air concentration measured in a residence to the vapor concentration measured in the subsurface materials underlying or adjacent to the residence. For soil gas, the attenuation factor (α) is calculated simply as:

$$\alpha = \frac{C_{indoor}}{C_{soil\ gas}}$$

where

C_{indoor} = measured indoor air concentration [ug/m^3]
$C_{soil\ gas}$ = measured soil gas concentration [ug/m^3]

For groundwater, the attenuation factor is calculated as:

$$\alpha = \frac{C_{indoor}}{C_{groundwater} H_c}$$

where

$C_{groundwater}$ = measured groundwater concentration [ug/L] x 1000 L/m^3
H_c = dimensionless Henry's Law Constant [--]

Henry's Law Constant is used to convert the measured groundwater concentration to a corresponding equilibrium soil gas concentration. Field data suggest that this conversion may result in over prediction of the soil gas concentration (by as much as a factor of ten) directly above the contaminated groundwater. However, this is not always the case and consequently Henry's Constant is used here without a correction factor.

In the database, attenuation factors are calculated using only those residences and chemicals for which both the indoor air and subsurface measurements were above the chemical's method detection limit (MDL). Because the subsurface concentrations are generally greater than the measured indoor air concentrations, the calculated attenuation factors are values less than one.

3. Groundwater-to-Indoor Air Attenuation Factor

The distribution of groundwater-to-indoor air attenuation factors is shown in Figures F-2 and F-3. Figure F-2 shows the distribution of attenuation factors for all residences in the database with associated measured indoor air and groundwater concentrations above the chemicals' MDLs. The calculated attenuation factors range from 10^{-1} to 10^{-7}. This range includes attenuation factors calculated for homes with high indoor air concentrations as well as for homes with indoor air concentrations at levels typical of background concentrations (Table F-1). Figure F-3 compares the distribution shown in Figure F-2 to the distribution of the subset of attenuation factors corresponding to residences with indoor air concentrations greater than the typical background levels (e.g., geometric mean of the mean background values shown in Table F-1). As can be seen in Figure F-3, fewer than 5% of the residences with indoor air concentrations above typical background levels have attenuation factors greater than 0.001 (1/1000). This means that for 95% of the residences in the database, the groundwater-to-indoor air attenuation factor is less than 0.001 (1/1000) and, consequently, this value (0.001) is considered to be a generally reasonable upper-bound value.

4. Soil Gas-to-Indoor Air Attenuation Factor

The shallow soil gas to indoor air attenuation factor represents the ratio of the indoor air concentration to the soil gas concentration at some shallow depth. For the purposes of this guidance, shallow soil gas samples are defined as those obtained either from directly below the foundation or from depths less than 5 feet below foundation level. Figure F-4 shows the distribution of subslab-to-indoor air attenuation factors for the subset of residences with indoor concentrations greater than the subslab concentration measured below the residence's foundation. As can be seen in the plot, approximately 15% of the residences have attenuation factors greater than 0.1 (1/10), or conversely, about 85% of the residences have attenuation factors smaller than 0.1 (1/10). Consequently, an attenuation factor of 0.1 was used to represent a generally reasonable upper-bound value for the case where the soil gas concentration immediately beneath a foundation is used (e.g., the indoor air concentration would not be expected to exceed 1/10 of the concentration immediately below the foundation). This value is also supported by an analysis of the dilution that occurs due to ventilation of a house. An attenuation factor of 0.1 suggests that 10% or less of the air exchanged in a house originates from the subsurface. This value is conservatively assumed to apply to shallow soil gas samples (< 5 feet below foundation level) as well as subslab samples.

Deep soil gas samples are defined for the purposes of this guidance as those obtained just above the water table or from depths greater than 5 feet below foundation level. A smaller attenuation factor than that used for shallow soil gas is warranted as the deep soil gas samples represent a more direct measurement of the source vapor concentration and are subject to less variability than is observed for shallow soil gas samples. On the other hand, a more conservative value than that used for groundwater is warranted, as there is not the added safety factor incorporated in the groundwater attenuation factor, which assumes equilibrium partitioning of chemicals between groundwater and soil vapor (Henry's Law). Consequently, a value of 0.01 was selected for deep soil gas.

5. BTEX versus Chlorinated Hydrocarbon Attenuation Factors

To be conservative, the recommended criteria developed for this guidance have been established assuming that the chemicals do not degrade as they migrate through the vadose zone. It should be recognized that many chemicals of interest do biodegrade. For example, petroleum hydrocarbon vapors will biodegrade in the presence of oxygen, and field studies have shown this biodegradation to be very significant in some settings. In contrast, analysis of data from sites impacted with chlorinated solvents suggest that degradation is insignificant for these compounds. The impact of biodegradation can be seen in the distribution of attenuation factors for BTEX compounds versus chlorinated hydrocarbons (Figure F-5). Figure F-5 suggests a three-fold to ten-fold decrease in attenuation factor for BTEX compounds.

Unfortunately, the significance of the biodegradation has also been highly variable, and the factors that determine its significance are not yet fully understood. In a very general sense, it is expected that aerobic biodegradation will have limited effect in settings where

oxygen re-supply is limited, and also will have little effect on the attenuation factors used for soil gas samples collected near a building. At this time, we recommend that the significance of biodegradation be determined through collection of vertical soil gas profiles beneath the buildings of concern. The occurrence of aerobic biodegradation will be reflected qualitatively in the oxygen and contaminant soil vapor profiles, and the quantitative effects can be estimated by the methods described in Johnson et al. (1999), or other defensible analysis methods. It is unlikely that the extensive site-specific information required to determine the influence of biodegradation will be available in the initial stages of site characterization. Therefore, we believe that it is generally prudent to assume that biodegradation is not a factor when screening sites for vapor intrusion issues.

6. Reliability Assessment

The reliability of the evaluation approach used in Questions 4, 5, and 6 of this guidance was assessed using the database described above in Section 1 of this appendix. For the assessment at the generic screening level (Question 4), the target levels in Tables 2(a) and 2(b) were used. For the assessment of Question 5, the target levels in Tables 3(a) and 3(b) were used. For Question 6, the Johnson and Ettinger Model was applied as described in Appendix G using the updated default model parameters. The following sections briefly describe the analysis and results. This analysis shows that the evaluation approach used in this guidance yields reliable results at both the 10^{-5} and 10^{-6} cancer risk levels when assessing the vapor intrusion pathway at all sites reviewed.

6.1 Analysis Approach

Cancer risk levels at both the 10^{-5} and 10^{-6} levels were evaluated. Table 2 was used to select target levels for evaluation of Question 4. For Question 5, the appropriate attenuation factor to use when selecting screening levels from Table 3 was determined from the figures 3a and 3b in Question 5 of the guidance as a function of site-specific SCS soil types and depth to groundwater. For the Question 6 assessment, information on foundation type (either slab-on-grade or basement) and building mixing height was incorporated into the analysis (basement defaults were used for buildings with crawl spaces) and a site-specific attenuation factor was calculated.

The assessment was performed by determining the number of false negative and false positives obtained using the most recently available toxicity data. As shown in Table F-2, a false negative occurs when a chemical's measured indoor air concentration exceeds the target level, but the measured groundwater (or soil gas) concentration does not. False negatives may appear if indoor or ambient (outdoor) sources of VOCs are present and they exceed the indoor air target level at the selected risk level. A false positive occurs when a chemical's measured indoor air concentration is below the target level, but the measured groundwater (or soil gas) concentration is above the target level. Correct positives and correct negatives are defined in a similar fashion, as shown in Table F-2.

6.2 Results

In order to effectively understand the results, it is important to differentiate between samples, buildings, and sites. There are seven sites evaluated in this analysis (Alliant, Eau Claire, Hamilton-Sunstrand, LAFB, MADEP, Mountain View, and Uncasville). Each site has one or more buildings. For example, the Alliant site has only one building. LAFB has 13 buildings and Mountain View has seven buildings. Each building has its own unique address. Several samples were taken at each building. Each sample consists of paired indoor air and groundwater concentrations for a unique chemical at a certain building. The number of samples and the number of chemicals identified in these samples varies by building.

The results are grouped into two types of tables. Tables F-3 (risk level 10^{-5}) and F-5 (risk level 10^{-6}) organize the results by building at each site. It shows whether or not a building has a correct negative, correct positive, false negative, or false positive result. An important note regarding Tables F-3 and F-5 is the difference between buildings that are not applicable for vapor intrusion analysis ("NA" is added to the results of these buildings) and buildings with wet basements. Buildings that are not applicable are those where the depth from the bottom of the foundation (whether it be a basement or slab-on-grade) to groundwater contamination is less than 1.5 meters (5 feet). This is one of the precluding factors listed in the guidance. We still included results for these buildings, but marked their results with an "NA" to indicate that they would be excluded from this analysis according to protocols set forth in the guidance. The false negative, false positive, correct negative, and correct positive results for non-NA buildings are summed at the bottom of each table.

The second set of results presents outcomes by chemical at each site. Tables F-4 (risk level 10^{-5}) and F-6 (risk level 10^{-6}) show the number of false positive and false negative outcomes for each chemical at each site. They do not indicate whether the false results occur in just one or two buildings at the site, or evenly across all buildings. It is important to note that the numbers in these tables are counts of samples, not of buildings. Therefore, it is possible to have a false negative result for a chemical at a particular site, but each building at that site can have correct positive results based on the outcomes for other chemicals. It is also important to note that results for those samples that are considered not applicable (NA) according to the criteria discussed in the guidance are not included in this table.

Tables F-3 and F-5 show that the evaluation approach used in this guidance yields no false negatives with respect to sites or buildings at either the 10^{-5} or 10^{-6} cancer risk level. Tables F-4 and F-6 show that for most chemicals either no or few false negatives are obtained, with the exception of tetrachloroethene and 1,2-dichloroethane. These two chemicals show a number of false negatives, especially at the 10^{-6} cancer risk level. It is important to note, however, that both of these chemicals are typically found as background contaminants, which may account for some of the false negatives. Several of the chemical-specific false negative results shown in Tables F-4 and F-6 also appear to

result from limiting the ground water target concentration to the MCL if the calculated target concentration would be less than the MCL.

Table F-1. Background indoor air concentrations for selected volatile organic compounds. All concentrations expressed in ug/m^3.

Compound	Shah and Singh (1988)	Samfield (1992)	Brown et al. (1994)	NOPES (1990)	Sheldon (1992)	MADEP (September 1998)	*EPA IAQ Reference Manual (July 1991)*	Foster et al., (2002)
1,1,1-Trichloroethane	271.4	-	-	-	-	30	70	0.7
1,1,2,2-Tetrachloroethane	0.098	-	-	-	-	0.01	-	-
1,1,2-Trichloroethane	-	-	-	-	-	-	-	RL (0.064)
1,1-Dichloroethylene	-	-	-	-	-	6.5	-	RL (0.08)
1,2-Dichloroethane	-	-	-	-	-	-	-	0.07
Acetaldehyde	-	9.6	-	-	-	-	-	-
Acetone	19.3	-	-	-	-	6	-	-
Benzene	16.8	8.2	8.0	-	2.2	21	14	4.08
Carbon Tetrachloride	2.6	12.0	-	-	0.5	1	5	-
Chlordane	-	2.8	-	0.18	-	-	-	-
Chlorobenzene	-	-	-	-	-	10	-	-
Chloroform	4.1	8.0	10.0	-	-	3	6	2.1
Cumene	0.2	5.1	-	-	-	-	-	-
DDE	-	-	-	0.001	-	-	-	-
Dichlorobenzenes	-	31.0	8.0	-	1.0	0.5	58	-
Ethylbenzene	12.7	13.8	5.0	-	-	10	14	-
Heptachlor	-	0.7	-	0.07	-	-	-	-
Hexachlorobenzene	-	0.0	-	0.0004	-	-	-	-
Hexane	-	33.0	12.0	-	-	-	-	-
Methoxychlor	-	-	-	0.0002	-	-	-	-
Methylene Chloride	-	342.0	17.0	-	15.0	10	-	0.98
Methylethylketone (2-butanone)	9.2	7.0	4.0	-	-	42	-	-
Methylisobutylketone (4-methyl-2-pentanone)	-	-	-	-	-	2	-	-
Naphthalene	-	11.0	-	-	-	-	-	-
Styrene	-	1.8	-	-	1.0	5	6	-
Tetrachloroethylene	21.1	9.5	7.0	-	0.3	11	28	1.62
Toluene	28.3	56.0	37.0	-	-	29	61	-
Trichlorobenzenes	0.5	-	-	-	-	-	-	-
Trichloroethylene	7.4	-	-	-	-	5	9	0.15
Vinyl chloride	-	-	-	-	-	-	-	0.01
Xylenes	-	25.0	24.0	-	6.0	3	14	-

Shah and Singh (1988): ES&T, Vl. 22, No.12, pp. 1381-1388, 1988

Samfield (1992): EPA-600-R-92-025, 1992.

Brown et al. (1994): Indoor Air, 4:123-134, 1994.

NOPES (1990): EPA/600/3-90/003, January 1990.

Sheldon (1992): California Air Resources Board, Final Report, January 1992.

MADEP (September 1998): From: Background Documentation for the Development of MCP Numerical Stds" April 1994, Table 4.2, except 1,1-dichloroethene (EPA TEAM study) and methylene chloride (Stolwijk, JAJ, 1990)

EPA IAQ Reference Manual (July 1991): Results from Wallace (1987), except toluene: Seifert & Abraham (1982).

Foster et al., (2002): Foster, S.J, J.P. Kurtz, and A.K. Woodland, Background indoor air risks at selected residences in Denver, Colorado, 2002.

Table F-2. Evaluation criteria for the reliability assessment.

Measurement	Relationship	Vapor Intrusion Screening Level	Condition
C(GW)	>	GWSL	CORRECT POSITIVE
C(IA)	>	IASL	
C(GW)	<	GWSL	CORRECT NEGATIVE
C(IA)	<	IASL	
C(GW)	<	GWSL	FALSE NEGATIVE
C(IA)	>	IASL	
C(GW)	>	GWSL	FALSE POSITIVE
C(IA)	<	IASL	

Table F-3
False Negative and False Positive Indoor Air Predictions Based on Comparison of Groundwater Concentrations to Target Levels, by Building at Each Site

$R=1x10^{-5}$

Site Name	Address	Vapor Intrusion Q4[1]	Vapor Intrusion Q5[2]	Compound(s) Responsible for False Result [3]
Alliant		NA(CP)	NA(CP)	
Eau Claire	Residence F	NA(CP)	WB	
	Residence K	NA(CP)	WB	
	Residence S	NA(CP)	WB	
Hamilton-Sunstrand	6800 Fern Dr.	CP	CP	
	6800 Osage St.	CP	CP	
	6800 Ruth Way	CP	CP	
	6801 Avrum Dr.	CP	CP	
	6801 Fern Dr.	CP	CP	
	6810 Jordan Dr.	CP	CP	
	6811 Ruth Way	CP	CP	
	6820 Fern Dr.	CP	CP	
	6821 Mariposa St.	CP	CP	
	6821 Pecos	CP	CP	
	6831 Navajo St.	CP	CP	
	6831 Zuni St.	CP	CP	
	6840 Mariposa	CP	CP	
LAFB	UA02	CP	CP	
	UA03	CP	CP	
	UA04	CP	CP	
	UA05	CP	CP	
	UA18	CP	CP	
	UA19	CP	CP	
	UA21	CP	CP	
	UA22	CP	CP	
	UA23	CP	CP	
	UA24	CP	CP	
	UA25	CP	CP	
	UA26	CP	CP	
	UA28	FP	FP	Trichloroethylene
MADEP	0907 A Hull	NA(CP)	WB	
	0907 B Hull	NA(CP)	WB	
	1019 Lynnf	NA(FP)	NA(FP)	Benzene, Ethylbenzene, Toluene
	11707 Quincy	NA(CP)	NA(CP)	
	12092 B Marble	CP	CP	Benzene
	1525 A Marble	NA(CP)	NA(CP)	
	1525 B Marble	NA(CP)	NA(CP)	
	2797 A Tewks	NA(FP)	NA(FP)	Benzene, Ethylbenzene, Toluene
	2797 B Tewks	NA(FP)	NA(FP)	Benzene, Ethylbenzene, Toluene
Mountain View	Residence 1	CP	CP	
	Residence 2	CP	CP	
	Residence 3	CP	CP	
	Residence 4	CP	CP	
	Residence 6	CP	CP	
	Residence 7	CP	CP	
	Residence 8	CP	CP	
Uncasville	Residence A	NA(CP)	NA(CP)	
	Residence B	NA(CP)	NA(CP)	
	Residence D	NA(CN)	NA(CN)	
	Residence E	NA(CP)	NA(CP)	

Key:
CP=Correct Positive; CN = Correct Negative
FP=False Positive; FN=False Negative
NA=Not applicable due to precluding factor--depth from foundation to groundwater contamination is less than 1.5 m.
WB=Wet Basement. This condition precludes the use of Figure 3 (for Q5).

Notes:
[1] Site data was compared to indoor air and groundwater screening values in Table 2.
[2] Site data was compared to indoor air and groundwater screening values in Table 3. The appropriate attenuation factor in this
[3] When false positive or false negative outcomes resulted with both Q4 and Q5, the same compounds were responsible for the false outcome in each scenario.

Table F-3 (continued)
Summary Table
False Negative and False Positive Indoor Air Predictions Based on Comparison of Groundwater Concentrations to Target Levels, by Building at Each Site
R=1x10^{-5}

	Q4		Q5	
	Number	**Percent**	**Number**	**Percent**
Total CP and CN	33	97.1%	33	97.1%
Total FP	1	2.9%	1	2.9%
Total FN	0	0.0%	0	0.0%
Total NA and WB	16	47.1%	11	32.4%
Total Number of Buildings	34		34	

Key:

CP=Correct Positive; CN = Correct Negative

FP=False Positive; FN=False Negative

NA=Not applicable due to precluding factor--depth from foundation to groundwater contamination is less than 1.5 m.
WB=Wet Basement. This condition precludes the use of Figure 3 (for Q5).

Notes:

[1] Site data was compared to indoor air and groundwater screening values in Table 2.

[2] Site data was compared to indoor air and groundwater screening values in Table 3. The appropriate attenuation factor in this analysis was obtained from Figure 3.

[3] When false positive or false negative outcomes resulted with both Q4 and Q5, the same compounds were responsible for the false outcome in each scenario.

Table F-4
Frequency of False Negative and False Positive Indoor Air Predictions Based on Comparison of Ground Water Concentrations to Target Levels, by Chemical[1]
Risk = $1x10^{-5}$

	Location	Benzene			1,1- Dichloroethane			1,2-Dichloroethane			1,1-Dichloroethylene			cis-1,2-Dichloroethylene[2]			trans-1,2-Dichloroethylene[2]			Ethyl Benzene*		
		Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN
VI Q4 [3]	Alliant	--	--	--	--	--	--	0	0	0	0	0	0	0	0	0	--	--	--	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	--	--	--	--	--	--
	LAFB	--	--	--	13	0	0	13	0	1	13	0	0	13	0	0	13	0	0	--	--	--
	Uncasville	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hamilton-Sunstrand	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--	--	--	--
	MADEP	1	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total	**1**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**1**	**26**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**1**	**0**	**0**
VI Q5 [4]	Alliant	--	--	--	--	--	--	0	0	0	0	0	0	0	0	0	--	--	--	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	--	--	--	--	--	--
	LAFB	--	--	--	13	0	0	13	0	1	13	0	0	13	0	0	13	0	0	--	--	--
	Uncasville	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hamilton-Sunstrand	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--	--	--	--
	MADEP	1	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total	**1**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**1**	**26**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**1**	**0**	**0**

Table F-4 (continued)
Frequency of False Negative and False Positive Indoor Air Predictions Based on Comparison of Ground Water Concentrations to Target Levels, by Chemical[1]
Risk = $1x10^{-5}$

	Location	Tetrachloroethylene*			Toluene			1,1,1-Trichloroethane			1,1,2-Trichloroethane			Trichloroethylene*			Vinyl chloride*			Xylene[2]		
		Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN
VI Q4 [3]	Alliant	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	0	0	0	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0	--	--	--
	LAFB	13	0	4	--	--	--	13	0	0	13	0	0	13	1	0	9	0	0	--	--	--
	Uncasville	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	--
	Hamilton-Sunstrand	--	--	--	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--
	MADEP	--	--	--	1	0	0	--	--	--	--	--	--	0	0	0	--	--	--	1	0	0
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	7	0	0	--	--	--	--	--	--
	Total	**13**	**0**	**4**	**1**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**33**	**1**	**0**	**9**	**0**	**0**	**1**	**0**	**0**
VI Q5 [4]	Alliant	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	0	0	0	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0	--	--	--
	LAFB	13	0	4	--	--	--	13	0	0	13	0	0	13	1	0	9	0	0	--	--	--
	Uncasville	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	--
	Hamilton-Sunstrand	--	--	--	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--
	MADEP	--	--	--	1	0	0	--	--	--	--	--	--	0	0	0	--	--	--	1	0	0
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	7	0	0	--	--	--	--	--	--
	Total	**13**	**0**	**4**	**1**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**33**	**1**	**0**	**9**	**0**	**0**	**1**	**0**	**0**

Key:
FP=False Positive; FN=False Negative
Notes:
[1] For each chemical we indicate the total number of samples at each site for each chemical and the number of samples with False Positive or False Negative results at that site across all buildings. "--" means the chemical was not found at any building at that site.
[2] Toxicity values from oral studies were used to develop screening levels for this chemical.
[3] Site data was compared to indoor air and ground water screening values in Table 2.
[4] Site data was compared to indoor air and ground water screening values in Table 3.
* Ground water target concentration for this compound is based on the Maximum Contaminant Level (MCL) in drinking water.

Table F-5
False Negative and False Positive Indoor Air Predictions Based on Comparison of Groundwater Concentrations to Target Levels, by Building at Each Site
$R=1x10^{-6}$

Site Name	Address	Vapor Intrusion Q4[1]	Vapor Intrusion Q5[2]	J&E Site Specific [3]	Compound(s) Responsible for False Result [4]
Alliant		NA(CP)	NA(CP)	NA(CP)	
Eau Claire	Residence F	NA(CP)	WB	WB	
	Residence K	NA(CP)	WB	WB	
	Residence S	NA(CP)	WB	WB	
Hamilton-Sunstrand	6800 Fern Dr.	CP	CP	CP	
	6800 Osage St.	CP	CP	CP	
	6800 Ruth Way	CP	CP	CP	
	6801 Avrum Dr.	CP	CP	CP	
	6801 Fern Dr.	CP	CP	CP	
	6810 Jordan Dr.	CP	CP	CP	
	6811 Ruth Way	CP	CP	CP	
	6820 Fern Dr.	CP	CP	CP	
	6821 Mariposa St.	CP	CP	CP	
	6821 Pecos	CP	CP	CP	
	6831 Navajo St.	CP	CP	CP	
	6831 Zuni St.	CP	CP	CP	
	6840 Mariposa	CP	CP	CP	
LAFB	UA02	CP	CP	CP	
	UA03	CP	CP	CP	
	UA04	CP	CP	CP	
	UA05	CP	CP	CP	
	UA18	CP	CP	CP	
	UA19	CP	CP	CP	
	UA21	CP	CP	CP	
	UA22	CP	CP	CP	
	UA23	CP	CP	CP	
	UA24	CP	CP	CP	
	UA25	CP	CP	CP	
	UA26	CP	CP	CP	
	UA28	CP	CP	CP	
MADEP	0907 A Hull	NA(CP)	WB	WB	
	0907 B Hull	NA(CP)	WB	WB	
	1019 Lynnf	NA(CP)	NA(CP)	NA(CP)	
	11707 Quincy	NA(CP)	NA(CP)	NA(CP)	
	12092 B Marble	CP	CP	CP	
	1525 A Marble	NA(CP)	NA(CP)	NA(FN)	Trichloroethylene
	1525 B Marble	NA(CP)	NA(CP)	NA(FN)	Trichloroethylene
	2797 A Tewks	NA(CP)	NA(CP)	NA(CP)	
	2797 B Tewks	NA(CP)	NA(CP)	NA(CP)	
Mountain View	Residence 1	CP	CP	CP	
	Residence 2	CP	CP	CP	
	Residence 3	CP	CP	CP	
	Residence 4	CP	CP	CP	
	Residence 6	CP	CP	CP	
	Residence 7	CP	CP	CP	
	Residence 8	CP	CP	CP	
Uncasville	Residence A	NA(CP)	NA(CP)	NA(CP)	
	Residence B	NA(CP)	NA(CP)	NA(CP)	
	Residence D	NA(FN)	NA(FN)	NA(FN)	Tetrachloroethylene
	Residence E	NA(CP)	NA(CP)	NA(CP)	

Key:
CP=Correct Positive; CN = Correct Negative
FP=False Positive; FN=False Negative
NA=Not applicable due to precluding factor--depth from foundation to groundwater contamination is less than 1.5 m.
WB=Wet Basement. This condition precludes the use of Figure 3 (for Q5) and the use of the Johnson and Ettinger Model.

Notes:
[1] Site data was compared to indoor air and groundwater screening values in Table 2.
[2] Site data was compared to indoor air and groundwater screening values in Table 3. The appropriate attentuation factor in this analysis was obtained from Figure 3.
[3] Site specific soil type, depth to groundwater, and building foundation type were used in the Johnson and Ettinger (J&E) model.
[4] When false positive or false negative outcomes resulted with both Q4 and Q5, the same compounds were responsible for the false outcome in each scenario.

Table F-5 (continued)
Summary Table
False Negative and False Positive Indoor Air Predictions Based on Comparison of Groundwater Concentrations to Target Levels, by Building at Each Site
$R=1x10^{-6}$

	Q4		Q5		J&E Site Specific	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Total CP and CN	34	100.0%	34	100.0%	34	100.0%
Total FP	0	0.0%	0	0.0%	0	0.0%
Total FN	0	0.0%	0	0.0%	0	0.0%
Total NA and WB	16	--	16	--	16	--
Total Number of Buildings	34		34		34	

Key:
CP=Correct Positive; CN = Correct Negative
FP=False Positive; FN=False Negative
NA=Not applicable due to precluding factor--depth from foundation to groundwater contamination is less than 1.5 m.
WB=Wet Basement. This condition precludes the use of Figure 3 (for Q5) and the use of the Johnson and Ettinger Model.
Notes:
[1] Site data was compared to indoor air and groundwater screening values in Table 2.
[2] Site data was compared to indoor air and groundwater screening values in Table 3. The appropriate attentuation factor in this analysis was obtained from Figure 3.
[3] Site specific soil type, depth to groundwater, and building foundation type were used in the Johnson and Ettinger (J&E) model.
[4] When false positive or false negative outcomes resulted with both Q4 and Q5, the same compounds were responsible for the false outcome in each scenario.

Table F-6
Frequency of False Negative and False Positive Indoor Air Predictions Based on Comparison of Ground Water Concentrations to Target Levels, by Chemical[1]
Risk = $1x10^{-6}$

	Location	Benzene*			1,1- Dichloroethane			1,2-Dichloroethane*			1,1-Dichloroethylene			cis-1,2-Dichloroethylene [2]			trans-1,2-Dichloroethylene [2]		
		Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN
VI Q4 [3]	Alliant	--	--	--	--	--	--	0	0	0	0	0	0	0	0	0	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	--	--	--
	LAFB	--	--	--	13	0	0	13	0	13	13	0	0	13	0	0	13	0	0
	Uncasville	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hamilton-Sunstrand	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--
	MADEP	1	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total	**1**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**13**	**26**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**
VI Q5 [4]	Alliant	--	--	--	--	--	--	0	0	0	0	0	0	0	0	0	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	--	--	--
	LAFB	--	--	--	13	0	0	13	0	13	13	0	0	13	0	0	13	0	0
	Uncasville	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hamilton-Sunstrand	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--
	MADEP	1	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total	**1**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**13**	**26**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**
JE Site Specific [5]	Alliant	--	--	--	--	--	--	0	0	0	0	0	0	0	0	0	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	--	--	--
	LAFB	--	--	--	13	0	0	13	0	13	13	0	0	13	0	0	13	0	0
	Uncasville	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hamilton-Sunstrand	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--
	MADEP	1	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total	**1**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**13**	**26**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**

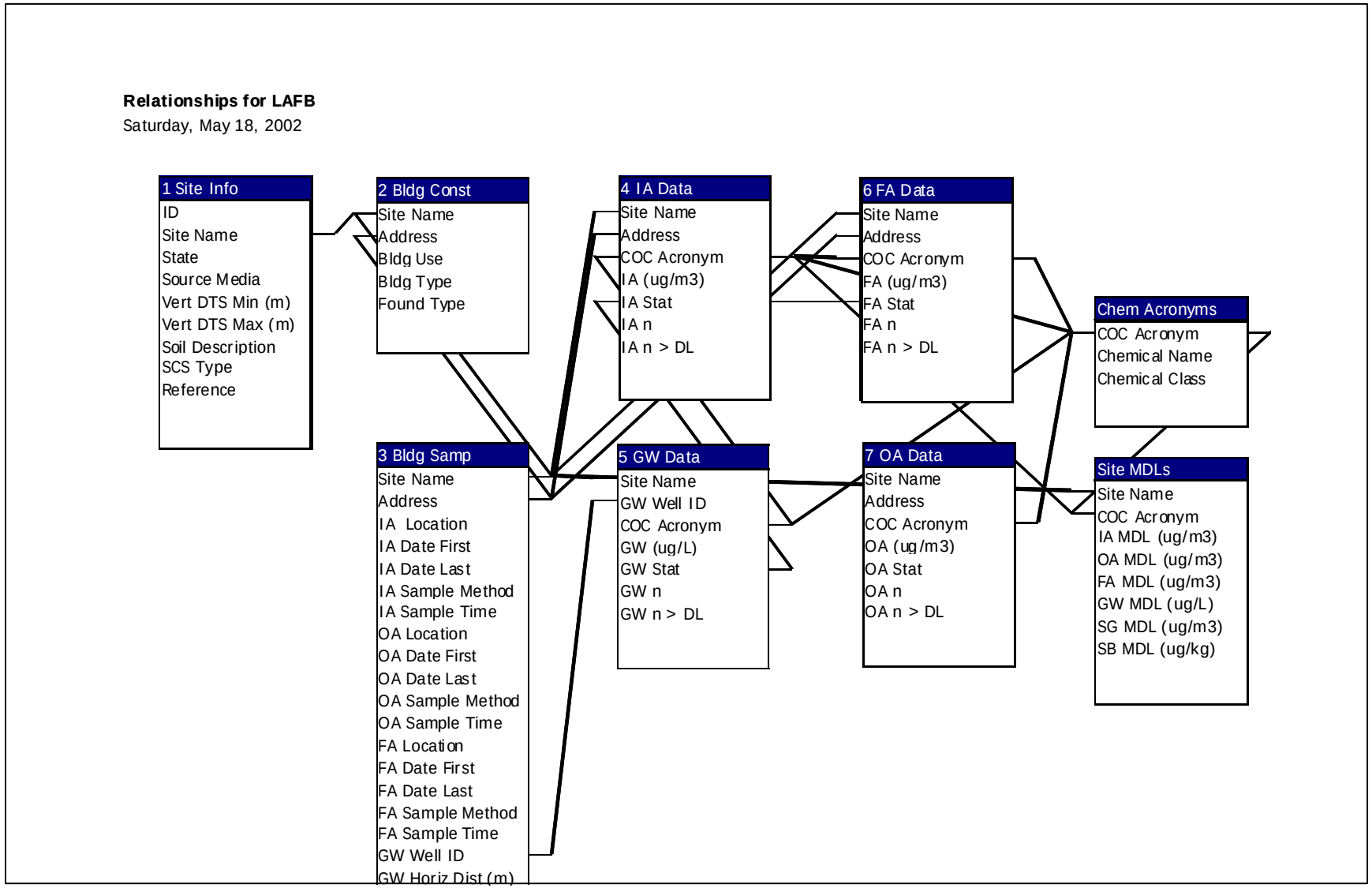
Table F-6 (continued)
Frequency of False Negative and False Positive Indoor Air Predictions Based on Comparison of Ground Water Concentrations to Target Levels, by Chemical [1]
Risk = $1x10^{-6}$

	Location	Ethylbenzene*			Tetrachloroethylene*			Toluene			1,1,1-Trichloroethane			1,1,2-Trichloroethane*			Trichloroethylene*			Vinyl chloride*			Xylene [2]		
		Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN	Samples	FP	FN
VI Q4 [3]	Alliant	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	0	0	0	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0	--	--	--
	LAFB	--	--	--	13	--	13	--	--	--	13	0	0	13	0	1	13	0	0	9	0	1	--	--	--
	Uncasville	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	--
	Hamilton-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--
	MADEP	1	0	1	--	--	--	1	0	0	--	--	--	--	--	--	0	0	0	--	--	--	1	0	0
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	0	0	--	--	--	--	--	--
	Total	1	0	1	13	0	13	1	0	0	13	0	0	13	0	1	33	0	0	9	0	1	1	0	0
VI Q5 [4]	Alliant	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	0	0	0	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0	--	--	--
	LAFB	--	--	--	13	--	13	--	--	--	13	0	0	13	0	1	13	0	0	9	0	1	--	--	--
	Uncasville	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	--
	Hamilton-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--
	MADEP	1	0	1	--	--	--	1	0	0	--	--	--	--	--	--	0	0	0	--	--	--	1	0	1
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	0	0	--	--	--	--	--	--
	Total	1	0	1	13	0	13	1	0	0	13	0	0	13	0	1	33	0	0	9	0	1	1	0	0
JE Site Specific [5]	Alliant	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	0	0	0	--	--	--
	Eau Claire	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	0	0	0	0	0	--	--	--
	LAFB	--	--	--	13	--	13	--	--	--	13	0	0	13	0	1	13	0	0	9	0	1	--	--	--
	Uncasville	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	--
	Hamilton-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	0	0	--	--	--	--	--	--
	MADEP	1	0	0	--	--	--	1	0	0	--	--	--	--	--	--	0	0	0	--	--	--	1	0	0
	Mountain View	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	0	0	--	--	--	--	--	--
	Total	1	0	0	13	0	13	1	0	0	13	0	0	13	0	1	33	0	0	9	0	1	1	0	0

Key:
FP=False Positive; FN=False Negative

Notes:
[1] For each chemical we indicate the total number of samples at each site for each chemical and the number of samples with False Positive or False Negative results at that site across all buildings. "--" means the chemical was not found at any building at that site.
[2] Toxicity values extrapolated from oral studies were used to develop screening levels for this chemical.
[3] Site data was compared to indoor air and ground water screening values in Table 2.
[4] Site data was compared to indoor air and ground water screening values in Table 3.
[5] Site specific soil type, depth to groundwater, and building foundation type were used in the J&E model.
* Ground water target concentration for this compound is based on the Maximum Contaminant Level (MCL) in drinking water.

Figure F-1. Schematic Diagram of Empirical Database Structure and Element



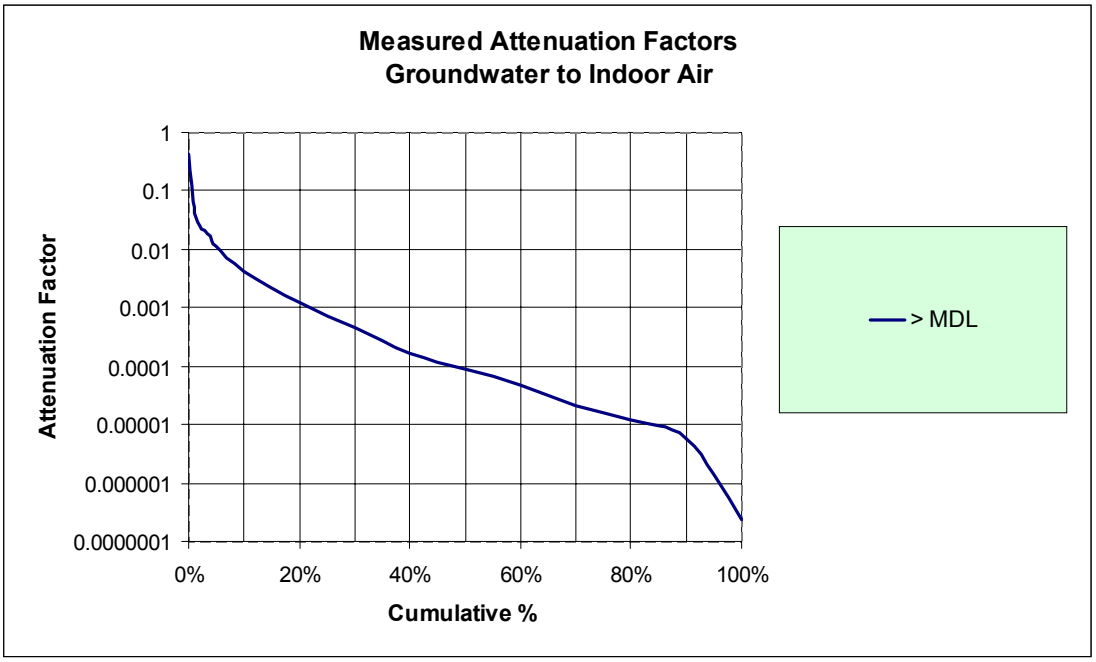


Figure F-2. Distribution of groundwater-to-indoor air attenuation factors for all residences in the empirical database with indoor air and groundwater measurements above their respective method detection limits (MDLs).

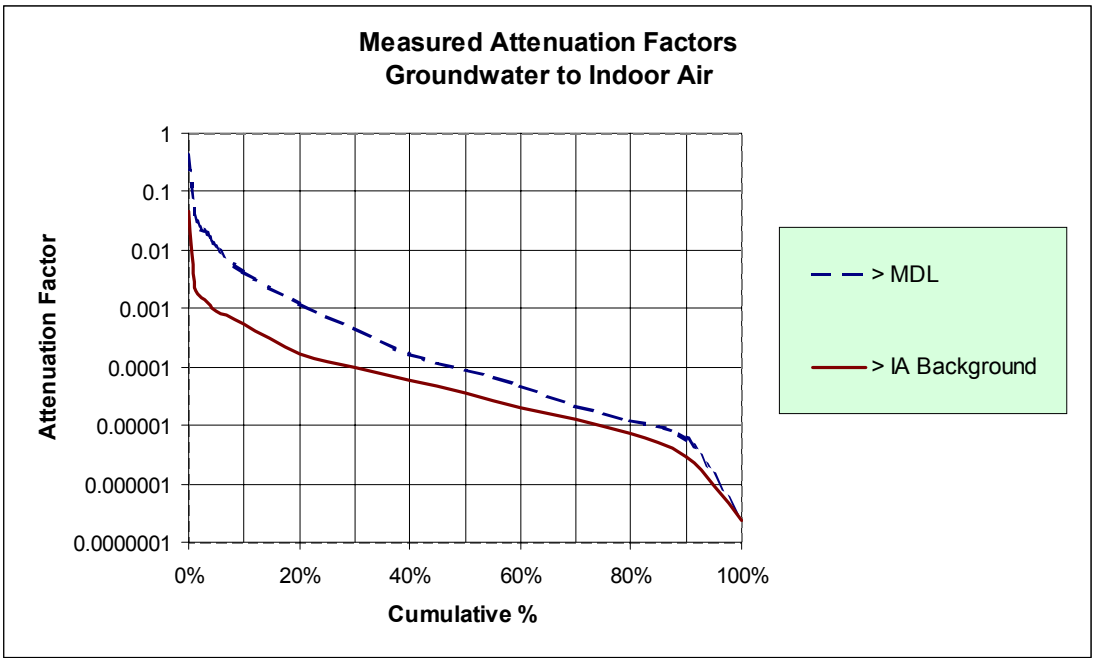


Figure F-3. Distribution of groundwater-to-indoor air attenuation factors for residences with concentrations above MDLs and above typical background levels.

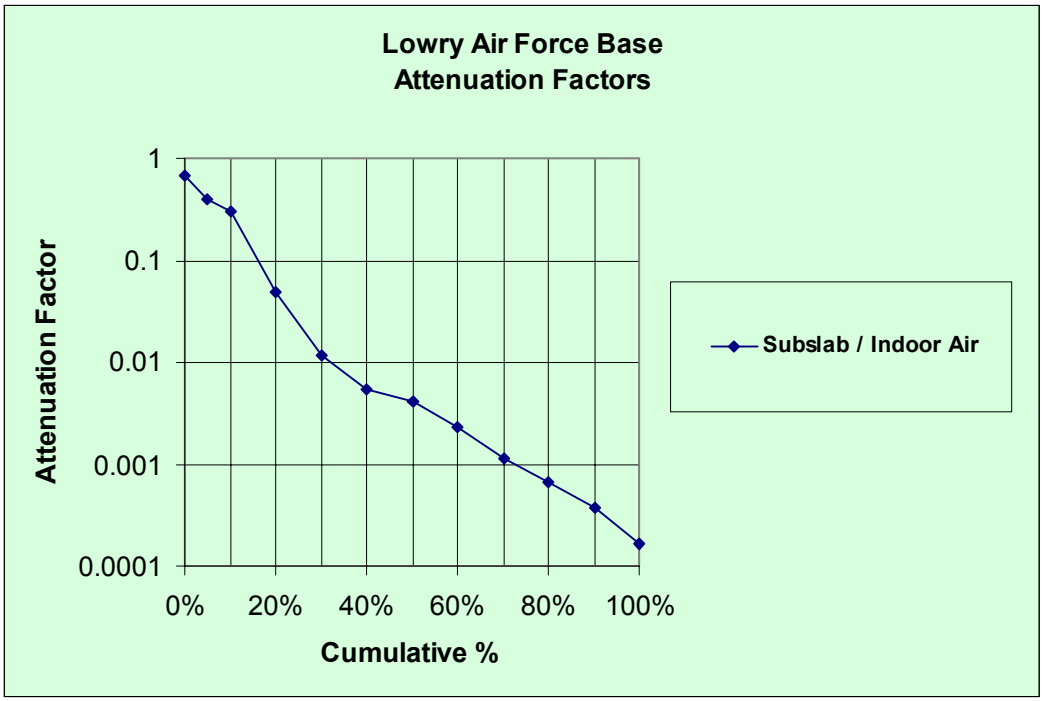


Figure F-4. Distribution of subslab-to-indoor air attenuation factors for residences for the subset of residences with indoor concentrations greater than the subslab concentrations measured below the residence's foundation. Subslab data were available for only one site—the Lowry Air Force Base in Colorado.

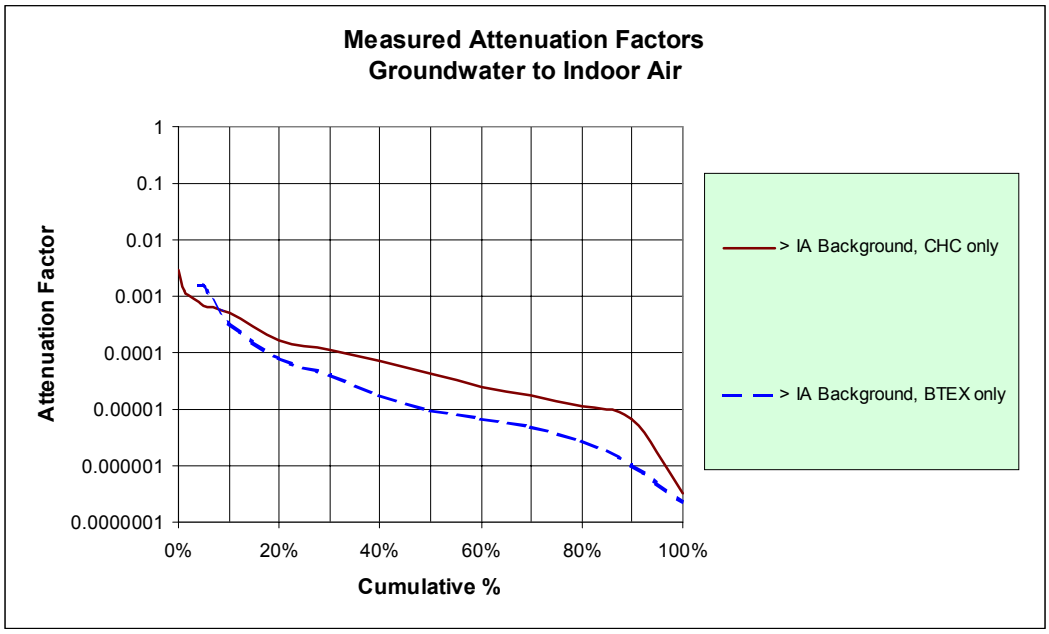


Figure F-5. Comparison of groundwater-to-indoor air attenuation factors for BTEX and chlorinated hydrocarbons (CHC).

APPENDIX G

CONSIDERATIONS FOR THE USE OF THE JOHNSON AND ETTINGER VAPOR INTRUSION MODEL

1. Introduction

At sites where soils or groundwater contain volatile or semi-volatile chemicals of concern, there is the potential for chemical vapors to migrate from the subsurface into indoor air spaces. Assessment of this potential indoor inhalation exposure pathway requires an understanding of the processes influencing vapor transport in the vadose zone and into buildings.

Johnson and Ettinger (1991) introduced a screening-level model for estimating the transport of contaminant vapors from a subsurface source into indoor air spaces. The model is a one-dimensional analytical solution to diffusive and convective transport of vapors formulated as an attenuation factor that relates the vapor concentration in the indoor space to the vapor concentration at the source. To facilitate use of the Johnson-Ettinger Model (JEM), EPA in 1997 developed spreadsheet versions of the model that calculate indoor air concentrations and associated health risks. A total of six spreadsheets were developed: a first tier and a more advanced version for each potential vapor source—groundwater, bulk soil, and soil gas. The spreadsheets were later updated in 2000 and 2002. The current spreadsheets may be downloaded from the web site:

http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm

This appendix addresses the assumptions and limitations that we recommend be considered when the Johnson and Ettinger model as implemented by EPA is employed in the evaluation of the vapor intrusion pathway. This appendix also provides guidance for the model's use both as a first-tier screening level tool to identify sites needing further assessment and as a site-specific tool to estimate indoor air impacts resulting from vapor intrusion.

2. Assumptions and Limitations of the Johnson and Ettinger Model

The Johnson-Ettinger Model (JEM) was developed for use as a screening level model and, consequently, is based on a number of simplifying assumptions regarding contaminant distribution and occurrence, subsurface characteristics, transport mechanisms, and building construction. The assumptions of the JEM as implemented in EPA's spreadsheet version are listed in Table G-1 along with the implications of and limitations posed by the assumptions. Also provided in the table is an assessment of the likelihood that the assumptions can be verified through field evaluation. The JEM assumptions are typical of most simplified models of subsurface contaminant transport with the addition of a few assumptions regarding vapor flux into buildings.

The JEM as implemented by EPA assumes the subsurface is characterized by homogeneous soil layers with isotropic properties. The first tier spreadsheet versions accommodate only one layer; the advanced spreadsheet versions accommodate up to three layers. Sources of contaminants that can be modeled include dissolved, sorbed, or vapor sources where the concentrations are below the aqueous solubility limit, the soil saturation concentration, and/or the pure component vapor concentration. The contaminants are assumed to be homogeneously distributed at the source. All but one of the spreadsheets assumes an infinite source. The exception is the advanced model for a bulk soil source, which allows for a finite source. For the groundwater and bulk soil models, the vapor concentration at the source is calculated assuming equilibrium partitioning. Vapor from the source is assumed to diffuse directly upward (one-dimensional transport) through uncontaminated soil (including an uncontaminated capillary fringe if groundwater is the vapor source) to the base of a building foundation, where convection carries the vapor through cracks and openings in the foundation into the building. Both diffusive and convective transport processes are assumed to be at steady state. Neither sorption nor biodegradation is accounted for in the transport of vapor from source to the base of the building.

The assumptions described above and in Table G-1 suggest a number of conditions that under most scenarios would preclude the application of the JE model as implemented by EPA. These include:

- The presence or suspected presence of residual or free-product nonaqueous phase liquids (LNAPL, DNAPL, fuels, solvents, etc) in the subsurface.
- The presence of heterogeneous geologic materials (other than the three layers in the advanced spreadsheets) between the vapor source and building. The JE model does not apply to geologic materials that are fractured, contain macropores or other preferential pathways, or are composed of karst.
- Sites where significant lateral flow of vapors occurs. These can include geologic layers that deflect contaminants from a strictly upward motion and buried pipelines or conduits that form preferential paths. Permeability contrasts between layers greater than 1000 times also are likely to cause lateral flow of vapors. The model assumes the source of contaminants is directly below the potential receptors.
- Very shallow groundwater where the building foundation is wetted by the groundwater.
- Very small building air exchange rates (e.g., <0.25/hr)
- Buildings with crawlspace structures or other significant openings to the subsurface (e.g., earthen floors, stone buildings, etc.). The EPA spreadsheet only accommodates either slab on grade or basement construction.
- Contaminated groundwater sites with large fluctuations in the water table elevation. In these cases, the capillary fringe is likely to be contaminated, whereas in the groundwater source spreadsheets, the capillary fringe is assumed to be uncontaminated.
- Sites with transient (time-varying) flow rates and/or concentrations and for which a steady state assumption is not conservative.

In theory, the above limitations are readily conceptualized, but in practice the presence of these limiting conditions may be difficult to verify even when extensive site characterization data are available. Conditions that are particularly difficult to verify in the field include the presence of residual NAPLs in the unsaturated zone and the presence and influence of macropores, fractures and other preferential pathways in the subsurface. Additionally, in the initial stages of evaluation, especially at the screening level, information about building construction and water table fluctuations may not be available. Even the conceptually simple assumptions (e.g., one-dimensional flow, lack of preferential pathways) may be difficult to assess when there are limited site data available.

3. Guidance for Application of the JEM as a First-Tier Screening Level Tool

Use of the JEM as a first-tier screening tool to identify sites needing further assessment necessitates careful evaluation of the assumptions listed in the previous section to determine whether any conditions exist that would render the JEM inappropriate for the site. If the model is deemed applicable at the site, we recommend that care be taken to ensure reasonably conservative and self-consistent model parameters are used as input to the model. Considering the limited site data typically available in preliminary site assessments, the JEM can be expected to predict only whether or not a risk-based exposure level will be exceeded at the site. Precise prediction of concentration levels is not possible with this approach.

The suggested minimum site characterization information for a first-tier evaluation of the vapor intrusion pathway includes: site conceptual model, nature and extent of contamination distribution, soil lithologic descriptions, groundwater concentrations and/or possibly near source soil vapor concentrations. The number of samples and measurements needed to establish this information varies by site, and it is not possible to provide a hard and fast rule. We do not recommend use of bulk soil concentrations unless appropriately preserved during sampling.

Based on the conceptual site model, the user can select the appropriate spreadsheet corresponding to the vapor source at the site and determine whether to use the screening level spreadsheet (which accommodates only one soil type above the capillary fringe) or the more advanced version (which allows up to three layers above the capillary fringe). As most of the inputs to the JEM are not collected during a typical site characterization, conservative inputs are typically estimated or inferred from available data and other non-site-specific sources of information.

The uncertainty in determining key model parameters and sensitivity of the JEM to those key model parameters is qualitatively described in Table G-2. As shown in the table, building-related parameters with moderate to high uncertainty and model sensitivity include: Qsoil, building crack ratio, building air-exchange rate, and building mixing height. Building related parameters with low uncertainty and sensitivity include: foundation area, depth to base of foundation, and foundation slab thickness. Of the soil-dependent properties, the soil moisture parameters clearly are of critical importance for the attenuation value calculations.

A list of generally reasonable conservative model input parameters for building-related parameters is provided in Table G-3, which also provides the practical range, typical or mean

value (if applicable), and most conservative value for these parameters. For building parameters with low uncertainty and sensitivity, only a single "fixed" value corresponding to the mean or typical value is provided in Table G-3. Soil-dependent properties are provided in Table G-4 for soils classified according to the US SCS system. If site soils are not classified according to the US SCS, Table G-5 can be used to assist in selecting an appropriate SCS soil type corresponding to the available site lithologic information. Note that the selection of the soil texture class should be biased towards the coarsest soil type of significance, as determined by the site characterization program.

The recommended values provided in Tables G-3 and G-4 were used in the advanced versions of the JEM spreadsheet to develop the graphs of attenuation factors provided in Question 5 of this draft guidance. These input parameters were developed considering soil-physics science, available studies of building characteristics, and expert opinion. Consequently, the input parameters listed in Tables G-3 and G-4 are considered default parameters for a first-tier assessment, which should in most cases provide a reasonably (but not overly) conservative estimate of the vapor intrusion attenuation factor for a site. Justification for the building-related and soil-dependent parameter values selected as default values for the JEM is described below.

3.1. Justification of Default Soil-Dependent Properties

The default soil-dependent parameters recommended for a first tier assessment (Table G-4) represent mean or typical values, rather than the most conservative value, in order to avoid overly conservative estimates of attenuation factors. Note, however, that the range of values for some soil properties can be very large, particularly in the case of moisture content and hydraulic conductivity. Consequently, selecting a soil type and corresponding typical soil property value may not accurately or conservatively represent a given site. Also, Table G-4 does not provide estimates of soil properties for very coarse soil types, such as gravel, gravelly sand, and sandy gravel, etc, which also may be present in the vadose zone. Consequently, in cases where the vadose zone is characterized by very coarse materials, the JEM may not provide a conservative estimate of attenuation factor.

As discussed above, the JEM is sensitive to the value of soil moisture content. Unfortunately, there is little information available on measured moisture contents below buildings; therefore, the typical approach is to use a water retention model (e.g., van Genuchten model) to approximate moisture contents. For the unsaturated zone, the selected default value for soil moisture is a value equal to half-way between the residual saturation value and field capacity, using the van Genuchten model-predicted values for U.S. SCS soil types. For the capillary transition zone, a moisture content corresponding to the air entry pressure head is calculated using the van Genuchten model. When compared to other available water retention models, the van Genuchten model yields somewhat lower water contents, which results in more conservative estimates of attenuation factor. However, the soil moisture contents listed in Table G-4 are based on agricultural samples, which are likely to have higher water contents than soils below building foundations and, consequently, result in less conservative estimates of attenuation factor.

3.2. Justification of Default Building-Related Properties

Building Air Exchange Rate (Default Value = 0.25 hr^{-1})

Results from 22 studies for which building air exchange data are available are summarized in Hers et al. (2001). There is a wide variation in ventilation rates ranging from about 0.1 air exchanges per hour (AEH) for energy efficient "air-tight" houses (built in cold climates) (Fellin and Otson, 1996) to over 2 AEH (AHRAE (1985); upper range). In general, ventilation rates will be higher in summer months when natural ventilation rates are highest. One of the most comprehensive studies of U.S. residential air exchange rates (sample size of 2844 houses) was conducted by Murray and Burmaster (1995). The data set was analyzed on a seasonal basis, and according to climatic region. When all the data was analyzed, the 10th, 50th and 90th percentile values were 0.21, 0.51 and 1.48 AEH. Air exchange rates varied depending on season and climatic region. For example, for the winter season and coldest climatic area (Region 1, Great Lakes area and extreme northeast US), the 10th, 50th and 90th percentile values were 0.11, 0.27 and 0.71 AEH. In contrast, for the winter season and warmest climatic area (Region 4, southern CA, TX, Florida, Georgia), the 10th, 50th and 90th percentile values were 0.24, 0.48 and 1.13 AEH. While building air exchange rates would be higher during the summer months, vapor intrusion during winter months (when house depressurization is expected to be most significant) would be of greatest concern. For this draft guidance, a default value of 0.25 for air exchange rate was selected to represent the lower end of these distributions.

Crack Width and Crack Ratio (Default Value = 0.0002 for basement house; = 0.0038 for slab-on-grade house)

The crack width and crack ratio are related. Assuming a square house and that the only crack is a continuous edge crack between the foundation slab and wall ("perimeter crack"), the crack ratio and crack width are related as follows:

$$\text{Crack Ratio} = \frac{4\,(\text{Crack Width})\sqrt{S\text{ubsurface Foundation Area}}}{S\text{ubsurface Foundation Area}}$$

Crack Ratio = Crack Width x 4 x (Subsurface Foundation Area)^0.5/Subsurface Foundation Area

There is little information available on crack width or crack ratio. One approach used by radon researchers is to back calculate crack ratios using a model for soil gas flow through cracks and the results of measured soil gas flow rates into a building. For example, the back-calculated values for a slab/wall edge crack based on soil gas-entry rates reported in Nazaroff (1992), Revzan *et al.* (1991) and Nazaroff *et al.* (1985) range from about 0.0001 to 0.001. Another possible approach is to measure crack openings although this, in practice, is difficult to do. Figley and Snodgrass (1992) present data from ten houses where edge crack measurements were made. At the eight houses where cracks were observed, the cracks widths ranged from hairline

cracks up to 5 mm wide, while the total crack length per house ranged from 2.5 m to 17.3 m. Most crack widths were less than 1 mm. The suggested defaults for crack ratio in regulatory guidance, literature and models also vary. In ASTM E1739-95, a default crack ratio of 0.01 is used. The crack ratios suggested in the VOLASOIL model (developed by the Dutch Ministry of Environment) range from 0.0001 to 0.000001. The VOLASOIL model values correspond to values for a "good" and "bad" foundation, respectively. The crack ratio used by Johnson and Ettinger (1991) for illustrative purposes ranged from 0.001 to 0.01. The selected default values fall within the ranges observed.

Building Area and Subsurface Foundation Area (Default Value = 10 m by 10 m)

The default building area is based on the following information:

- default values used in the Superfund User's Guide **(9.61 m by 9.61 m or 92.4 m^2)**, and
- default values used by the State of Michigan, as documented in Part 201, Generic Groundwater and Soil Volatilization to Indoor Air Inhalation Criteria: Technical Support Document (**10.5 m by 10.5 m of 111.5 m^2**).

The Michigan guidance document indicates that the 111.5 m^2 area approximately corresponds to the 10th percentile floor space area for residential single family dwellings, based on statistics compiled by the U.S. DOC and U.S. HUD. The typical, upper and lower ranges presented in Table G-3 are subjectively chosen values. The subsurface foundation area is a function of the building area, and depth to the base of the foundation, which is fixed.

Building Mixing Height (Default Value = 2.44 m for slab-on-grade scenario; = 3.66 m for basement scenario)

The JEM assumes that subsurface volatiles migrating into the building are completely mixed within the building volume, which is determined by the building area and mixing height. The building mixing height will depend on a number of factors including the building height, the heating, ventilation and air conditioning (HVAC) system operation, environmental factors such as indoor-outdoor pressure differentials and wind loading, and seasonal factors. For a single-story house, the variation in mixing height can be approximated by the room height. For a multi-story house or apartment building, the mixing height will be greatest for houses with HVAC systems that result in significant air circulation (e.g., forced-air heating systems). Mixing heights would likely be less for houses with electrical baseboard heaters. It is likely that mixing height is, to some degree, correlated to the building air exchange rate.

There are little data available that provide for direct inference of mixing height. There are few sites, with a small number of houses where indoor air concentrations were above background, and where both measurements at ground level and the second floor were made (CDOT, Redfields, Eau Claire). Persons familiar with the data sets for these sites indicate that in most cases a fairly significant reduction in concentrations (factor of two or greater) was observed,

although at one site (Eau Claire, "S" residence), the indoor TCE concentrations were similar in both the basement and second floor of the house. For the CDOT site apartments, there was an approximate five-fold reduction between the concentrations measured for the first floor and second floor units (Mr. Jeff Kurtz, EMSI, personal communication, June 2002). Less mixing would be expected for an apartment since there are less cross-floor connections than for a house. The value chosen for a basement house scenario (3.66 m) would be representative of a two-fold reduction or attenuation in vapor concentrations between floors.

Qsoil (Default Value = 5 L/min)

The method often used with the JEM for estimating the soil gas advection rate (Q_{soil}) through the building envelope is an analytical solution for two-dimensional soil gas flow to a small horizontal drain (Nazaroff 1992) ("Perimeter Crack Model"). Use of this model can be problematic in that Q_{soil} values are sensitive to soil-air permeability and consequently a wide range in flows can be predicted.

An alternate empirical approach is to select a Q_{soil} value on the basis of tracer tests (i.e., mass balance approach). When soil gas advection is the primary mechanism for tracer intrusion into a building, we recommend the Q_{soil} be estimated by measuring the concentrations of a chemical tracer in indoor air, outdoor air and in soil vapor below a building, and measuring the building ventilation rate (Hers et al. 2000a; Fischer et al. 1996; Garbesi et al. 1993; Rezvan et al. 1991; Garbesi and Sextro, 1989). The Q_{soil} values measured using this technique are compared to predicted rates using the Perimeter Crack model, for sites with coarse-grained soils. The Perimeter Crack model predictions are both higher and lower than the measured values, but overall are within one order of magnitude of the measured values. Although the Q_{soil} predicted by models and measured using field tracer tests are uncertain, the results suggest that a "typical" range for houses on coarse-grained soils is on the order of 1 to 10 L/min. A disadvantage with the tracer test approach is that there are only limited data, and there do not appear to be any tracer studies for field sites with fine-grained soils.

It is also important to recognize that the advective zone of influence for soil gas flow is limited to soil immediately adjacent to the building foundation. There is some data on pressure coupling that provides insight on the extent of the advective flow zone. For example, Garbesi *et al.* (1993) report a pressure coupling between soil and experimental basement (i.e., relative to that between the basement and atmosphere) equal to 96 % directly below the slab, between 29 % and 44 % at 1 m below the basement floor slab, and between 0.7 % and 27 % at a horizontal distance of 2 m from the basement wall. At the Chatterton site in Canada, the pressure coupling immediately below the building floor slab ranged from 90 % to 95 % and at a depth of 0.5 m was on the order of 50 %. These results indicate that the advective zone of influence will likely be limited to a zone within 1 m to 2 m of the building foundation.

Since the advective flow zone is relatively limited in extent, the soil type adjacent to the building foundation is of importance. In many cases, coarse-grained imported fill is placed below foundations, and either coarse-grained fill, or disturbed, loose fill is placed adjacent to the

foundation walls. Therefore, a conservative approach for the purposes of this draft guidance is to assume that soil gas flow will be controlled by coarse-grained soil, and not to rely on the possible reduction in flow that would be caused by fine-grained soils near the house foundation. For these reasons, a soil gas flow rate of 5 L/min (midpoint between 1 and 10 L/min) was chosen as the input value.

4. Guidance for Application of JEM as a Site-Specific Tool

We generally recommend use of the JE model as a site-specific tool only where the site conceptual model matches the restrictive assumptions. When these assumptions cannot be met, we recommend that other models or direct measurement be substituted, because there is no *a priori* scientific reason to believe that the model is adequate to represent complex site conditions. If the JE model is deemed applicable to the site, critical model parameters from site data are needed. We recommend that site-specific information include soil moisture, soil permeability, building ventilation rate, and subslab as well as deep vapor concentrations.

In order to ensure the model can reproduce observed field observations, we recommend the model output be compared with measured concentrations, fluxes and/or other model outputs. Calibration has been developed as a process for minimizing the differences between model results and field observations. Through model calibration a parameter set is selected that causes the model to best fit the observed data. When done properly, this process establishes that the conceptualization and input parameters are appropriate for the site. Because of the number of parameters to be identified, calibration is known to produce non-unique results. This is particularly the case in heterogeneous environments where every parameter of the model can vary from point to point. Confidence in the model, however, is increased by using the calibrated model to predict the response to some additional concentration or flux data (i.e., that were not previously used in calibration). At each step in this process, additional site investigation data improve knowledge of the behavior of the system.

From a regulatory standpoint, the JE model when used as a site-specific tool typically should be calibrated to predict within an order of magnitude the indoor air concentrations resulting from intrusion of vapors from the subsurface. Consequently, prior to its use, we recommend an evaluation of the critical input parameters be performed. If the uncertainty in the critical parameters cannot be reduced to yield an order of magnitude estimate of indoor air concentrations, it may not be practical to perform the modeling.

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Table G-1. Assumptions and Limitations of the Johnson and Ettinger Vapor Intrusion Model

Assumption	Implication	Field Evaluation
Contaminant		
No contaminant free-liquid/precipitate phase present	JEM not representative of NAPL partitioning from source	NAPL presence–easier to evaluate for floating product or soil contamination sites. Most DNAPL sites with DNAPL below the water table defy easy characterization.
Contaminant is homogeneously distributed within the zone of contamination		
No contaminant sources or sinks in the building.	Indoor sources of contaminants and/or sorption of vapors on materials may confound interpretation of results.	Survey building for sources, assessment of sinks unlikely
Equilibrium partitioning at contaminant source.	Groundwater flow rates are low enough so that there are no mass transfer limitations at the source.	Not likely
Chemical or biological transformations are not significant (model will predict more intrusion)	Tendency to overpredict vapor intrusion for degradable compounds	From literature
Subsurface Characteristics		
Soil is homogeneous within any horizontal plane	Stratigraphy can be described by horizontal layers (not tilted layers)	Observe pattern of layers and unconformities. Note: In simplified JEM layering is not considered
All soil properties in any horizontal plane are homogeneous		
The top of the capillary fringe must be below the bottom of the building floor in contact with the soil.		
EPA version of JE Model assumes the capillary fringe is uncontaminated.		
Transport Mechanisms		
One-dimensional transport	Source is directly below building, stratigraphy does not influence flow direction, no effect of two- or three-dimensional flow patterns.	Observe location of source, observe stratigraphy, pipeline conduits, not likely to assess two- and three-dimensional pattern.
Two separate flow zones, one diffusive one convective.	No diffusion (disperson) in the convective flow zone. Plug flow in convective zone	Not likely
Vapor-phase diffusion is the dominant mechanism for transporting contaminant vapors from contaminant sources located away from the foundation to the soil region near the foundation	Neglects atmospheric pressure variation effects, others?	Not likely

Straight-line gradient in diffusive flow zone.	Inaccuracy in flux estimate at match point between diffusive and convective sections of the model.	Not likely
Diffusion through soil moisture will be insignificant (except for compounds with very low Henry's Law Constant	Transport through air phase only. Good for volatiles. Only low volatility compounds would fail this and they are probably not the compounds of concern for vapor intrusion	From literature value of Henry's Law Constant.
Convective transport is likely to be most significant in the region very close to a basement, or a foundation, and vapor velocities decrease rapidly with increasing distance from a structure		Not likely
Vapor flow described by Darcy's law	Porous media flow assumption.	Observations of fractured rock, fractured clay, karst, macropores, preferential flow channels.
Steady State convection	Flow not affected by barometric pressure, infiltration, etc.	Not likely
Uniform convective flow near the foundation	Flow rate does not vary by location	Not likely
Uniform convective velocity through crack or porous medium	No variation within cracks and openings and constant pressure field between interior spaces and the soil surface	Not likely
Significant convective transport only occurs in the vapor phase	Movement of soil water not included in vapor impact	Not likely
All contaminant vapors originating from directly below the basement will enter the basement, unless the floor and walls are perfect vapor barriers. (Makes model over est. vapors as none can flow around the building)	Model does not allow vapors to flow around the structure and not enter the building	Not likely
Contaminant vapors enter structures primarily through cracks and openings in the walls and foundation	Flow through the wall and foundation material itself neglected	Observe numbers of cracks and openings. Assessment of contribution from construction materials themselves not likely

Table G-2. Uncertainty and Sensitivity of Key Parameters for the Johnson & Ettinger Model.

Input Parameter	Parameter Uncertainty or Variability Variability	Parameter Sensitivity: Shallower Contamination Building Underpressurized	Deeper Contamination Building Underpressurized	Shallower Contamination Building Not Underpressurized	Deeper Contamination Building Not Underpressurized
Total Porosity	Low	Low	Low	Low	Low
Unsaturated Zone Water-filled Porosity	Moderate to High	Low to Moderate	Moderate to High	Moderate to High	Moderate to High
Capillary Transition Zone Water-filled Porosity	Moderate to High	Moderate to High	Moderate to High	Moderate to High	Moderate to High
Capillary Transition Zone Height	Moderate to High	Moderate to High	Moderate to High	Moderate to High	Moderate to High
Soil Bulk Density	Low	Low	Low	Low	Low
Qsoil	High	Moderate to High	Low to Moderate	N/A	N/A
Soil air permeability	High	Moderate to High	Low to Moderate	N/A	N/A
Building Depressurization	Moderate	Moderate	Low to Moderate	N/A	N/A
Henry's Law Constant (for single chemical)	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate
Free-Air Diffusion Coefficient (single chemical)	Low	Low	Low	Low	Low
Building Air Exchange Rate	Moderate	Moderate	Moderate	Moderate	Moderate
Building Mixing Height	Moderate	Moderate	Moderate	Moderate	Moderate
Subsurface Foundation Area	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate
Depth to Base of Foundation	Low	Low	Low	Low	Low
Building Crack Ratio	High	Low	Low	Moderate to High	Low to Moderate
Crack Moisture Content	High	Low	Low	Moderate to High	Low to Moderate
Building Foundation Slab Thickness	Low	Low	Low	Low	Low

Table G-3. Building-Related Parameters for the Johnson & Ettinger Model - First Tier Assessment.

Input Parameter	Units	Typical or Mean Value	Range	Conservative Value	Modeled
Total Porosity	cm^3/cm^3	********** Specific to soil texture, see Table G-4 **********			
Unsaturated Zone Water-filled Porosity	cm^3/cm^3	********** Specific to soil texture, see Table G-4 **********			
Capillary Transition Zone Water-filled Porosity	cm^3/cm^3	********** Specific to soil texture, see Table G-4 **********			
Capillary Transition Zone Height	cm^3/cm^3	********** Specific to soil texture, see Table G-4 **********			
Qsoil[1]	L/min	5	1-10	10	5
Soil air permeability	m^2	********** Specific to soil texture, see Table G-4 **********			
Building Depressurization	Pa	4	0-15	15	N/A
Henry's Law Constant (for single chemical)	-	********** Specific to chemical **********			
Free-Air Diffusion Coefficient (single chemical)	-	********** Specific to chemical **********			
Building Air Exchange Rate	hr^{-1}	0.5	0.1-1.5	0.1	0.25
Building Mixing Height - Basement scenario	m	3.66	2.44-4.88	2.44	3.66
Building Mixing Height - Slab-on-grade scenario	m	2.44	2.13-3.05	2.13	2.44
Building Footprint Area - Basement Scenario	m^2	120	80-200+	80	100
Building Footprint Area - Slab-on-Grade Scenario	m^2	120	80-200+	80	100
Subsurface Foundation Area - Basement Scenario	m^2	208	152-313+	152	180
Subsurface Foundation Area - Slab-on-Grade Scenario	m^2	127	85-208+	85	106
Depth to Base of Foundation - Basement Scenario	m	2	N/A	N/A	2
Depth to Base of Foundation - Slab-on-Grade Scenario	m	0.15	N/A	N/A	0.15
Perimeter Crack Width	mm	1	0.5-5	5	1
Building Crack Ratio - Slab-on-Grade Scenario	dimensionless	0.00038	0.00019-0.0019	0.0019	0.00038
Building Crack Ratio - Basement Scenario	dimensionless	0.0002	0.0001-0.001	0.001	0.00020
Crack Dust Water-Filled Porosity	cm^3/cm^3	Dry	N/A	N/A	Dry
Building Foundation Slab Thickness	m	0.1	N/A	N/A	0.1

[1] The values given for Qsoil are representative of sand, but are recommended for other soil types as well because coarse-grained soil or disturbed fine-grained soil often is found below and adjacent to foundations.

Table G-4. Soil-Dependent Properties for the Johnson & Ettinger Model - First Tier Assessment.

U.S. Soil Conservation Service (SCS) Soil Texture	Saturated Water Content Total Porosity θ_s (cm^3/cm^3)	Residual Water Content θ_r (cm^3/cm^3)	Unsaturated Zone Water-Filled Porosity: Mean or Typical $(FC_{1/3bar}+\theta_r)/2$ $\theta_{w,unsat}$ (cm^3/cm^3)	Range $\theta_{w,unsat}$ (cm^3/cm^3)	Conservative $\theta_{w,unsat}$ (cm^3/cm^3)	Modeled $\theta_{w,unsat}$ (cm^3/cm^3)	Capillary Transition Zone: Saturated Water Content Total Porosity θ_s (cm^3/cm^3)	$\theta_{w,cap}$ Cap @ air-entry	Height Cap Zone Fetter (94) (cm)
Clay	0.459	0.098	0.215	0.098-0.33	0.098	0.215	0.459	0.412	81.5
Clay Loam	0.442	0.079	0.168	0.079-0.26	0.079	0.168	0.442	0.375	46.9
Loam	0.399	0.061	0.148	0.061-0.24	0.061	0.148	0.399	0.332	37.5
Loamy Sand	0.39	0.049	0.076	0.049-0.1	0.049	0.076	0.39	0.303	18.8
Silt	0.489	0.05	0.167	0.05-0.28	0.050	0.167	0.489	0.382	163.0
Silt Loam	0.439	0.065	0.180	0.065-0.3	0.065	0.180	0.439	0.349	68.2
Silty Clay	0.481	0.111	0.216	0.11-0.32	0.111	0.216	0.481	0.424	192.0
Silty Clay Loam	0.482	0.09	0.198	0.09-0.31	0.090	0.198	0.482	0.399	133.9
Sand	0.375	0.053	0.054	0.053-0.055	0.053	0.054	0.375	0.253	17.0
Sandy Clay	0.385	0.117	0.197	0.117-0.28	0.117	0.197	0.385	0.355	30.0
Sandy Clay Loam	0.384	0.063	0.146	0.063-0.23	0.063	0.146	0.384	0.333	25.9
Sandy Loam	0.387	0.039	0.103	0.039-0.17	0.039	0.103	0.387	0.320	25.0
Loamy Sand	0.39	0.049	0.076	0.049-0.1	0.049	0.076	0.39	0.303	18.8

Table G-5. Guidance for Selection of US SCS Soil Type Based on Site Lithologic Information.

If your boring log indicates that the following materials are the predominant soil types …	***Then use the following texture classification when obtaining the attenuation factor.***
Sand or **Gravel** or **Sand and Gravel**, with less than about 12 % fines, where "fines" are smaller than 0.075 mm in size.	Sand
Sand or **Silty Sand**, with about 12 % to 25 % fines	Loamy Sand
Silty Sand, with about 25 % to 50 % fines	Sandy Loam
Silt and Sand or **Silty Sand** or **Clayey, Silty Sand** or **Sandy Silt** or **Clayey** with about 50 to 85 % fines	Loam

APPENDIX H

COMMUNITY INVOLVEMENT GUIDANCE

RECOMMENDATION FOR WHAT TO DO IF YOU HAVE A NEIGHBORHOOD NEEDING INDOOR AIR SAMPLING DUE TO SUBSURFACE VAPOR INTRUSION

As in any effort that strives for good community involvement, these five key principles are important considerations:

- ***Be proactive in engaging the community.***
- ***Listen carefully to what community members are saying.***
- ***Take the time needed to deal with community concerns.***
- ***Change plans where community suggestions have merit.***
- ***Explain to the community what is being done, by whom and why.***

The following provides an outline of recommended public participation activities that are consistent with EPA's ***1996 RCRA Public Participation Manual*** (EPA 530-R-96-007S) OSW September 1996
(URL = http://www.epa.gov/epaoswer/hazwaste/permit/pubpart/manual.htm) and the ***Superfund Community Involvement Handbook*** (EPA 540-K-01-003) OERR April 2002 (URL = http://www.epa.gov/superfund/tools/cag/ci_handbook.pdf) considered appropriate for addressing vapor intrusion concerns. These activities may occur concurrently or sequentially.

1. Get to know the neighborhood, key stakeholders and the concerns of the community

- Demographics
- Elected officials (Congressional, local, and state)
- Homeowners association (HOA) board
- Local school district officials, principals, etc.
- Local church leaders
- Residents
- Languages - English-speaking or not; will translation capability be needed?
- Media (although typically the media will seek you out; at least some sense of their interest can be useful. Press statements are usually reserved for announcing major milestones or for particularly hot button issues.)
- Local health department(s)
- Local or neighboring businesses
- Conduct briefings with most key stakeholders (face-to-face meetings preferred, but not always possible)
- Conduct community interviews (determine some number to conduct)
- Consider other possibilities to listen to community members' concerns e.g. hotline, public availability sessions

.

2. ***Establish a mailing list of all interested parties***

In establishing a mailing list, it is important to clarify that anybody can sign up and that no cost is involved.

3. ***Inform stakeholders of the situation***

Part of informing and educating the community is the distribution of information. Easy to understand and technically accurate flyers describing the history of the spill or contamination, the chemicals of concern, the potential risks that may be posed, and who to contact for more information are usually well received by the community. Anticipate that people will want information and be ready to give it to them. Consider use of web pages and establishing a knowledgeable person as a contact to call for accurate information.

- Send a letter/newsletter explaining the situation and the need for indoor air sampling and invite them to an open house/informational meeting

- Hold an open house/informational meeting to explain:
  - environmental conditions at the site;
  - health impacts;
  - indoor air sampling;
  - what level of remediation is needed; and
  - the type(s)of remediation (have pictures of ventilation systems)

(*Note: we recommend having toxicologists, health professionals, or other knowledgeable individuals available for this meeting*)

- Devote one booth to explaining indoor air sampling, include a SUMMA cannister

- Devote one booth at the open house/informational meeting to obtaining permission to conduct the indoor air sampling

- Conduct an exit poll of people as they leave the open house to determine the effectiveness of the meeting and whether it met their needs

Note: include many visuals/maps in this meeting

4. ***Develop a community involvement/public participation plan*** - We recommend the plan highlight key community concerns, establish goals and objectives, and identify a commitment to ongoing communications activities. At RCRA sites, a community involvement plan that is a component of a RCRA 3008(h) order specifying implementation of a remedy is enforceable.

5. Implement the Public Participation Plan

- Establish an information repository; consider using web pages
- Establish knowledgeable persons who can provide accurate information as key points of contact
- Establish a hotline that includes a recorded message of key activities for the week or determined period of time and allows caller to leave message/ask questions, and be sure to call them back
- Establish a mailing list of all interested parties
- Prepare periodic status updates/newsletters
- Other items as needed

For areas targeted for indoor air sampling:

- Contact individuals via phone and mail and seek written permission to sample
- If no response, then send a certified letter
- If still no response, document that resident was contacted but did not give permission to sample
- If at all possible, try to visit homes not responding and talk directly with occupants

6. Conduct indoor air sampling

- Schedule appointments to 1) conduct an inspection of the residence, complete an occupant survey to adequately identify the presence of (or occupant activities that could generate) any possible indoor air emissions of target VOCs in the dwelling, 2) remove possible sources, and 3) conduct residential sampling
- Be prompt on the day scheduled for sampling
- Send someone extremely knowledgeable and articulate about the indoor air sampling to accompany technical folks who do the sampling; if necessary, include a translator

7. Communicate indoor air sampling results

- Send letters to residents with their individual indoor air sampling results
- Follow-up with a phone call to explain results
- Hold an open house/informational meeting to share sampling results and answer any questions

Note: include map of area sampled and indicate the levels found

8. *Continually evaluate what communication activities are needed to optimize public participation and community involvement*

Additional Tools - to increase effectiveness of involvement with community residents

The following are examples of pre-sampling interview forms that may be adapted by others for site specific use to facilitate interaction/involvement with building/dwelling occupants prior to indoor air sampling:

> ***Occupied Dwelling Questionnaire*** developed by the OERR Emergency Response Team (below).
>
> ***Massachusetts Department of Environmental Protection - Indoor Air Sampling Guide (April 2002)*** Appendix 2 of this document provides an *Indoor Air Quality Building Survey* form and a set of *Instructions for Residents of Homes to Be Sampled.* These can be found at:
> http://www.state.ma.us/dep/bwsc/finalpol.htm

OCCUPIED DWELLING QUESTIONNAIRE

Indoor Air Assessment Survey

Date: _____

1. Name:_____

   Address:_____

   _____

   Home Phone:_____ Work Phone:_____

2. What is the best time to call to speak with you?_____ At: Work ❑ or Home ❑?

3. Are you the Owner ❑, Renter ❑, Other ❑ (please specify)_____ of this Home/Structure?

4. Total number of occupants/persons at this location?_____
   Number of children? _____ Ages?_____

5. How long have you lived at this location? _____

General Home Description

6. Type of Home/Structure (check only one): Single Family Home ❑, Duplex ❑, Condominium❑, Townhouse ❑, Other ❑_____

7. Home/Structure Description: number of floors _____
   Basement? Yes ❑ No ❑
   Crawl Space? Yes ❑ No ❑
   If Yes, under how much of the house's area? ____%

8. Age of Home/Structure: _____ years, Not sure/Unknown ❑

9. General Above-Ground Home/Structure construction (check all that apply):
   Wood ❑, Brick ❑, Concrete ❑, Cement block ❑, Other ❑_____

10. Foundation Construction (check all that apply):
    Concrete slab ❑
    Fieldstone ❑
    Concrete block ❑

Elevated above ground/grade ❑
Other_____

11. What is the source of your drinking water (check all that apply)?
Public water supply ❑
Private well ❑
Bottled water ❑
Other, please specify _____

12. Do you have a private well for purposes other than drinking?
Yes ❑ No ❑
If yes, please describe what you use the well for:_____
_____

13. Do you have a septic system? Yes ❑ No ❑ Not used ❑ Unknown ❑

14. Do you have standing water outside your home (pond, ditch, swale)? Yes ❑ No ❑

Basement Description, please check appropriate boxes.
<u>If you do not have a basement</u> go to question 23.

15. Is the basement finished ❑ or unfinished ❑?
16. If finished, how many rooms are in the basement?_____
How many are used for more than 2 hours/day?_____
17. Is the basement floor (check all that apply) concrete ❑, tile ❑, carpeted ❑, dirt ❑, other❑(describe)_____?
18. Are the basement walls poured concrete ❑, cement block ❑, stone ❑, wood ❑, brick ❑, other❑_____?
19. Does the basement have a moisture problem (check one only)?
Yes, frequently (3 or more times/yr) ❑
Yes, occasionally (1-2 times/yr) ❑
Yes, rarely (less than 1 time/yr) ❑
No ❑

20. Does the basement ever flood (check one only)?
Yes, frequently (3 or more times/yr) ❑
Yes, occasionally (1-2 times/yr) ❑
Yes, rarely (less than 1 time/yr) ❑
No ❑

21. Does the basement have any of the following? (check all that apply) Floor cracks ❑, Wall cracks ❑, Sump ❑, Floor drain ❑, Other hole/opening in floor ❑ (describe)_____

22. Are any of the following used or stored in the basement (check all that apply)
Paint ❑ Paint stripper/remover ❑ Paint thinner ❑
Metal degreaser/cleaner ❑ Gasoline ❑ Diesel fuel ❑ Solvents ❑ Glue ❑
Laundry spot removers ❑ Drain cleaners ❑ Pesticides ❑

23. Have you recently (within the last six months) done any painting or remodeling in your home? Yes ❑ No ❑
If yes, please specify what was done, where in the home, and what month:
_____
_____

24. Have you installed new carpeting in your home within the last year? Yes ❑ No ❑
If yes, when and where?_____

25. Do you regularly use or work in a dry cleaning service (check only one box)?
Yes, use dry-cleaning regularly (at least weekly)❑
Yes, use dry-cleaning infrequently (monthly or less)❑
Yes, work at a dry cleaning service ❑
No ❑

26. Does anyone in your home use solvents at work?
Yes ❑ If yes, how many persons_____
No ❑ If no, go to question 28

27. If yes for question 26 above, are the work clothes washed at home? Yes ❑ No ❑

28. Where is the washer/dryer located?
Basement ❑
Upstairs utility room ❑
Kitchen ❑
Garage ❑
Use a Laundromat ❑
Other, please specify ❑_____

29. If you have a dryer, is it vented to the outdoors? Yes ❑ No ❑

30. What type(s) of home heating do you have (check all that apply)
Fuel type: Gas ❑, Oil ❑, Electric ❑, Wood ❑, Coal ❑, Other_____
Heat conveyance system: Forced hot air ❑
Forced hot water ❑
Steam ❑
Radiant floor heat ❑
Wood stove ❑
Coal furnace ❑
Fireplace ❑
Other_____

31. Do you have air conditioning? Yes ❑ No ❑. If yes, please check the appropriate type(s)
Central air conditioning ❑
Window air conditioning unit(s)❑
Other ❑, please specify_____

32. Do you use any of the following? Room fans ❑, Ceiling fans ❑, Attic fan ❑
Do you ventilate using the fan-only mode of your central air conditioning or forced air heating system? Yes ❑ No ❑

33. Has your home had termite or other pesticide treatment: Yes ❑ No ❑ Unknown ❑
If yes, please specify type of pest controlled, _____
and approximate date of service _____

34. Water Heater Type: Gas ❑, Electric ❑, By furnace ❑, Other ❑_____
Water heater location: Basement ❑, Upstairs utility room ❑, Garage ❑, Other ❑ (please describe) _____

35. What type of cooking appliance do you have? Electric ❑, Gas ❑, Other ❑_____

36. Is there a stove exhaust hood present? Yes ❑ No ❑
Does it vent to the outdoors? Yes ❑ No ❑

37. Smoking in Home:
None ❑, Rare (only guests)❑, Moderate (residents light smokers)❑,
Heavy (at least one heavy smoker in household)❑

38. If yes to above, what do they smoke?
Cigarettes ❑ Cigars ❑
Pipe ❑ Other ❑

39. Do you regularly use air fresheners? Yes ❑ No ❑

40. Does anyone in the home have indoor home hobbies of crafts involving: None ❑
Heating ❑, soldering ❑, welding ❑, model glues ❑, paint ❑, spray paint, wood finishing ❑, Other ❑ Please specify what type of hobby: _____
_____

41. General family/home use of consumer products (please circle appropriate): Assume that **Never** = never used, **Hardly ever** = less than once/month, **Occasionally** = about once/month, **Regularly** = about once/week, and **Often** = more than once/week.

Product	Frequency of Use				
Spray-on deodorant	Never	Hardly ever	Occasionally	Regularly	Often

Aerosol deodorizers	Never	Hardly ever	Occasionally	Regularly	Often
Insecticides	Never	Hardly ever	Occasionally	Regularly	Often
Disinfectants	Never	Hardly ever	Occasionally	Regularly	Often

(Question 41, continued)

Product	Frequency of Use				
Window cleaners	Never	Hardly ever	Occasionally	Regularly	Often
Spray-on oven cleaners	Never	Hardly ever	Occasionally	Regularly	Often
Nail polish remover	Never	Hardly ever	Occasionally	Regularly	Often
Hair sprays	Never	Hardly ever	Occasionally	Regularly	Often

42. Please check weekly household cleaning practices:
    Dusting ❑
    Dry sweeping ❑
    Vacuuming ❑
    Polishing (furniture, etc) ❑
    Washing/waxing floors ❑
    Other ❑_____

43. Other comments: _____
_____
_____
_____
_____
_____
_____
_____
_____
_____

APPENDIX I

CONSIDERATION OF BACKGROUND INDOOR AIR VOC LEVELS IN EVALUATING THE SUBSURFACE VAPOR INTRUSION PATHWAY

1. General

We recommend that the presence of background indoor air concentrations of VOCs at a site be carefully considered in evaluating the vapor intrusion to indoor air pathway at the site. The concentrations of VOCs detected in indoor air may originate from the subsurface contamination and/or they may represent typical concentrations of VOCs in that building from other sources. Consequently, indoor air sampling results may be difficult to interpret when background concentrations of the same VOCs emitted from other sources are present, if efforts are not made to identify and quantify the background concentrations.

Prior to indoor air sampling, it is generally important to conduct an inspection of the residence and an occupant survey to adequately identify the presence of (or occupant activities that could generate) any possible indoor air emission sources of target volatile organic chemicals (VOCs) in the dwelling (see Appendix H). For example, sources of indoor contaminants typically found in the home include consumer products (e.g., cleaners, paints, and glues), occupant activities (e.g., craft hobbies, smoking), and some construction materials. VOCs in ambient (outdoor) air may also contribute to indoor air background levels, though typically the main sources of background concentrations of VOCs in indoor air background arise from indoor activities or products used indoors. Any of these sources may result in relatively high background indoor air concentrations.

It is also important to recognize that typically there is high variability in background indoor air VOC concentrations both within and between buildings, so that small numbers of background samples typically available should be carefully interpreted. If there is more than one potential constituent of concern, we recommend that the ratios of potential constituents be used to distinguish subsurface-derived VOCs from those contributed by other non-subsurface-related sources (i.e, indoor air and/or ambient (outdoor) air emission sources). Collecting paired samples (spatially and temporally) of both indoor air and soil vapor data may also assist with establishing the constituents of concern.

Comparative review of VOCs air sampling results taken in various parts of a building may reveal contaminant concentration gradients or hot spots among the various floors or rooms in the building. Such gradients or hot spots shown in upper floors may indicate the indoor air VOC levels originated from other indoor emission sources rather than subsurface contamination, whereas, gradients or hot spots in basements or lower levels could suggest a scenario that is consistent with subsurface vapor intrusion or a preferential pathway. A contemporaneous ambient (outdoor) air sample may be useful to include for comparison to indoor concentrations and aid in characterizing possible background contribution from ambient (outdoor) air. More detail about indoor air sampling protocols is provided in Appendix E.

We recommend that all information on background indoor air concentrations be considered along with all of the information collected about the site and the nature of the contamination when conducting any site-specific risk assessments, determining appropriate risk management actions, and in advising citizens via risk communications. We recommend that the assessment of background contribution focus on the constituents and degradation products observed in the subsurface. However, while it is important to identify background indoor air concentrations, we recommend that they not be discounted when making a determination or communicating with the public about site-related impact and/or risk.

2. CERCLA Guidance on the Role of Background

EPA recently published the "**Role of Background in the CERCLA Cleanup Program"** (OSWER 9285.6-07P; APR 2002; URL = http://www.epa.gov/superfund/programs/risk/role.pdf) outlining a preferred approach for the consideration of background constituent concentrations of hazardous substances, pollutants, and contaminants in certain steps of the remedy selection process at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund") sites. This policy recommends that when conducting site risk assessments contaminant concentrations attributable to background sources should *not* be eliminated from further consideration, since it could result in the loss of important risk information for those potentially exposed, even though cleanup may or may not eliminate a source of risks caused by background levels. This policy encourages a baseline risk assessment approach that retains constituents that exceed risk-based screening concentrations and encourages addressing site-specific background issues at the end of the risk assessment phase. Although VOCs and indoor air concerns are not explicit in the CERCLA "Role of Background..." it seems to suggest that VOCs with both subsurface site release-related and background-related sources should be included in any site risk assessment. Consistent with the CERCLA "Role of Background..."it is recommended that any significant background concentrations of VOCs be discussed in the risk characterization in a comprehensive manner along with any available data distinguishing the background contribution from site release-related VOC concentrations.

3. State Guidance Examples

Some states have developed specific approaches to considering indoor air background concentrations of VOCs when evaluating a cleanup site. Measurements of background VOC concentrations taken *before* any site-related contamination of the indoor air may have occurred are considered ideal. However, this type of data is rarely available. Given the variability in background concentrations in buildings, studies of representative indoor air background VOCs are preferred. In some cases, data may be available from background studies that have been conducted in representative "on-site" buildings out of the contamination zone or in nearby "off-site" buildings. The Colorado Department of Public Health and Environment (personal communication, August 2002) has stated that post-remediation studies of background indoor air VOCs provide reliable data.

Illinois
Environmental
Protection Agency

Office of Chemical Safety
2200 Churchill Road
Springfield, IL 62794-9276

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A Summary of Selected Background Conditions for Inorganics in Soil

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TECHNICAL REPORT

A SUMMARY OF SELECTED BACKGROUND CONDITIONS FOR INORGANICS IN SOIL

Office of Chemical Safety
Illinois Environmental Protection Agency
August 1994

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Introduction

The Office of Chemical Safety has completed a summary of selected background conditions for inorganic chemicals in surface soils in Illinois. The objectives of this project were as follows:

(1) to ascertain a reasonable indication of statewide background concentrations in soil of selected inorganic chemicals of public health and ecological interest;

(2) to support the Agency's efforts in determining the presence of elevated levels of lead in soil by determining the levels of lead present in selected background soils across the state; and

(3) to utilize, to the extent possible, existing site-specific studies and background data which represents a major data resource already existing within Agency files.

Technical Approach

The first step of this project involved the review of existing Agency files in order to obtain data on background concentrations in soil. The results were obtained from samples taken in areas, judged by the field staff taking the samples, to be undisturbed and unimpacted by site-related activities. No efforts were made to investigate these results relative to the potential for past sources of atmospheric deposition (e.g., smelter, leaded gasoline, etc.) or previous site activities at the background sample location. Certain areas of the state have likely been impacted by anthropogenic sources and therefore represent conditions

that may vary from naturally occurring levels. Sample results were obtained from Preliminary Assessment/Site Investigations performed since 1986 plus sample results from State and Federal Superfund site investigations in Illinois.

The second step in the process of generating this technical report involved the collection of additional samples. Surface soil samples were obtained by Agency staff from those counties in the State for which data were lacking. These samples were specifically taken from areas expected to represent naturally occurring background.

The current database includes 275 data points from sample locations in all 102 counties in Illinois. Since some of these sites required varying degrees of investigation, certain samples do not include the complete list of analytical parameters. As a result, each inorganic may have a different number of data points. The minimum concentrations, maximum concentrations, mean concentrations, and median concentrations were calculated for each of the inorganic parameters. Values which were reported as less than the detection limit were included in the summary statistics by using one-half of the detection limit. If upon analysis of these data, it could be concluded that the background sample had been impacted by site-related activities then the sample was not used in the summary data.

Data used in this report are laboratory analytical values for total metals determined by USEPA SW-846 methods. These methods convert all of each metal tested to a soluble ion that can be detected. Since the original ionic speciation of the metals are not known, conclusions regarding mobility, exposure, assimilations, and toxicity cannot be directly inferred.

It should be noted that uncertainties inherent in a report of this type include those due to variation in sampling procedures, variation in sampling depth, the use of one-half the detection limit for non-detects, differences in

analytical techniques between laboratories, and the impact of anthropogenic sources on the concentrations existing at the sample location. Furthermore, we wish to emphasize that the samples were not collected randomly nor in accordance with an a priori experimental design. Due to resource constraints, the majority of data used pre-existed this study. Consequently, this study is not and should not be characterized as having a totally unbiased scientific basis.

Results

Figure 1 shows the survey locations across the State. Table 1, 2, and 3 include an overall summary of the ranges, means, and medians calculated for the inorganic parameters. This overall data set includes samples from urban and rural locations.

Statewide Data -- Table 1 includes a summary of data obtained for the entire state. It should be noted that the statewide summary statistics should be used in conjunction with Tables 2 and 3. These breakouts of urban vs. rural counties indicate that certain inorganic parameters such as lead, zinc, and cadmium are generally higher in the urban environment.

Urban Data -- Table 2 includes data for counties within metropolitan statistical areas (MSAs) and Table 3 includes data for counties outside MSAs. MSAs are geographic areas consisting of a large population nucleus - a census-defined "urbanized area" - together with adjacent communities that have a high degree of economic and social integration with that nucleus. In MSAs with a population of one million or more, primary metropolitan statistical areas (PMSAs) may be identified. When PMSAs are defined, the MSA of which they are component part is redesignated a consolidated metropolitan statistical area (CMSA). Figure 2 shows the MSAs, PMSAs, and CMSA for Illinois.

The following inorganic constituents were detected in certain locations in the state at levels above the ranges for natural soils from the scientific literature: cadmium, lead, barium, mercury, thallium, and zinc.

Cadmium -- Those locations in the state where there is the greatest diversion from background levels published in the scientific literature for cadmium were in the counties of St. Clair and Lake. In St. Clair County, the levels of cadmium detected were highest in Sauget and Fairmont City where the levels detected were 7.3 mg/kg and 8.2 mg/kg, respectively. In Lake County, the highest level of cadmium was 7.4 mg/kg which was obtained from a background site in Waukegan.

Lead -- The highest levels of total lead identified during the survey were found in the counties of Cook and Lake. Two of the three highest detections for lead were in Chicago where the concentrations reported were 346 mg/kg and 647 mg/kg. The second highest concentration of lead detected was 384 mg/kg and was obtained in the City of Waukegan in Lake County.

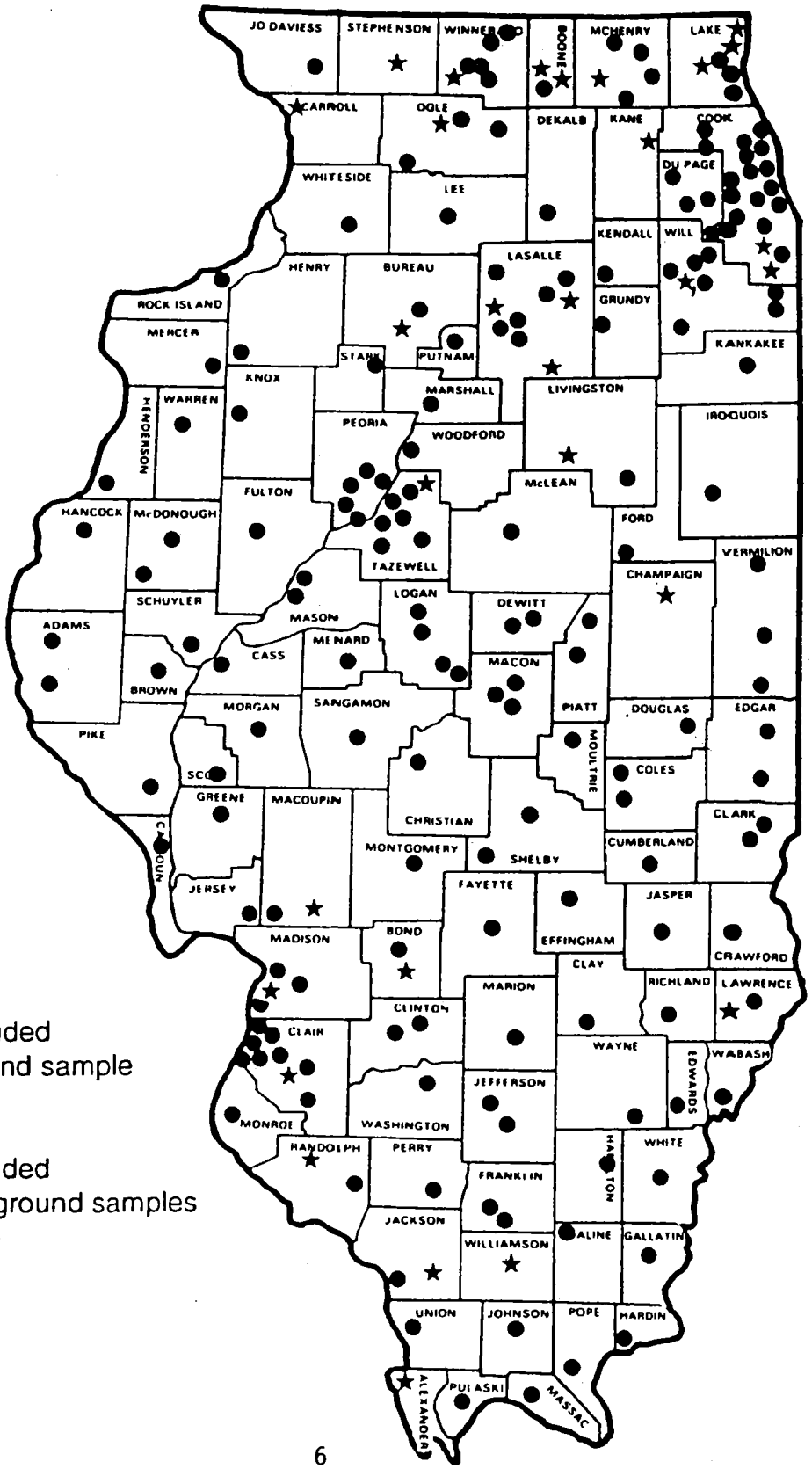
Data Utilization

These data can be used by programs in the Agency to evaluate the plausible validity of any site-specific background data collected for various cleanup sites across the state. These data, however, are not meant to replace the collection of site-specific background data for sites.

A second use for these data is as a general screening check for determining the potential presence of inorganic contamination at a site. These data appear to present a reasonable indication of background conditions in Illinois and can be used to compare with site data. Doing so could identify any inorganic

Figure 1

Sample Locations for Selected Background Samples for Inorganics in Soil

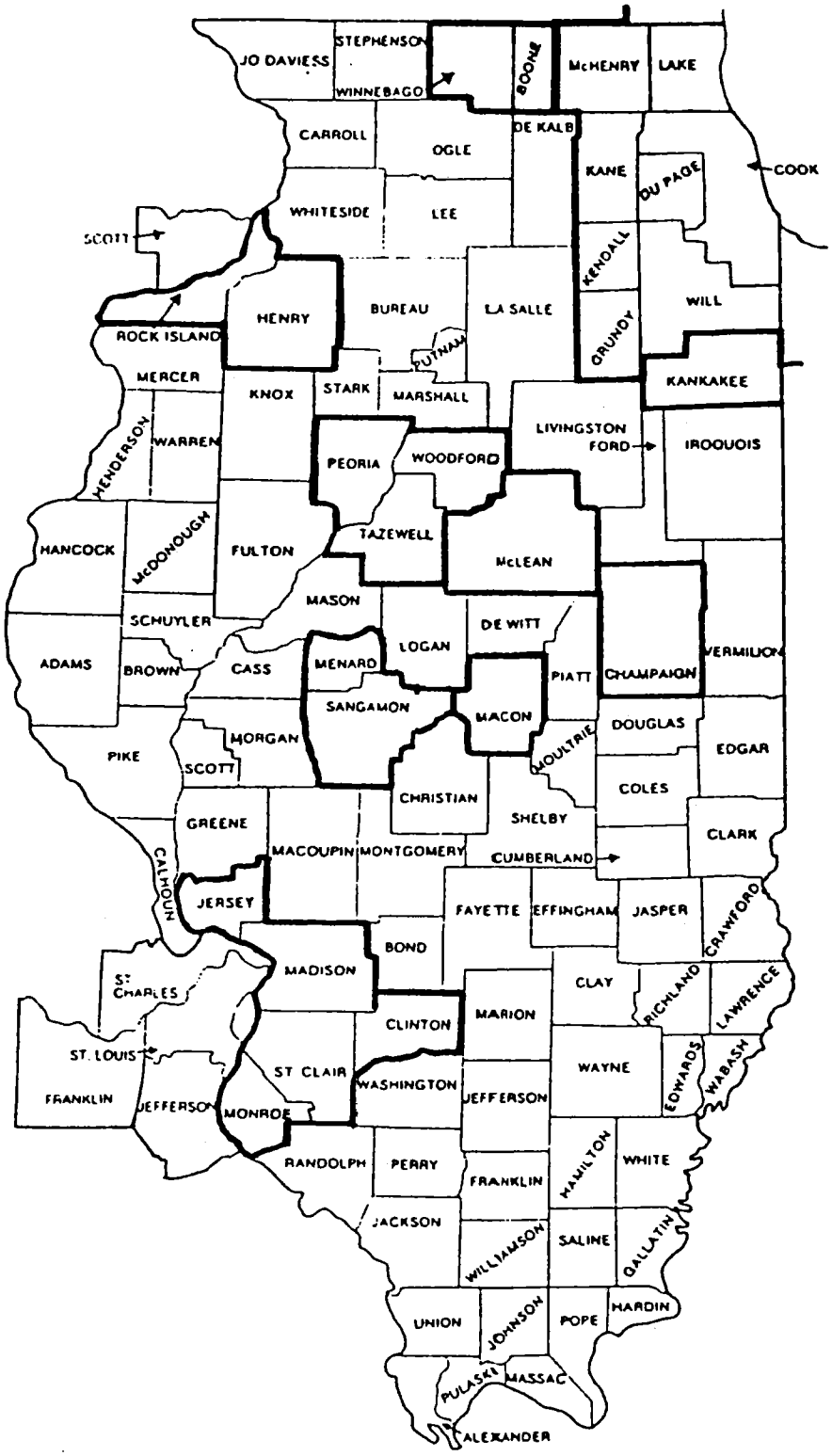


● Location included one background sample *(175 sites)*

★ Location included multiple background samples *(29 sites)*

FIGURE 2

Illinois Consolidated Metropolitan Statistical Areas, Primary Metropolitan Statistical Areas, Metropolitan Statistical Areas, and Counties



Aurora-Elgin, IL PMSA
Kane & Kendall Counties, IL
Bloomington-Normal, IL MSA
McLean County, IL
Champaign-Urbana-Rantoul, IL MSA
Champaign County, IL
Chicago, IL PMSA
Cook, DuPage, & McHenry Counties, IL
Chicago-Gary-Lake Cnty, IL-IN-WI CMSA
Aurora-Elgin, IL PMSA
Chicago, IL PMSA
Gary-Hammond, IN PMSA (Lake & Porter Cntys., IN)
Joliet, IL PMSA
Kenosha, WI PMSA (Kenosha Cnty., WI)
Lake County, IL PMSA
Davenport-Rock Island-Moline, IA-IL MSA
Henry & Rock Island Counties, IL (Scott Cnty, IA)
Decatur, IL MSA
Macon County, IL
Joliet, IL PMSA
Grundy & Will Counties, IL
Kankakee, IL MSA
Kankakee County, IL
Lake County, IL PMSA
Lake County, IL
Peoria, IL MSA
Peoria, Tazewell, & Woodford Counties, IL
Rockford, IL MSA
Boone & Winnebago Counties, IL
St. Louis, MO-IL MSA
Clinton, Jersey, Madison, Monroe, & St. Clair Counties, IL
Franklin, Jefferson, St. Charles, & St. Louis Cntys., MO; St. Louis City, MO)
Springfield, IL MSA
Menard & Sangamon Counties, IL

Source: Illinois Statistical Abstract. 1991.

TABLE 1.

Summary Information for Total Concentrations of
Inorganic Chemicals in Background Soils in Illinois (mg/kg)

STATEWIDE DATA

Parameter	Number of Data Points	Range	Mean	Median
Aluminum	213	1388 - 37200	10126	9270
Antimony	142	0.18 - 8.6	3.7	3.6
Arsenic	234	0.35 - 24	6.7	5.9
Barium	251	ND (<5) - 1720	130	119
Beryllium	213	ND (<0.02) - 9.9	0.69	0.58
Cadmium	243	ND (<0.2) - 8.2	0.97	0.5
Calcium	213	630 - 184000	16443	6340
Chromium	261	ND (<2.14) - 151	17.3	14.0
Cobalt	214	0.9 - 32	8.9	8.8
Copper	254	1.0 - 156	19.7	14.0
Cyanide*	163	ND (<0.06) - 2.7	0.58	0.5
Iron	246	3200 - 80000	16190	15200
Lead	267	4.7 - 647	49.2	25.0
Magnesium	214	476 - 74500	7231	3410

TABLE 1. - CONTINUED

Parameter	Number of Data Points	Range	Mean	Median
Manganese	244	61.5 - 5590	767	631
Mercury	200	ND (<0.01) - 1.67	0.11	0.06
Nickel	252	ND (<3.1) - 135	16.8	14.1
Potassium	240	270 - 5820	1363	1120
Selenium	200	ND (<0.1) - 2.6	0.50	0.39
Silver	233	ND (<0.06) - 5.9	0.84	0.50
Sodium	205	14.1 - 7600	216	130
Sulfate	28	10 - 260	93.8	88.9
Sulfide	18	ND (<1.00) - 10.1	3.7	3.0
Thallium*	191	0.02 - 2.8	0.57	0.39
Vanadium	214	ND (<2.5) - 80	25.0	25.0
Zinc	246	ND (<5.5) - 798	102.9	67.4

* The total number of data points for cyanide (163) and thallium (191) are higher for the statewide data vs. the combined total from Tables 2 and 3 (158 and 183 respectively). This difference is due to the omission of certain data points in the MSA vs. non-MSA breakouts due to elevated detection limits (1/2 detection limit was higher than the highest detected concentration).

TABLE 2.

Summary Information for Total Concentrations of
Inorganic Chemicals in Background Soils in Illinois (mg/kg)

Counties **WITHIN** Metropolitan Statistical Areas

Parameter	Number of Data Points	Range	Mean	Median
Aluminum	103	1388 - 37200	10148	9500
Antimony	67	0.24 - 8	4.2	4.0
Arsenic	114	1.1 - 24	7.4	7.2
Barium	109	ND (<5) - 1720	133	110
Beryllium	99	0.05 - 9.9	0.73	0.59
Cadmium	104	ND (<2.5) - 8.2	1.3	0.6
Calcium	103	813 - 130000	20783	9300
Chromium	114	ND (<2.14) - 151	21.2	16.2
Cobalt	103	2.1 - 23	8.8	8.9
Copper	107	ND (<2.93) - 156	28.9	19.6
Cyanide	81	ND (<0.07) - 2.7	0.64	0.51
Iron	105	5000 - 80000	17607	15900
Lead	119	4.7 - 647	71.1	36.0
Magnesium	103	541 - 74500	10872	4820

TABLE 2. - CONTINUED

Parameter	Number of Data Points	Range	Mean	Median
Manganese	105	155 - 5590	742	636
Mercury	87	0.02 - 0.99	0.12	0.06
Nickel	105	ND (<3.1) - 135	20.9	18.0
Potassium	105	270 - 5820	1560	1268
Selenium	85	ND (<0.12) - 2.6	0.58	0.48
Silver	91	ND (<0.32) - 5.6	0.97	0.55
Sodium	97	20.2 - 1290	208	130
Sulfate	15	17.6 - 240	85.8	85.5
Sulfide	11	ND (<1.00) - 10.1	3.9	3.1
Thallium	78	0.02 - 1.6	0.46	0.32
Vanadium	103	ND (<2.5) - 80	25.0	25.2
Zinc	106	23 - 798	137.9	95.0

TABLE 3.

Summary Information for Total Concentrations of
Inorganic Chemicals in Background Soils in Illinois (mg/kg)

Counties **OUTSIDE** Metropolitan Statistical Areas

Parameter	Number of Data Points	Range	Mean	Median
Aluminum	110	2640 - 23300	10105	9200
Antimony	75	0.18 - 8.6	3.2	3.3
Arsenic	120	0.35 - 22.4	5.9	5.2
Barium	142	22.4 - 253	127	122
Beryllium	114	ND (<0.02) - 8.8	0.65	0.56
Cadmium	139	ND (<0.2) - 5.2	0.73	0.50
Calcium	110	630 - 184000	12379	5525
Chromium	147	4.3 - 37	14.3	13.0
Cobalt	111	0.9 - 32	8.9	8.4
Copper	147	1 - 42	13.0	12.0
Cyanide	77	ND (<0.06) - 1.2	0.46	0.50
Iron	141	3200 - 29100	15134	15000
Lead	148	ND (<7.44) - 270	31.5	20.9
Magnesium	111	476 - 24100	3853	2700

TABLE 3. - CONTINUED

Parameter	Number of Data Points	Range	Mean	Median
Manganese	139	61.5 - 3710	784	630
Mercury	113	ND (<0.01) - 1.67	0.10	0.05
Nickel	147	ND (<5) - 34.6	13.9	13.0
Potassium	135	280 - 5600	1210	1100
Selenium	115	ND (<0.1) - 1.7	0.44	0.37
Silver	142	ND (<0.06) - 5.9	0.76	0.50
Sodium	108	14.1 - 7600	222.8	130.0
Sulfate	13	10 - 260	103	110
Sulfide	7	ND (<1) - 8.8	3.4	2.9
Thallium	105	0.05 - 2.8	0.50	0.42
Vanadium	111	6 - 47	25.0	25.0
Zinc	140	ND (<5.5) - 400	76.3	60.2

DEPARTMENT OF THE NAVY
OFFICE OF THE SECRETARY
1000 NAVY PENTAGON
WASHINGTON, D.C. 20350-1000

April 2, 2003

MEMORANDUM FOR DEPUTY UNDER SECRETARY OF DEFENSE
(INSTALLATIONS and ENVIRONMENT)

Subj: MONITORING AND ENFORCEMENT OF LAND USE CONTROLS

Ref: (a) DUSD(I&E) memo of April 23, 2001
(b) ADUSD(E) memo of June 4, 2002

For approximately 24 months, the Department of Defense (DoD) and the Environmental Protection Agency (EPA) have been in dispute over the responsibilities, authorities and related documentation concerning Land Use Controls (LUC) used to protect contaminated sites. The dispute has slowed or halted progress on a number of cleanup Records of Decision (RoDs) throughout DoD at both active and closed bases. Despite a long series of discussions and communications between the Office of the Secretary of Defense (OSD) and EPA, the dispute has not been resolved. In order to continue progress in the cleanup program, the Services developed alternative approaches for resolving the issue and were given direction by OSD to negotiate with EPA to develop RoDs and Federal Facilities Agreements (FFAs) using these approaches.

We are pleased to report that the Department of Navy (DON) has reached a comprehensive settlement to this issue through a series of negotiations with EPA headquarters and Regions over several months. Attachment (1) provides the framework to be followed by EPA and DON. The Department of Army has been participating throughout the negotiations and concurs with the approach. The key components are:

- Standard FFAs based on the EPA-DoD model with the addition of one "primary document" - a Remedial Action Completion Report. We believe documenting the completion of a remedial action/site closeout and getting EPA concurrence on the closeout is reasonable and good public policy.

- Performance-based RoDs that contain only broad LUC objectives, not DoD implementation actions. This eliminates potential debates in the field about whether changes to LUC implementation actions in a RoD are "significant".

- Remedial Designs or Remedial Action Work Plans (already primary documents under the EPA-DoD model) containing the LUC implementation actions.

- A commitment for an EPA-DoD task force to further streamline document size and number.

Our proposed approach concentrates on getting results - site completions and property transfers - rather than disputing EPA's post-RoD authorities. We believe this approach provides the most productive path forward and we plan to develop and submit RoDs and FFAs using this approach. We recommend that you rescind and/or revise references (a) and (b) since they do not reflect the new approaches by the services, are not compatible with draft, nationally applicable EPA guidance, and are not like recent RoDs approved by OSD. Additionally, we request elimination of the moratorium on signing RoDs without multi-service headquarters review as long as the RoDs comport with the attached Principles. The headquarters review of cleanup RoDs has created a choke-point and is contrary to our organizational streamlining and delegation practices.

We need to move forward and resolve this issue in consensus with EPA. We have a number of other important issues to work with EPA including legislative and regulatory range initiatives and the disposition of FFAs at Base Realignment and Closure (BRAC) installations on the National Priorities List where we desire to effect early transfers.

HT Johnson

Hansford T. Johnson
Secretary of the Navy
Acting

Attachment:
1. Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-RoD Actions

17 Mar 2003 v8.1

PRINCIPLES AND PROCEDURES FOR SPECIFYING, MONITORING AND ENFORCEMENT OF LAND USE CONTROLS AND OTHER POST-ROD ACTIONS

PREAMBLE

Since the Department of Defense (DoD)/Environmental Protection Agency (EPA) Model Interagency Agreement (IAG)/Federal Facility Agreement (FFA) was developed in 1988, EPA and DoD have gained considerable knowledge and understanding about post-Records of Decisions (RoD) activities, especially Land Use Controls (LUCs). Thinking, policies, regulations and procedures concerning LUCs have evolved considerably since DoD and EPA developed the 1988 FFA model language. New statutes and regulations related to LUCs are being considered in many states. Accordingly, EPA and the Department of Navy (DON) believe that a set of Principles will assist Navy field commands and EPA Regions to better implement our respective Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) responsibilities. The Principles described below do not replace or substitute for any existing CERCLA statutory or regulatory requirement. Rather they provide a mutually agreeable framework to provide a more efficient process to implement LUCs at National Priority List (NPL) installations.

These Principles will guide the EPA and DON personnel involved in these decisions. They are written in full knowledge that state regulatory and trustee organizations have independent responsibilities and authorities. EPA and the Navy recognize the importance of the state role in helping to ensure a cleanup is protective of human health and the environment. EPA and the Navy will jointly develop a communications plan to ensure we include the states in this important issue.

PRINCIPLES

- At sites where remedial action is determined necessary to protect human health and the environment, the actions must be documented in accordance with CERCLA and its implementing regulation, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

- At sites where contaminants are left in place, LUCs are used to ensure that the contaminants do not pose an unacceptable risk to human health or the environment. LUCs consist of engineering controls and/or institutional controls.

- The EPA and DON desire to ensure that LUCs are specified, implemented, monitored, reported on, and enforced in an efficient, cost-effective manner that ensures long-term protectiveness.

- The EPA acknowledges DON role and responsibilities as the Federal Lead Agent for response actions. This role includes selecting remedies with EPA at NPL sites and funding response actions.

- The DON acknowledges EPA's role and responsibilities for regulatory oversight and enforcement, particularly at NPL sites. This role includes ultimate ability to select the remedy at NPL sites if EPA disagrees with DON proposed remedy and dispute resolution fails.

- Federal Facilities Agreements (FFAs) are CERCLA 120 agreements used by DoD and EPA to describe in detail the roles and relationships among DoD, EPA and often the state. They form the foundation for these relationships regarding DoD's response actions at NPL sites. FFAs also contain installation specific details and procedures for planning, budgeting, and dispute resolution. DON and EPA desire FFAs to be as standardized as possible and relatively static (i.e., the FFA should not need to be changed for a given installation).

- Primary Documents developed under the FFA are relatively dynamic and document important plans and actions. In that sense, they are action-oriented. For example, a Site Management Plan is revised yearly via collaboration among DON and EPA remedial project managers and is an important tool for planning response actions and demonstrating commitment to the public. Likewise, a LUC Remedial Design (RD) or Remedial Action Work Plan (RAWP) describes actions that will ensure viability of both long-term engineered and institutional control remedies.

- Records of Decision should document the remedy selection process and remedy decision in accordance with CERCLA and the NCP, as well as applicable guidance, regulations, standards, criteria, and policy. With regard to LUCs, the RoD should describe the LUC objectives, explain why and for what purpose the LUCs are necessary, where they will be necessary, and the entities responsible for implementing, monitoring, reporting on and enforcing the LUCs. The RoD will refer to the RD or RAWP for implementation actions.

- Given the above, EPA and DON agree that the most efficient framework for specifying, implementing, monitoring, reporting on and enforcing LUCs is:
    - A standard FFA for NPL sites.
    - A clear, concise RoD with LUC objectives.
    - RD or RAWP with LUC implementation actions.
- *Note: These documents are described more fully below.*

- EPA and DON will move expeditiously to finalize all outstanding FFAs using a standard FFA template as a guide to minimize the development/writing process.

- *Note: A "standard FFA" means the Agreement presently being used between EPA and DON using the DoD-EPA model language, plus site-specific statements of fact, plus the additional primary and secondary documents shown in Attachment (1).*

- EPA and DON will initiate a task force with appropriate headquarters and field representatives from EPA and the military services. The task force will examine ways to reduce document size, review time and revisions. The task force will seek ways to recommend changes to guidance and policy that will help reduce document size or streamline the process. The task force may also include other stakeholders.

GENERAL PROCEDURES

1. Federal Facility Agreement

- The LUC implementation and operation/maintenance actions will be included in the RD or RAWP which are already primary documents deliverable under standard FFAs. In addition, a Remedial Action Completion Report (RACR) will be provided as a primary document for new FFAs. For existing FFAs without a RACR, the RACR will be provided as an attachment to the RD or RAWP with the same enforceability as a primary document. For existing FFAs without a Five-year review, the Five-year review will be submitted to EPA as a secondary document and is subject to dispute resolution under the FFA.

Note: Model FFA language will need *to be supplemented to reflect these Principles and Procedures. Attachment (1) contains necessary modifications to FFA language.*

2. Record of Decision

- It is EPA's and DON's intent that Records of Decision (RoDs) continue to be consistent with CERCLA and the National Contingency Plan. Relative to land use controls and institutional controls, the RoD shall:
    - Describe the risk(s) necessitating the remedy including LUCs;
    - Document risk exposure assumptions and reasonably anticipated land uses;
    - Generally describe the LUC, the logic for its selection and any related deed restrictions/notifications;
    - State the *LUC performance objectives*. (See attachment (2) for examples of LUC performance objectives);
    - List the parties responsible for implementing, monitoring, reporting on, and enforcement of the LUC;
    - Provide a description of the area/property covered by the LUC (should include a map);
    - Provide the expected duration of the LUCs; and
    - Refer to the RD or RAWP for LUC *implementation actions*, since these details may need to be adjusted periodically based on site conditions and other factors. (See attachment (2) for examples of LUC implementation actions).

- The RoD at transferring properties will need to be crafted based on the responsibilities of the new owner and state-specific laws and regulations regarding LUCs. At transferring properties, compliance with the LUC performance objectives may involve actions by the subsequent owners in accordance with deed restrictions, however, ultimate responsibility for assuring that the objectives are met remains with DON as the party responsible under CERCLA for the remedy. DON and regulators will consult to determine appropriate enforcement actions should there be a failure of a LUC objective at a transferred property.

3. LUC Remedial Design (RD) or Remedial Action Work Plan (RAWP)

- The RD or RAWP will be provided as a primary document in accordance with the FFA.
- The RD or RAWP will describe short and long-term implementation actions and responsibilities for the actions in order to ensure long-term viability of the remedy which may include both LUCs (e.g., institutional controls) and an engineered portion (e.g., landfill caps, treatment systems) of the remedy. The term "implementation actions" includes all actions to implement, operate, maintain, and enforce the remedy. Depending on the LUC and site conditions, these actions can include:
  - Conducting CERCLA five-year remedy reviews for the engineered remedies and/or LUCs.
  - Conducting periodic monitoring or visual inspections of LUCs; frequency to be determined by site-specific conditions.
  - Reporting inspection results.
  - Notifying regulators prior to any changes in the risk, remedy or land use including any LUC failures with proposed corrective action.
  - Including a map of the site where LUCs are to be implemented.
  - *For active bases*,
    - Developing internal DON policies and procedures with respect to LUC monitoring, reporting, and enforcement in order to institutionalize LUC management and to ensure base personnel are aware of restrictions and precautions that should be taken; Consulting with EPA at least 14 days prior to making any changes to these policies and procedures to ensure that any changes maintain a remedy that is protective of human health and the environment.
    - Developing a comprehensive list of LUCs with associated boundaries and expected durations.
    - Notifying regulators of planned property conveyance, including federal-to-federal transfers. "Property conveyance" includes conveying leaseholds, easements and other partial interests in real property.
    - Obtaining regulator concurrence before modifying or terminating land use control objectives or implementation actions.

  - *For closing bases/excess property*:
    - Notifying regulators of planned property conveyance, including federal-to-

federal transfers.

- Consulting with EPA on the appropriate wording for land use restrictions and providing a copy of the wording from the executed deed.
- Defining responsibilities of DON, the new property owner and state/local government agencies with respect to LUC implementation, monitoring, reporting, and enforcement.
- Providing a comprehensive list of LUCs with associated boundaries and expected durations.
- Obtaining regulator concurrence before modifying or terminating land use control objectives or implementation actions.

Note: Tthe mix of responsibilities among DON, new property owner and other government agencies depends on state and federal laws and regulations that are applied in the state. Implementation actions at closing bases may include components characteristic of both active and closing bases, depending on the timing of transfer.

- Should there be a failure to complete LUC implementation actions at an active base, the EPA Region shall notify the installation and seek immediate action. Should there be a failure to complete LUC actions after such notification to the base, EPA may notify the Deputy Assistant Secretary of the Navy (Environment) who will ensure that LUC actions are taken.

- Should there be a failure to complete implementation actions that are the responsibility of a subsequent owner or third party at a transferred property, EPA and DON will consult on the appropriate enforcement action. Should there be a failure to complete implementation actions that are the remaining responsibility of DON at a transferred property, the EPA Region will notify the cognizant Navy Engineering Field Division. If necessary, EPA may notify the Deputy Assistant Secretary of the Navy (Environment) who will ensure that corrective action is taken.

Note: The RD or RAWP should contain no more or no less implementation actions than needed to ensure the viability of the remedy. There is a delicate balance required. EPA and DON both desire to ensure protectiveness while minimizing process and documents. The parties agree to work diligently to define the appropriate implementation actions for each LUC. EPA and Navy believe the key elements can be easily developed between RPMs in a matter of a few hours. Based on detailed discussions and the examples shown in Attachment (2), EPA and DON expect that the LUC portion of the RDs or RAWPs to be in the range of 2-6 pages. If combined with a sampling plan, there may be additional pages needed to list the analyses, sampling locations and frequencies.

4. LUC Data

- The DON will ensure that all LUCs at its installations are included in the DON LUC database.

Attachments:
1. Incorporating Land Use Control (LUC) Objectives and Implementing Actions into Federal Facilities Agreements (FFA's)
2. Examples of LUC objectives and LUC Implementation Actions

Attachment 1

INCORPORATING LAND USE CONTROL (LUC) OBJECTIVES AND IMPLEMENTATION ACTIONS INTO FEDERAL FACILITIES AGREEMENTS (FFAs)

FFA Model Template Additions/Changes

1. Definitions Section:

Add: "Land use controls" shall mean any restriction or administrative action, including engineering and institutional controls, arising from the need to reduce risk to human health and the environment.

2. Primary Documents:

Add: A Remedial Action Completion Report (RACR).

Note: EPA and DON believe the RACR is an important document to (1) document the completion of remedy-in-place and/or site close-out and (2) receive concurrence from EPA. The document shall not duplicate information in the Administrative Record or previously provided to EPA. Previously provided information shall be referenced and itemized. New information/data (e.g., sampling data) may be needed to demonstrate that the Remedial Action Objectives have been met. The report shall also include any as-built drawings for remedies if different from the remedial design. EPA and DON do not envision this to be a lengthy document, but shall contain only the information needed to justify the remedy completion. EPA and DON believe the RACR should discuss how the remedial objectives in the RoD have been met. It should not be used to expand the scope of requirements beyond the original RoD.

Change: Eliminate the sub-bullets (subsidiary documents) under remedial action work plan for document streamlining purposes.

3. Secondary Documents:

Add: Five-Year Remedy Review (required by CERCLA)
- Provided to EPA for review and comment
- Subject to dispute resolution

Note: EPA has an important oversight role regarding the continuing protectiveness of the LUC. Therefore, EPA and Navy believe it is reasonable that EPA should review and comment on the Five-year Remedy Review. Since the review is required by CERCLA, it does not need to be a Primary Document.

Attachment 2

EXAMPLES OF LUC OBJECTIVES AND LUC IMPLEMENTATION ACTIONS

(Note: Actions are to be tailored to site-specific conditions.
This is neither a mandatory nor a complete list)

LUC OBJECTIVES (contained in RoD)

- Ensure no construction on, excavation of, or breaching of the landfill cap.
- Ensure no residential use or residential development of the property.
- Ensure no withdrawal and/or use of groundwater.
- Ensure no excavation of soils without a use permit and special handling procedures.

LUC IMPLEMENTATION ACTIONS (contained in the RD or RAWP)

- Conduct a CERCLA five-year remedy review of the LUC and provide to EPA for review (as a secondary document deliverable under the FFA).
- Conduct annual inspections of the LUC and report results (active or BRAC – responsible party to be defined).
- Record the LUC in the base master plan. (active)
- Produce a survey plat of the LUC by a state registered land surveyor. (active or BRAC).
- File the survey plat with the local government/Circuit Court for purposes of public notification (active or BRAC)
- Place a survey plat in CERCLA administrative record, and send copies to EPA and state. (active or BRAC).
- Develop and implement a base procedure that requires excavation to be approved by the Public Works Officer or equivalent official. (active)
- Develop and implement a base procedure that requires changes in land use to be approved by the Public Works Officer or equivalent official. (active)
- Notify the regulatory agencies 45 days in advance of any Base proposals for a major land use change at a site inconsistent with the use restrictions and exposure assumptions described in the RoD, any anticipated action that may disrupt the effectiveness of the land use controls, any action that might alter or negate the need for the land use controls, or any anticipated transfer of the property subject to the land use controls.
- Obtain regulator concurrence before modifying or terminating land use control objectives or implementation actions.
- Maintain a comprehensive list of LUCs with associated boundaries and expected durations.

Note: These examples are consistent with draft EPA guidance: "Describing Institutional Controls in Remedy Decision Documents at Active Federal Facilities".

Remedial Investigation and Risk Assessment Report

for

Site 19 – Small Arms Range 910

Naval Station Great Lakes

Great Lakes, Illinois

Naval Facilities Engineering Command Midwest

Contract Number N62467-04-D-0055

Contract Task Order 468

July 2010

REVISION 1
JULY 2010

REMEDIAL INVESTIGATION AND RISK ASSESSMENT REPORT

FOR

SITE 19 – SMALL ARMS RANGE 910

NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Midwest
201 Decatur Avenue, Building 1A
Great Lakes, Illinois 60088

Submitted by:
Tetra Tech NUS, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 468

JULY 2010

PREPARED UNDER THE SUPERVISION OF:

ROBERT DAVIS, PE
PROJECT MANAGER
TETRA TECH NUS, INC.

TERESE VAN DONSEL
REMEDIAL PROJECT MANAGER
NAVFAC MIDWEST

HOWARD HICKEY
PLC M-LINE
NAVFAC MIDWEST

APPROVED FOR SUBMITTAL BY:

JOHN TREPANOWSKI, PE
PROGRAM MANAGER
TETRA TECH-NUS, INC.

BRIAN A. CONRATH
REMEDIAL PROJECT MANAGER
ILLINOIS EPA

LESLIE MORROW
RISK ASSESSOR
ILLINOIS EPA

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ACRONYMS AND ABBREVIATIONS

ADAF	age-dependent adjustment factors
ATSDR	Agency for Toxic Substances and Disease Registry
BAP	Benzo(a)pyrene
BCF	bioconcentration factor
bgs	below ground surface
^{o}C	degrees Celsius
Cal EPA	California Environmental Protection Agency
CDC	Center for Disease Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic foot per second
COC	chemical of concern
COPC	chemical of potential concern
CSF	Cancer Slope Factor
CSM	conceptual site model
CTE	central tendency exposure
DA_{event}	absorbed dose per event
DAF	Dilution attenuation factor
DPT	direct push technology
eData	Electronic Data Collection Application
Eh	redox potential
EPC	exposure point concentration
EPRI	Electric Power Research Institute
ERA	Ecological risk assessment
EU	exposure unit
GRO	Groundwater Remediation Objective
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	Hazard Index
HQ	hazard quotient
IAS	Initial Assessment Study
IEUBK	Integrated Exposure Uptake Biokinetic
ID	inside diameter
IDQTF	Intergovernmental Data Quality Task Force

IDW	investigation-derived waste
ILCR	incremental lifetime cancer risk
Illinois EPA	Illinois Environmental Protection Agency
IRIS	Integrated Risk Information System
K_d	distribution coefficient
K_{oc}	organic carbon partition coefficient
K_{ow}	octanol/water partition coefficient
MCL	Maximum Contaminant Level
MI	mobility index
MRL	minimal risk level
MSA	metropolitan statistical area
MS/MSD	matrix spike/matrix spike duplicate
NCEA	National Center for Environmental Assessment
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response
PAH	polynuclear aromatic hydrocarbon
PCE	tetrachloroethene
PEF	particulate emissions factor
PID	photoionization detector
PPRTV	Provisional Peer Reviewed Toxicity Value
PRG	preliminary remediation goal
QA/QC	quality assurance/quality control
RA	Risk Assessment
RAIS	Risk Assessment Information System
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RTC	Recruit Training Center
S	solubility
SAP	Sampling Analysis Plan
SDG	sample delivery group
SL	Screening level

SOP	Standard Operating Procedure
SQL	sample quantitation limit
SRO	Soil Remediation Objective
SSL	Soil Screening Level
TACO	Tiered Approach to Corrective Action Objectives
TAL	Target Analyte List
TAU	Toxicity Assessment Unit
T_c	time of concentration
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TtNUS	Tetra Tech NUS, Inc.
UCL	upper confidence limit
UFP QAPP	Unified Federal Policy Quality Assurance Project Plan
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
XRF	x-ray fluorescence
VF	volatilization factor
VP	vapor pressure

EXECUTIVE SUMMARY

This Remedial Investigation (RI) and Risk Assessment (RA) Report was prepared for Site 19, Small Arms Range 910, at the Department of the Navy's Naval Station Great Lakes, Great Lakes, Illinois, under Contract Task Order 468. The RI/RA Report was prepared in accordance with the Comprehensive Long-Term Environmental Action Navy IV Contract Number N62467-04-D-0055 and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidance for conducting RIs and Feasibility Studies (USEPA, 1988). This investigation will provide data on select organic and inorganic chemical concentrations in soil and groundwater at Site 19.

SITE 19 SUMMARY

This report summarizes the environmental investigation of Site 19, Small Arms Range 910. Site 19 is the location of a former Recruit Training Center (RTC) Rifle Range housed within Building 910. The shooting range was in operation for 55 years until the demolition of Building 910 in 2000. Volatile organic compound (VOC), polynuclear aromatic hydrocarbon (PAH), and metal (primarily lead) contamination was suspected in the soil and groundwater at the site due to the spent ammunition and the use of solvents for gun cleaning operations. A former dry cleaning operation is in close proximity to Site 19, and contaminants from this operation may have migrated into the groundwater and soil of Site 19. Site 19 is currently open space composed of both grassy area and a gravel driveway/parking area.

Limited historical sampling has occurred at Site 19 and the surrounding area. These investigations are summarized in Section 2 of this report.

SUMMARY OF FIELD INVESTIGATION

The overall goal of this environmental investigation at Naval Station Great Lakes is to characterize the nature and extent of contamination at the site and to estimate human health risk for receptors exposed to groundwater, surface soil, and subsurface soil.

The RI field program involved collecting and analyzing groundwater, surface soil, and subsurface soil samples. Groundwater samples were collected from 2 monitoring wells and analyzed for VOCs, PAHs, and Target Analyte List (TAL) metals and cyanides. Sixteen surface samples were collected and analyzed for VOCs, PAHs, and TAL metals and cyanides. Twenty-two subsurface samples were collected by Direct Push Technology and the samples were analyzed for VOCs, PAHs, and TAL metals and cyanides. .

CONCLUSIONS

Based on the investigation and the risk assessment:

- Very few VOCs were detected at Site 19. Low concentrations of VOCs were detected in Site 19 groundwater, subsurface soil, and surface soil, and VOCs were detected at concentrations that were less than the minimum screening criteria.

- PAHs were present in groundwater, surface soil, and subsurface soil samples collected at Site 19. Benzo(a)anthracene and Benzo(a)pyrene exceeded the minimum screening criteria most frequently of the detected PAHs and were found in the three media sampled. PAH exceedances at Site 19 do not appear to be confined to any particular area of the site.

- Several metals were detected in surface soil and subsurface soil (but not groundwater) samples collected at Site 19 at concentrations greater than minimum screening levels. Lead concentrations exceeded the minimum screening level at most surface soil sampling locations except for NTC19SB15. Exceedances of lead in subsurface soil at Site 19 do not appear to be confined to any particular area of the site. In subsurface soil samples, lead was not detected as frequently in excess of the minimum screening level. Lead was detected at 7 of the 18 subsurface sample locations.

- Based on the human health risk assessment, the following contaminants were identified as chemicals of concern (COCs) based on non-cancer Hazard Quotients greater than 1.0 or cancer risks greater than $1x10^{-6}$: arsenic and PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and dibenzo(a,h)anthracene) in groundwater potentially used as drinking water and in soil. These are the primary COC risk drivers for total future residents. Groundwater at the site is not used and is not expected to be used in the future as drinking water. Naval Station Great Lakes is an active Navy facility and is expected to remain active for the foreseeable future. In accordance with Naval Station Great Lakes Instruction 11130.1 dated September 29, 2003, use of groundwater and surface water runoff within all geographical areas of the base, for any purpose, is strictly prohibited without prior written approval. Groundwater underlying Naval Station Great Lakes is not used for drinking water and is not expected to be used in the future. Drinking water for the base and residents of the surrounding communities is supplied from municipal systems drawing water from Lake Michigan.

- No chemicals in soil and groundwater were eliminated as chemicals of potential concern (COPCs) on the basis of comparisons to background concentrations. Most PAHs selected as COPCs in exposed

surface soil were detected at maximum concentrations that did not exceed surface soil background data. Based on this information and Illinois Environmental Protection Agency (Illinois EPA) determination of PAH background urban concentrations, it is possible that these PAHs could be attributed to background conditions and inclusion of these chemicals as COPCs may result in an overestimation of total risks for this site. In addition, based on the Illinois EPA Summary of Selected Background Conditions for Inorganics in Soil study, it is possible that the arsenic and manganese concentrations could also be attributed to background. The Illinois EPA TACO regulations that include the concentrations of PAH in background soil (Title 35, Part 742, Appendix A, Table H) and the concentrations of inorganics in background soil (Title 35, Part 742, Appendix A, Table G) are not Applicable nor Relevant and Appropriate Regulations at this site but merely a To Be Considered (TBC) regulation.

- The lead risk assessment results, based on the Integrated Exposure Uptake Biokinetic (IEUBK) Model, estimate a 0.136 percent chance that any child will have a blood lead value greater than 10 µg/dL, which is less than the United States Environmental Protection Agency (USEPA) acceptable target of 5 percent. The Adult Lead Model results indicate that the central estimate blood lead levels for construction workers and maintenance/occupational workers and their fetuses were less than the established level of concern (10 µg/dL). The model also shows the probabilities that receptor blood-lead levels would be less than USEPA's goal of limiting exposure to lead so that no more than 5 percent of the exposed receptors have an estimated blood-lead level greater than the established level of concern.

RECOMMENDATIONS

Based on the results of this RI/RA, no further investigation is warranted and preparation of a Focused Feasibility Study is recommended for this site. Potential remedial alternatives would include, but not be limited to, No Action, Limited Action (Land Use Controls), and a Removal Action. A Proposed Plan and Record of Decision should be prepared for the alternative recommended by the Focused Feasibility Study.

1.0 INTRODUCTION

This Remedial Investigation (RI) and Risk Assessment (RA) Report was prepared for Site 19, Small Arms Range 910, at the Department of the Navy's Naval Station Great Lakes, Great Lakes, Illinois, under Contract Task Order 468. The RI/RA Report was prepared in accordance with the Comprehensive Long-Term Environmental Action Navy IV Contract Number N62467-04-D-0055 and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidance for conducting RIs and Feasibility Studies (USEPA, 1988). This investigation will provide data on select organic and inorganic chemical concentrations in soil and groundwater at Site 19.

The Navy implemented the investigation of this site with a team of representatives from the Illinois Environmental Protection Agency (Illinois EPA), Naval Facilities Engineering Command Midwest and its consultant Tetra Tech NUS, Inc. (TtNUS), and the Naval Station Great Lakes Environmental Department. This RI/RA Report summarizes the December 2008 environmental investigation of Site 19 and the subsequent human health risk assessment (HHRA) for the site.

Figure 1-1 is an aerial view of Naval Station Great Lakes showing the location of Site 19, and Figure 1-2 is a site map. Site 19 is the location of a former Recruit Training Center (RTC) Rifle Range housed within Building 910. The shooting range was in operation for 55 years until the demolition of Building 910 in 2000. Volatile organic compound (VOC), polynuclear aromatic hydrocarbon (PAH), and metals (primarily lead) contamination was suspected in soil and groundwater at the site due to spent ammunition and the use of solvents for gun cleaning operations. A former dry cleaning operation is in close proximity to Site 19, and contaminants from this operation may have migrated to groundwater and soil at Site 19. Results from field screening 35 soil samples, laboratory analysis of the soil samples, and sampling of groundwater from two new monitoring wells are included in this R/RA Report. The soil and groundwater samples were analyzed for VOCs, PAHs, and metals.

1.1 RI/RA APPROACH AND OBJECTIVES

The overall goals of this RI/RA were to delineate the nature and extent of contamination and to identify potential risks associated with Site 19. The chemical data for Site 19 (groundwater and soil) were used to delineate the nature and extent of contamination and to conduct a HHRA (see Section 6.0). Exposure of ecological receptors to site contaminants is expected to be minor based on the industrial nature of the site and lack of suitable habitat. Therefore, it is not necessary to evaluate potential risks to ecological receptors at the site.

Naval Station Great Lakes is a Navy installation located within United States Environmental Protection Agency (USEPA) Region 5 and the State of Illinois. TtNUS has prepared this report on behalf of Naval Facilities Engineering Command Midwest and Naval Station Great Lakes to comply with USEPA Region 5 and Illinois EPA requirements and guidance governing the performance of RIs and RAs. In accordance with those requirements, project planning followed the USEPA Data Quality Objectives process (USEPA, 2000) and the Unified Federal Policy Quality Assurance Project Plan/Sampling and Analysis Plan (UFP QAPP/SAP) process (IDQTF, 2005), which require the following:

- Explicit statements of the problems to be solved.
- Identification of the spatial and temporal boundaries related to the problem and the measurements to be made in solving the problem.
- If applicable, quantitative specifications of the error tolerances for making decisions.

The processes culminated in the specification of decision rules designed to solve the stated problems documented in the Sampling and Analysis Plan (SAP) (TtNUS, 2008b).

1.2 REPORT SCOPE AND ORGANIZATION

This report documents the results from the RI/RA and contains the following sections:

1.0 Introduction
2.0 Site Background
3.0 Site Investigation Activities
4.0 Nature and Extent of Contamination
5.0 Chemical Fate and Transport Analysis
6.0 Human Health Risk Assessment
7.0 Conclusions and Recommendations

1.3 NAVAL STATION GREAT LAKES LOCATION AND DESCRIPTION

Naval Station Great Lakes is located in Lake County, Illinois, along the shore of Lake Michigan. It is bounded on the north by the City of North Chicago, on the south by the Veterans Administration Hospital and Shore Acres Golf Course and Country Club, on the east by Lake Michigan, and on the west by U.S. Route 41 (Skokie Highway).

1.4 REGIONAL ENVIRONMENTAL SETTING

1.4.1 Geography, Demography, and Land Use

Naval Station Great Lakes covers 1,632 acres in Lake County, Illinois. Lake County is located in northeastern Illinois, north of the City of Chicago, and includes 24 miles of Lake Michigan shoreline. Lake County extends from the Wisconsin border south to Cook County and from Lake Michigan west to McHenry County. Lake County is divided into 18 townships, 52 incorporated cities and villages, and 18 unincorporated cities and villages.

There are numerous lakeside communities in Lake County. The United States Census Bureau estimates the county's 2006 population to be 713,076. During the 1950s and 1960s, population growth occurred primarily in the lakefront communities, but by the 1980s and 1990s, population growth continued north and west. Currently, most of Lake County's population lives in the 52 incorporated cities and villages.

Current land uses in Lake County include agricultural, industrial, and residential. Farmland and lake resorts characterize the western portions of the county, and industrial, urban, and suburban areas follow the 24 miles of Lake Michigan shoreline on the east. There are also three state parks in Lake County.

Naval Station Great Lakes administers base operations and provides facilities and related support to training activities (including the U.S. Navy's only boot camp) as well as a variety of other military commands located on base. A variety of land uses currently surround Naval Station Great Lakes. Along the northern boundary of the base are the most highly urbanized and industrial areas. Much of the land beyond the northwestern site boundary comprises unincorporated lands of Lake County and is vacant except for scattered retail and residential properties. Adjacent to the western boundary are primarily industrial properties, and along the southern boundary is a mixture of public open space and residential land (TtNUS, 2008a).

1.4.2 Physiography and Topography

The gently rolling topography of Lake County, Illinois, is the result of glaciation. The most prominent topographic features are glacial moraines and other unconsolidated glacial deposits that cover most of Naval Station Great Lakes. The terrain of Naval Station Great Lakes consists of relatively flat glacial drift deposits bordered by steep lake-facing bluffs cut with vertical sloping ravines. The unconsolidated glacial material that comprises the bluff faces and ravine walls is under continual erosion.

The topography of Lake County creates poorly defined drainage patterns consisting of swales that enter depressions and marshes. Most of Naval Station Great Lakes is located on a plateau with elevations of 640 to 660 feet above mean sea level. The eastern portion of Naval Station Great Lakes and the Lake Michigan shoreline are at an elevation of approximately 600 feet above mean sea level.

Intensive development has replaced most of the oak, hickory, maple, and other hardwood forests that originally covered the area. Native woodlands occur primarily on the vertical sloped ravine of Pettibone Creek and on the bluffs facing Lake Michigan. The forested areas of Naval Station Great Lakes include white and red oak, maple, European larch, white and scotch pine trees, and shrubs including raspberry and blackberry bushes. The principal mammals in the Naval Station Great Lakes area include groundhogs, raccoons, squirrels, opossum, rabbits, chipmunks, and deer (TtNUS, 2008a).

1.4.3 Climate

The climate of Lake County, Illinois, is considered continental. Changes in temperature, humidity, cloudiness, and wind direction occur frequently. The summer season is warm with few prolonged hot periods. Although major droughts are infrequent, there are commonly long periods of dry weather during the growing season. The area receives approximately 34 inches of rain per year, with 63 percent occurring between April and September. The average seasonal snowfall range is 37.2 to 41.1 inches. The average temperature is 58 degrees Fahrenheit; the winter months normally have temperatures below freezing.

1.4.4 Soil

The soil of Lake County, Illinois, is classified into two groups, Morley-Beecher-Hennepin and Made Land soil. Morley-Beecher-Hennepin soil consists primarily of loams and silt loams and is located on level to very steep ravines. This soil is characterized as well to poorly drained and has low to moderate permeability. Made Land includes areas of man-made cuts and fills covered by roads and buildings. This fill material includes a variety of soil and non-soil materials that have not been characterized. The soil types that form the plateau where Naval Station Great Lakes is located include Morley, Aptakisic, Wauconda, Beecher, and silt loams (TtNUS, 2008a).

1.4.5 Regional Geology

The geologic units encountered at Naval Station Great Lakes include aeolian and lacustrine deposits, glacial till, and bedrock. Bedrock consists of Silurian Niagran and Alexandrian dolomite, the lowermost geologic unit encountered at Naval Station Great Lakes. The bedding is nearly horizontal to gently

eastward dipping in the vicinity of Naval Station Great Lakes. The interface between the bedrock surface and overlying till consists of 1 to 15 feet of broken bedrock (dolomite), gravel, sand, and coarser material. This material appears to be debris ground from the bedrock by the advancing glaciers of the Wisconsin Stage of glaciation during the Late Pleistocene epoch.

Unconsolidated glacial tills blanket Lake County. Several glacial moraine systems are present within the county including the Valparaiso, Tinley, Zion City, and Lake Border systems. Naval Station Great Lakes falls within both the Lake Border and Zion City moraine systems. In the northern portions of Naval Station Great Lakes, the Zion City moraine is exposed at the ground surface and extends from North Chicago to Waukegan, Illinois. These glacial moraine systems are composed of Wadsworth till, which constitutes the largest volume of surficial deposits overlying the bedrock. The Wadsworth till ranges from approximately 170 to 210 feet in thickness overlying the Silurian bedrock. This till is an unsorted mixture of sand, silt, and clay imbedded with pebbles, cobbles, and boulders. Interstices between the coarser-grained sediments are typically filled with fine clay-sized particles, resulting in low permeability. Generally, the Wadsworth till is clayey, with thin and irregular lenses of sand or silty sand occurring over limited areas. The till has been further subdivided into clayey and sandy phases according to the size of the dominant particles. Because clay comprises up to 70 percent of the till at Naval Station Great Lakes, the clayey phase dominates in the local area.

An aeolian material, the Richland loess, covers the Wadsworth till and ranges from 16 to 20 inches in thickness. This aeolian material is much finer grained than the underlying Wadsworth till. These wind-blown materials of the Richland Loess make up the current soil profile of Naval Station Great Lakes. Deposits of silt, clay, and sand of the Equality Formation characterize the central and southern portions of Naval Station Great Lakes (TtNUS, 2008a).

1.4.6 Regional Hydrology

Naval Station Great Lakes is located within both the North Branch Chicago River Drainage Basin and Lake Michigan North Drainage Basin. The divide between the basins is along Green Bay Road, which runs north to south through the center of the base. Overland flow from precipitation that does not infiltrate into the ground flows into the Skokie River (located south of Naval Station Great Lakes) or Pettibone Creek. The areas east of Green Bay Road drain into Lake Michigan through Pettibone Creek, and areas west of Green Bay Road drain into the Skokie River. Site 19 is located in the Pettibone Creek watershed.

Pettibone Creek is a small creek consisting of the North and South Branches, each with a minor tributary branch that flows through Naval Station Great Lakes and into Lake Michigan. Pettibone Creek flows

through well-defined ravines within Naval Station Great Lakes, and is characterized by moderately steep stream bed gradients and banks with 30 to 60 percent slopes. The Pettibone Creek watershed, one of five Lake Michigan watersheds in Lake County, Illinois, drains an area of 4.2 square miles. The hydrology of the watershed is well established.

There is very little floodplain area along Pettibone Creek because of the steeply sloped creek banks. During precipitation events, runoff from overhead bridges and nearby streets adds to the volume of Pettibone Creek. The North Branch of the creek has a short time of concentration (T_C), or time it takes for a unit of water to run the watercourse. The T_C is short because the water source is primarily from an urban area that has low infiltration rates and fast runoff rates during storms. As a result, Pettibone Creek is susceptible to flash floods characterized by high channel velocities and great erosive potential.

The North Branch of Pettibone Creek, which ranges between 15 to 30 feet wide and several inches to 2 feet deep, is a perennial stream that originates from three storm sewers at 22nd Street, runs southeast from the North Chicago area, and merges with the South Branch of Pettibone Creek. The North Branch, on Naval Station Great Lakes property, measures approximately 3,600 feet long before it discharges to the Boat Basin. An unnamed tributary flows into North Branch approximately 910 feet downstream of the origin of North Branch.

The South Branch, which ranges from 10 to 20 feet wide and several inches to 2 feet deep, begins in a residential area southwest of Naval Station Great Lakes. The South Branch, on Naval Station Great Lakes property, measures approximately 2,600 feet long before it merges with the North Branch approximately 950 feet upstream of the Boat Basin. An unnamed tributary flows into the South Branch approximately 1,500 feet downstream from the origin of the South Branch.

The Boat Basin is nearly 850 feet long and approximately 100 feet wide near the discharge of Pettibone Creek, widens to 225 feet in the center of the basin, and then decreases to 60 feet wide where it discharges into Lake Michigan. The water depth in the Boat Basin ranges from several inches to 5 feet.

Surface water in Pettibone Creek flows eastward. The Illinois State Water Survey calculated the average flow of Pettibone Creek as less than 10 cubic feet per second (cfs) or 4,488 gallons per minute. This can greatly increase during periods of precipitation (TtNUS, 2003b).

1.4.7 Regional Hydrogeology

Naval Station Great Lakes is located within the Great Lakes Basin aquifer system for groundwater storage. There are three major regional aquifer systems within the state of Illinois: the surficial aquifer system which are aquifers of alluvial and glacial origin (found throughout the Great Lakes Basin), the Silurian-Devonian aquifers (found in Wisconsin, Michigan, Illinois, Indiana, and Ohio), and the Cambrian-Ordovician (found in Wisconsin, Illinois, and Indiana). The surficial aquifer consists of unconsolidated glacial and alluvial deposits (mostly silt and pebbly clay) approximately 135 to 155 feet thick that overlie the limestone bedrock throughout much of the Great Lakes Basin. With exception to the surficial aquifer, the Silurian-Devonian and Cambrian-Ordovician aquifers are capable of yielding substantial quantities of water (USGS, 2006).

The silt and pebbly clay in the surficial aquifer has insufficient permeability to allow free groundwater movement. Water-bearing sand stringers do exist in this aquifer but these deposits which would characteristically be capable of transporting groundwater are neither abundant nor extensive to be considered favorable sources of groundwater (Illinois State Geological Survey, 1950).

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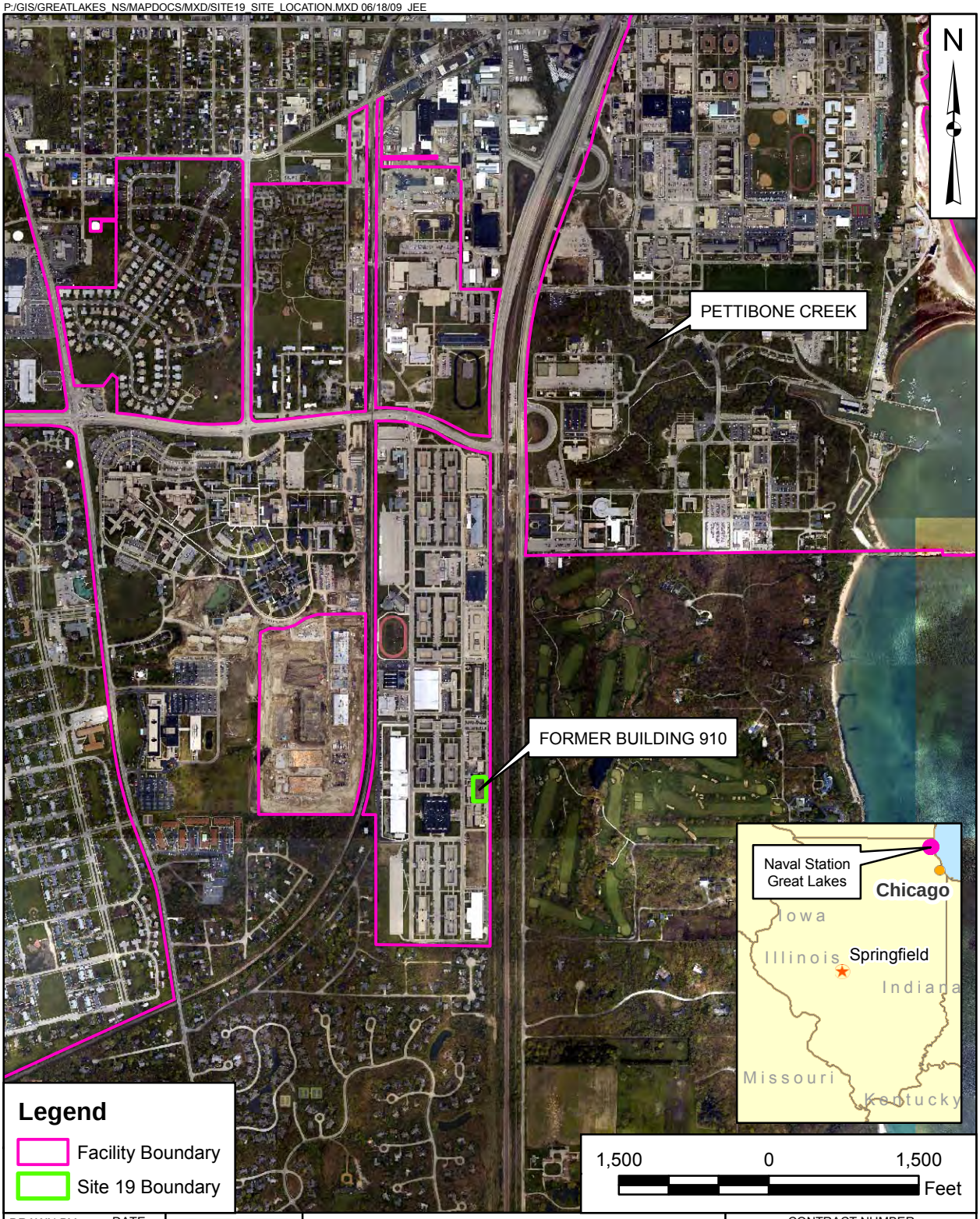

DRAWN BY K. MOORE	DATE 8/15/07	LOCATION MAP SITE 19 - FORMER BUILDING 910 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER CTO 0468
CHECKED BY G. STIEGEL	DATE 06/18/09		APPROVED BY RFD — DATE 06/19/09
REVISED BY ___	DATE ___		APPROVED BY ___ — DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 1-1 — REV 0

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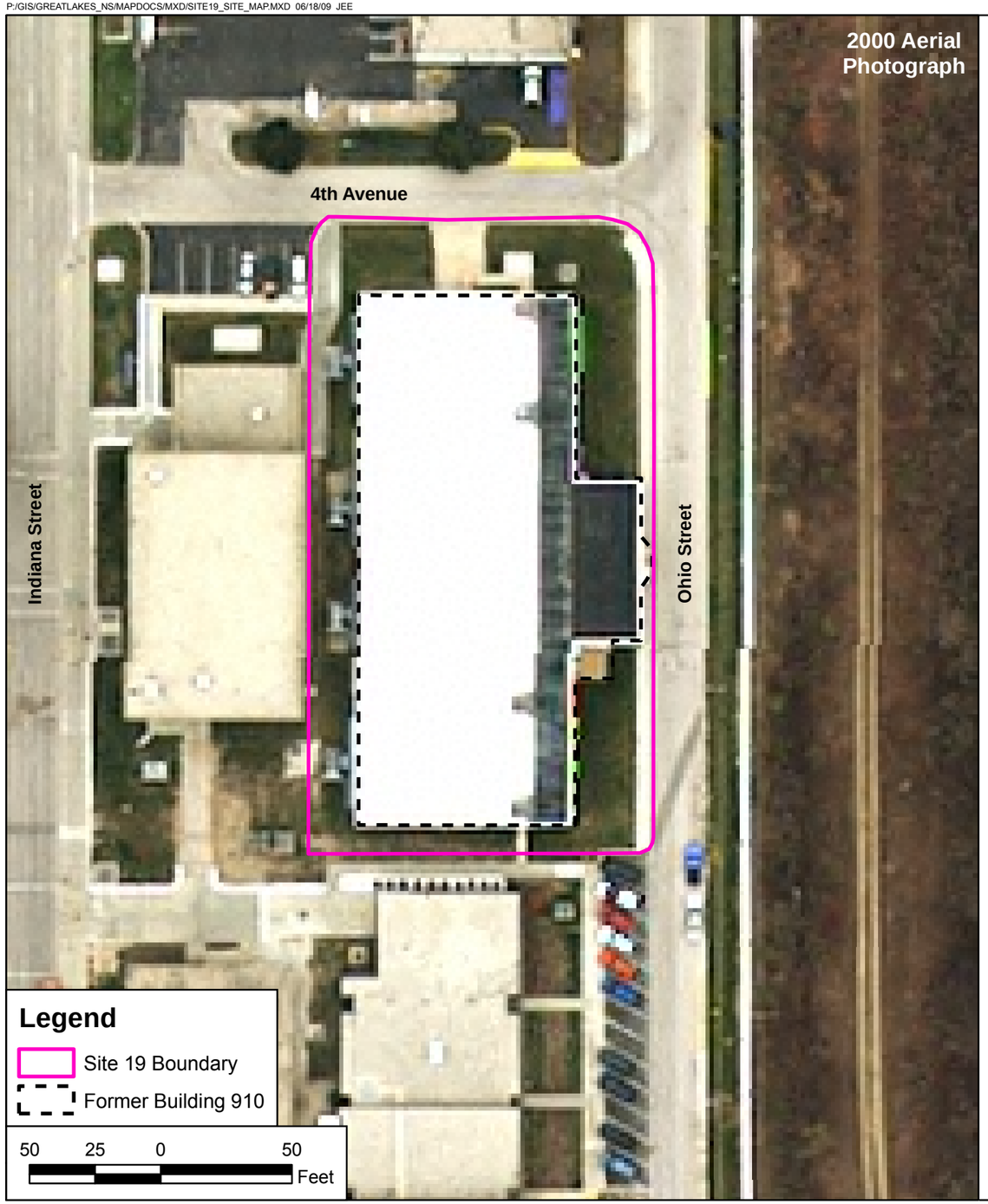

DRAWN BY K. MOORE	DATE 08/15/07	NAVFAC	SITE MAP SITE 19 - FORMER BUILDING 910 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER CTO 0468
CHECKED BY G. STIEGEL	DATE 06/18/09			APPROVED BY RFD — DATE 06/19/09
REVISED BY J. ENGLISH	DATE 06/18/09			APPROVED BY — DATE —
SCALE AS NOTED				FIGURE NO. FIGURE 1-2 — REV 0

2.0 SITE BACKGROUND

In 1986, an Initial Assessment Study (IAS) conducted at Naval Station Great Lakes identified waste management areas, disposal sites, and contaminated areas caused by past hazardous substance storage, handling, or disposal practices associated with Naval activities. Each site was evaluated with respect to contamination characteristics, migration pathways, pollutant receptors, and potential threats to human health or the environment. As part of the IAS, the Navy identified 14 potential areas where hazardous materials may have been released to the environment at Naval Station Great Lakes. Although it was not 1 of the 14 sites identified, the RTC Rifle Range (now known as Site 19) was named as a waste generation operation within Naval Station Great Lakes (Rogers, Golden, & Halpern, 1986). Following demolition of Building 910 in 2000, soil samples collected at the site had lead concentrations exceeding Illinois Tiered Approach to Corrective Action Objectives (TACO) values for commercial/industrial uses. Based on these results, the RTC Rifle Range was recommended for further investigation. The following sections provide a historical overview and background for Site 19.

2.1 SITE CHARACTERIZATION

2.1.1 Location and Description

Site 19 is the location of a former RTC Rifle Range housed within Building 910. The site is bounded on the north by 4th Avenue, on the east by Ohio Street, and on the south and west by grass and concrete associated with other buildings (Figure 1-2). Site 19 is currently open space composed of both a grassy area and gravel driveway/parking area. A former dry cleaning operation was located approximately 50 feet southwest of Site 19.

2.1.2 History

Site 19 was an indoor rifle range that operated between 1942 and 1997 and was demolished in 2000. Approximately 340,000 rounds of small arms ammunition (.22 caliber, .45 caliber, and 12 gauge) per year were delivered from the Mainside armory to the rifle range. Spent ammunition was collected from the floor of the range and deposited into 22-gallon cans. This waste spent ammunition was collected by the Defense Reutilization and Marketing Office once every 2 to 3 months. It is estimated that 19 million pounds of ammunition were generated by this facility, providing the potential for lead to have impacted site soil and groundwater.

Chemicals used at the rifle range include CLP brand cleaner (20 cases per year, each case containing 150 pint bottles) and standard issue bore cleaner #6850-00-224-6663 (3751-gallon cans per year). These chemicals are primarily composed of petroleum products and distillates (i.e., VOCs and PAHs) and were used on rags, with most of the chemical evaporating. Rags were reused for as long as possible and then disposed of in facility dumpsters along with the empty chemical cans or bottles The use of these chemicals provides the potential for VOCs and PAHs to have impacted site soil and groundwater.

A dry cleaning facility was located just southwest of former Building 910. Dry cleaning operations were active for over 50 years and ended in 2008. A Resource Conservation and Recovery Act (RCRA) storage unit and tanks were located at the northern end of the dry cleaning facility approximately 80 feet southwest of Site 19. Soil contamination associated with the dry cleaning operation has been documented, and these contaminants (i.e., chlorinated VOCs and their byproducts) may be present in soil and groundwater at Site 19. Although the quantity of solvents used at the dry cleaning facility is unknown, it is known that no more then 1,200 gallons of spent tetrachloroethene (PCE) were stored at the dry cleaning facility at any given time.

It was suspected that the former shooting and dry cleaning activities have impacted site soil and groundwater. The purpose of this RI/RA was to determine the risk to human health, if any, associated with this contamination.

2.2 SITE ENVIRONMENTAL SETTING

2.2.1 Geography and Land Use

Site 19 covers approximately 0.67 acre in an area that is mainly open space consisting of both a grassy surface and gravel area used as a parking lot.

2.2.2 Physiography and Topography

The topography of Site 19 is relatively flat with a gentle slope to the east towards Lake Michigan. Site 19 is on a plateau with elevations ranging from 640 to 660 feet above mean sea level.

2.2.3 Soil

The soil types that form the plateau where Site 19 is located include Morley, Aptakisic, Wauconda, Beecher, and silt loams. Soil in this area is characterized as well drained to poorly drained with slow to moderate permeability (TtNUS, 2001).

2.2.4 Ecology

General discussions of threatened and endangered plants and animals that occur or could potentially occur at Naval Station Great Lakes can be found in the Environmental Assessment for Implementation of an Integrated Natural Resources Management Plan at Naval Station Great Lakes, Illinois (U.S. Navy, 2001a).

Site 19 is located approximately 3,600 feet inland from the Lake Michigan shoreline of Naval Station Great Lakes. Recent bird surveys at Naval Station Great Lakes documented 34 species of breeding birds and 100 species of migratory birds, including the downy woodpecker and cooper's hawk (U.S. Navy, 1995 and 2000). Mammals likely or known to occur at Site 19 include the woodchuck, white-tailed deer, and raccoon. Ecological receptors that occur at Site 19 consist of those typically found in urban areas, such as terrestrial invertebrates, mammals, and various songbirds.

2.3 PREVIOUS SAMPLING EVENTS

Limited sampling has occurred at Site 19 and the surrounding area. In 1998, prior to the demolition of Building 910, two soil samples were collected adjacent to the building and analyzed for Toxicity Characteristic Leaching Procedure (TCLP) lead. The TCLP lead concentration in the sample collected near the northeastern corner of Building 910 was 18.3 mg/L, and the concentration in the sample collected near the southern edge of Building 910 was 6.16 mg/L (TtNUS, 2008b).

Soil samples were also collected in 2001 on Lake County property located east of Building 910, two of which were near Site 19. A sample collected slightly north and east of Site 19 had a lead concentration of 94.7 mg/kg and also had several PAH detections that exceeded residential and commercial criteria based on Illinois EPA TACO limits. A sample collected southeast of Site 19 had a lead concentration of 21.1 mg/kg and no TACO exceedances for PAHs (TtNUS, 2008b).

3.0 SITE INVESTIGATION ACTIVITIES

RI field activities for Site 19 were conducted from December 1 to 10, 2008, and consisted of surface and subsurface soil sampling, installation of two temporary monitoring wells, groundwater sampling of these monitoring wells, and aquifer testing of the two temporary monitoring wells. These field activities supported the collection of data to meet the following objectives:

- To characterize the nature and extent of contamination at the site.
- To estimate human health risk for receptors exposed to surface and subsurface soil and groundwater.
- To provide water level and hydraulic conductivity data useful for determining groundwater flow direction and velocity.

A summary of the field investigation sampling rationale is presented in Table 3-1, and summary of environmental sampling (surface soil, subsurface soil, and groundwater) activities is provided in Table 3-2. The following sections discuss deviations from the project SAP, field activities conducted, and site-specific geologic and hydrogeologic characteristics at Site 19 based on information collected as part of the RI.

3.1 DEVIATIONS FROM THE SAP

The following minor deviations from the SAP (TtNUS, 2008b) occurred during RI field activities at Site 19:

- Soil boring locations were adjusted due to large mounds of dirt recently stockpiled on the site. Borings were kept as close as possible to their original locations and actual locations were surveyed.

- Based on previous site information, lead contamination was expected to be detected 1 to 2 feet below ground surface (bgs) because the area was backfilled with topsoil, graded, and seeded after the demolition of the Small Arms Range 910 building. However, the X-Ray Fluorescence (XRF) instrument indicated elevated lead readings at the surface rather than deeper (1 to 2 feet bgs). Because of this observation, surface soil samples were classified as “native” or “fill” to distinguish between samples consisting of topsoil (fill) or samples consisting of native soil.

- Only two of the six proposed monitoring wells were successfully installed. Two well locations were advanced up to 40 feet bgs (deeper than the planned 20 feet bgs) in attempts to accumulate

groundwater in the well boring. Five additional (seven total) locations were attempted and were monitored for accumulated groundwater for at least 2 days after monitoring wells were installed. Because no water accumulated in these well points, they were abandoned and grouted.

Task modification forms were completed for these deviations and are included in Appendix A.1.

3.2 FIELD INVESTIGATION

The following sections discuss the activities performed during the RI at Site 19, including sampling of surface soil (native and fill), subsurface soil, and groundwater; monitoring well installation; groundwater level measurements; aquifer testing; and investigation-derived waste (IDW) management. The activities were conducted to meet the requirements of the SAP for Site 19 – Small Arms Range 910 Remedial Investigation at Naval Station Great Lakes, Illinois (TtNUS, 2008b). A TtNUS geologist supervised drilling and well installation activities and reviewed the associated field documentation, included in Appendix A. A TtNUS Illinois-licensed Professional Geologist reviewed the drilling logs, well completion logs, and field documentation. Field activities were conducted in accordance with TtNUS Standard Operating Procedures (SOPs) provided in the SAP (TtNUS, 2008b).

3.2.1 Direct-Push Technology Drilling/Sampling

Surface and subsurface soil samples were collected to provide information on the horizontal and vertical extent of constituents, primarily lead, in the area where Building 910 was located. A total of 20 soil borings (Table 3-2 and Figure 3-1) were advanced to 12 feet bgs using direct-push technology (DPT) methods. This technique involves pushing tools hydraulically into the ground to the desired depth and was used to collect both surface and subsurface soil samples at the 20 locations throughout Site 19. The soil samples were collected in 1.5-inch inside diameter (ID) 4-foot-long acetate liners. Soil cuttings generated during soil boring activities were placed in 55-gallon drums labeled as soil cuttings and handled as described in Section 3.2.10.

3.2.2 Surface and Subsurface Soil Sample Handling/Analysis

A summary of the soil samples collected and analyses performed during the Site 19 RI is presented in Table 3-2. Upon sample retrieval, each soil core was screened by a TtNUS geologist for the presence of volatile organics with a photoionization detector (PID) (calibrated to 100 part per million isobutylene) and lead using an XRF, and visually classified for lithology, soil moisture, and other pertinent observations. Soil samples for laboratory analysis were collected at each location. According to the SAP, surface soil samples were to be collected from 1 to 2 feet bgs based on information that approximately 1 foot of fill

material had been placed over native soils. Subsurface soil samples were to be collected at depth intervals greater than 3 feet at locations with maximum XRF lead readings. Some XRF lead readings were greater at the surface (0 to 2 feet), and samples were collected at the surface (surface soil "fill") as well as at locations that were observed to be native soil locations (surface soil "native") (Table 3-2). At a minimum 10 samples were collected in each, "fill" and "native", to assist in the risk analysis.

Soil boring logs were recorded in an Electronic Data Collection Application (eData) and are provided in Appendix A.2. eData is a web-based software for the comprehensive planning, collection, management, and use of environmental data.

The soil fractions to be analyzed for VOCs were collected first using EnCore samplers and placed in a cooler of ice maintained at 4 degrees Centigrade (°C). The soil fractions to be analyzed for PAHs and metals were mixed, placed into the required containers, immediately sealed, and placed in a cooler at 4°C. The 4-foot-long clear acetate sleeves were cleaned of soil and disposed of as non-hazardous municipal trash on site. Soil sample log sheets were also recorded in eData and are provided in Appendix A.3.

The soil samples were shipped to Empirical Laboratories in Nashville, Tennessee, for chemical analysis (see Section 3.2.8 for additional information on sample handling, packaging, and shipping procedures). In general, sample fractions were containerized in the following sequence: VOCs, metals and PAHs, and grain size (Table 3-2). Results of soil sample analyses are presented in Section 4, validated laboratory data memoranda are provided in Appendix B, and laboratory analytical summary sheets are provided in Appendix C.

3.2.3 Well Drilling and Installation

Six monitoring wells were proposed to be installed at Site 19 during the RI with screened intervals between 5 and 15 feet bgs based on information from Site 7, which is approximately 2,200 feet north of Site 19 (TtNUS, 2003a). However, after placing temporary wells at seven locations to depths up to 40 feet bgs, only two were producing water after 2 days. The well locations attempted are shown on Figure 3-2. At these two locations, NTC19MW01 and NT19MW02, temporary groundwater monitoring wells were installed, and a summary of the monitoring well construction information can be found in Table 3-3. At the other five locations, very dense clay was observed from approximately 5.5 feet bgs to the bottom of the well, between 30 and 40 feet bgs.

Hollow-stem auger techniques were used for monitoring well drilling operations. The total depths of the two monitoring wells, NTC19MW01 and NTC19MW02, were 16 and 18 feet bgs, respectively. The nominal diameter of the well borings was approximately 8 inches. Each monitoring well was constructed of 2-inch, ID Schedule 40 polyvinyl chloride, flush-joint riser pipe, and 10-foot-long, flush-joint, factory-slotted, polyvinyl chloride well screen and an end cap, as described in the SAP (TtNUS, 2008b). Each section of casing and screen was National Sanitation Foundation approved and met American Society for Testing and Materials Standard A312-86a. The well screens had a slot size of 0.01 inch (10 slot) and were supplied with a flush-joint end cap. The locations of the five borings that did not produce groundwater and were abandoned are shown on Figure 3-2.

After the riser pipe and screens were in place, the annulus of the boring was backfilled with U.S. Standard Sieve size of No. 10-20 clean silica sand from the bottom of the boring to a minimum of 1 foot above the top of the well screen. Four and a quarter-inch ID hollow-stem augers were used to hold the borehole open as the clean silica sand was placed around the well screen. As the sand pack was installed, the augers were slowly retrieved to provide an adequate sand pack around the well. A bentonite seal consisting of bentonite chips (minimum 2-foot thickness) was then installed above the sand pack and allowed to hydrate in accordance with the manufacturer's recommendations. The depths of construction materials were constantly monitored during the installation of the monitoring wells by using a weighted stainless steel or plastic tape to make sure that no bridging of the sand pack or bentonite seal occurred during the installation process. Grout was then poured into the remaining borehole annulus to ground level and then concrete was poured to complete the well. Because these wells were installed as temporary wells, the surface around the well was finished with a concrete well pad and stick-up PVC pipe with a locked well plug.

Environmental Field Services, a licensed Illinois driller, installed the two monitoring wells at the site. A TtNUS geologist supervised the drilling and well installation activities, prepared the drilling logs and well completion logs, and reviewed the field documentation. A TtNUS Illinois-licensed Professional Geologist reviewed the drilling logs, well completion logs, and field documentation. Boring logs are provided in Appendix A.2, and well construction diagrams are provided in Appendix A.4. Well permit records are provided in Appendix A.8.

3.2.4 Monitoring Well Development

After the two monitoring wells were installed, they were developed to remove fine materials (i.e., silts and clays) from the sand pack and the immediate area around the screened interval of the wells. The monitoring wells were developed no sooner than 24 hours after well completion to allow for settling/curing

of the grout. NTC19MW01 was developed by using a whaler pump (a high-rate submersible pump). During pumping, the well screen was periodically surged and the saturated screen interval was swept to remove fine materials. NTC19MW01 was pumped for 1 hour, and approximately 9.5 gallons of water was purged. Because NTC19MW02 was not producing much water, a peristaltic pump was used to develop it at a lower rate. After pumping approximately 1.5 gallons of water for 10 minutes, the well went dry. Development water was monitored for pH, temperature, turbidity, and specific conductance every 5 minutes during pumping. The development water was containerized in 55-gallon drums and labeled as IDW.

The wells were considered developed after the water was visually clear or the well went dry. Measurements from monitoring well development were recorded on development sheets included in Appendix A.5.

3.2.5 Groundwater Level Measurements

One round of synoptic water level measurements was collected from the two wells at the site to determine static water potentiometric water surface elevations for shallow groundwater. The five other proposed well locations did not produce water, and therefore, wells were not installed.

The synoptic measurements were collected within a 1-hour period of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater levels. Measurements were collected with a Solinst electronic water level indicator using the top of the well casing (i.e., riser pipe) as the reference point for determining the depth to water in each well. Water level measurements were collected from a notch made at the top of each casing to make sure that future rounds of synoptic measurements are collected from a consistent point. Water level measurements were recorded to the nearest 0.01 foot on groundwater sample log sheets included in Appendix A.6.

3.2.6 Groundwater Sampling

Two groundwater samples were collected at Site 19 occurred on December 8, 2008, and analyzed for VOCs, PAHs, and metals. Table 3-2 provides a summary of the groundwater samples collected.

The monitoring wells were purged and sampled using standard purging techniques (low flow) in accordance with the SAP (TtNUS, 2008b). Using a peristaltic pump and disposable polyethylene tubing, one to three screen casing volumes were purged from the NTC19MW01. Prior to purging, the intake of

the sampling pump was placed at the approximate midpoint of the water column present in the well and at least 2 feet from the bottom of the well.

At the start of purging NTC19MW01, pumping was conducted at a low rate to minimize drawdown. Water quality parameters (pH, temperature, specific conductance, turbidity, and dissolved oxygen) were measured and recorded at 5- to 10-minute intervals (Appendix A.6) until the parameters stabilized for at least three consecutive readings and the minimum purge volume (one screen volume) was removed. Stabilization of the above parameters was defined as follows:

- pH ± 0.2 standard unit
- Temperature ± 10 percent
- Turbidity less than 10 nephelometric turbidity units (NTUs)
- Specific conductance ± 10 percent
- Dissolved oxygen ± 10 percent

Because the turbidity remained greater than 10 NTUs but the other field parameters stabilized, a filtered sample for metals analysis was collected in addition to the unfiltered sample. Purge water was containerized in 55-gallon drums and labeled as IDW.

After the parameters stabilized and immediately prior to sampling, the temperature, pH, specific conductance, turbidity, and dissolved oxygen of the groundwater sample from NTC19MW01 were measured and recorded on a Groundwater Sample Log Sheet in eData. The sample containers were filled by allowing the pump discharge to flow with minimal turbulence down the inside of the container. For the collection of filtered samples, an in-line, 0.45-micron, disposable particulate filter was used.

Based on how quickly NTC19MW02 went dry during development and produced very little water within the next 24 hours, this well was not purged prior to sampling. Instead, water quality parameters were measured after the sample containers were filled. The sample from this well was collected within 24 hours of the well being pumped dry during development.

Groundwater Sample Log Sheets are provided in Appendix A.6. The results of groundwater sample analyses are presented in Section 4, validated laboratory data memoranda are provided in Appendix B, and laboratory analytical summary sheets are provided in Appendix C.

3.2.7 Aquifer Testing

A slug test was performed in monitoring well NTC19MW01 to determine the hydraulic characteristics of the formation in the immediate vicinity of the well. There was insufficient water to complete a slug test in NTC19MW02. Prior to performing the slug test, the static water level was recorded along with the well construction details on a Hydraulic Conductivity Testing Data Sheet (see Appendix D). A rising-head test was performed by inserting a solid plastic slug into the well to raise the water level, and water level and time data were collected until the static water level returned to equilibrium. The solid slug was then removed and the rate of increase in the water level back to equilibrium (rising-head test) was measured. The change in water level was induced as quickly as possible because slug test data analysis methods assume an instantaneous change in head. A falling-head test was not performed because the water level was within the screened interval (i.e., below the top of the well screen). The well that was slug tested was developed prior to slug testing.

Slug test data (water levels in feet of head and time) were collected using a Solinst levelogger with a pressure transducer and manually checked using an electronic water-level indicator. Slug test data were used to calculate a horizontal hydraulic conductivity value for the aquifer in the immediate vicinity of the well. The data were analyzed using the Bouwer-Rice Method (Bouwer and Rice, 1976) in the Windows-based program AQTESOLV. Slug test results are discussed in Section 3.5.3, and slug test calculations are provided in Appendix D.

3.2.8 Sample Handling, Packaging, and Shipping

This section of the RI identifies the general procedures used for storing and transferring collected samples. The following subsections describe the precautions taken to make sure that sample integrity was maintained throughout the sample collection and shipping processes.

3.2.8.1 Sampling Handling

Each sample was divided among three to four containers, with each container specific to the analysis of one or more analyte groups (fractions). Sample collection followed a logical sequence to make sure that the more volatile components of samples were not lost or that losses were minimized during sample handling. For example, samples for VOCs were collected first and containerized immediately after collection to prevent or minimize losses from volatilization. For groundwater, the VOC sample vial was tilted and the water sample was allowed to slowly trickle down the side to minimize agitation and disturbance, again to prevent loss of VOCs. Aqueous VOC samples were collected so that the vials did

not have air bubbles in them after containerization (no head space). In general, sample fractions were containerized in the following sequence: VOCs, metals, PAHs, and grain size.

Sample nomenclature was assigned in accordance with the SAP (TtNUS, 2008b). Samples were shipped in coolers via air courier (e.g., Federal Express) to Empirical Laboratories in Nashville, Tennessee. Samples were associated into sample delivery groups (SDGs) compiled in the chronological sequence in which the samples were received at the laboratory over a period of up to 4 days. Additional details concerning various aspects of sample handling are provided below.

3.2.8.2 Sample Preservation

Preservation requirements for samples for each of the analytes of interest were provided in Worksheet #19 of the SAP (TtNUS, 2008b). Sample bottles for aqueous samples contained the proper amounts and types of preservatives prior to being shipped to Naval Station Great Lakes. The samples were promptly chilled with ice to 4 ± 2°C and packaged in an insulated cooler. Each cooler included a temperature blank. The samples and ice were sealed in heavy-duty plastic bags to prevent water leakage.

3.2.8.3 Sample Labeling

Sample labels were printed from eData during sample collection. Before samples were packaged, the sample labels were checked to make sure that the information on the label was complete and correct. This information was also compared to the information on the sample collection log sheet and the chain-of-custody form.

3.2.8.4 Sample Packaging

Each sample container was placed in a zip-lock bag to prevent cross-contamination or leakage. The zip-lock bag was then placed in a bubble-wrap sleeve to protect it from breakage. Only shipping containers that met minimum packaging requirements of 49 Code of Federal Regulations 174 for safe shipment were used. Ice was then placed around and between the samples in sufficient quantity to chill the samples to 4 ± 2°C during transport to the analytical laboratory.

The completed field chain-of-custody forms were signed, placed in a sealed plastic envelope, and taped to the top inside cover of the shipping container. Appendix A.9 includes copies of the completed chain-of-custody forms. The Field Operations Leader was responsible for completion of the following forms:

- Sample labels
- Chain-of-custody forms
- Custody seals for coolers
- Shipping labels for coolers
- Express mail air bills

3.2.8.5 Sample Shipping

Shipping containers (i.e., coolers) were sealed with nylon strapping tape, and custody seals were signed, dated, and affixed in a manner that would allow the receiver to identify tampering that may have occurred during transport to the laboratory.

Shipments were made by Federal Express following completion of sample collection. Copies of the air bills were retained by the Field Operations Leader and assigned to the chain-of-custody in eData for tracking purposes, if needed, and for communications with the laboratory.

3.2.9 Surveying

The soil boring locations at Site 19 were surveyed for horizontal control by Graef, Anhalt, Schloemer & Associates, Inc. (Illinois licensed) in accordance with the SAP (TtNUS, 2008b). The monitoring wells at Site 19 were also surveyed for horizontal and vertical control. The soil boring and monitoring well locations were surveyed horizontally to the nearest 0.10 foot. The top of riser (where notched) and ground surface elevations adjacent to the protective cover at each monitoring well location were surveyed to within 0.01-foot vertical accuracy. The northing and easting coordinates are referenced to the Illinois State Plane Coordinate System, North American Datum 1988 and the vertical elevations are referenced to the North American Vertical Datum 1988.

3.2.10 Investigation-Derived Waste

During RI field activities, decontamination water, development water, purge water, and soil cuttings were containerized in 55-gallon drums and stored on site. Other IDW such as disposable trowels, paper towels, and acetate sleeves were double-bagged and placed in Naval Station Great Lakes trash receptacles (dumpsters). Following the investigation, composite soil and water samples from the drums were submitted for laboratory testing to characterize the waste for appropriate disposal. Composite samples for both soil and purge/decontamination water were collected and analyzed for TCLP organics, inorganics, flash point, pH, reactive sulfide, reactive cyanide, phenolics, polychlorinated biphenyls and

Naval Station Great Lakes required parameters. Completed Waste Profiles were signed and are provided in Appendix E. The IDW was handled in accordance with the SAP (TtNUS, 2008b). The drums were picked up, transported, and disposed by Industrial Water Services of Chicago, Illinois; a Naval Station Great Lakes approved transportation and disposal company.

3.2.11 Borehole Abandonment

Abandonment of boreholes for temporary monitoring wells that did not produce groundwater occurred after it was determined that no water was accumulating in the borehole. Environmental Field Services performed the borehole abandonment according to Illinois State regulations. The temporary well points were removed and the boreholes were backfilled with bentonite chips and hydrated per the manufacturer's recommendations. Surface conditions were matched to the surrounding area.

3.3 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

TtNUS established a quality control (QC) program to monitor and assess the quality of field work and laboratory work performed during environmental investigation. This program included various types of QC samples as indicated below. The field quality control samples consisted of temperature blanks, field duplicates, matrix spike/matrix spike duplicate (MS/MSD), trip blanks, equipment rinsate blanks, and source water blanks. Temperature blanks were included in each cooler submitted to the laboratory to monitor sample storage conditions prior to arrival at the laboratory. One field duplicate sample was collected per 10 samples. The purpose of the field duplicate sample was to examine the variability of the samples. One trip blank was collected per shipment of VOC samples. The purpose of the trip blank was to examine the potential for cross contamination of samples during shipping. One equipment rinsate blank was collected for each type of non-dedicated soil sampling equipment used. The common purpose of the equipment rinsate blank is to examine the effectiveness of the decontamination procedures. One source water blank was collected per water source used for the purpose of evaluating contamination in water used for decontamination activities. Matrix spikes (MS) are investigative samples analyzed to provide information about the effect of the sample matrix on the digestion and measurement methodology. The MS for organic analysis are performed in duplicate. MS and duplicate samples were collected at a frequency of 1 per 20 samples. For inorganics; an MS and a sample duplicate was collected. For organics, an MS and a matrix spike duplicate (MSD) was collected. MS/MSDs and sample duplicates are not applicable for field analyses. Each type of field QC sample had the same preservation, analysis, and reporting procedures as the related environmental samples with the exception of temperature blanks. The log sheets for the quality assurance/quality control (QA/QC) samples are included in Appendix A.7. Laboratory QC samples consisted of laboratory control samples, laboratory

duplicates, internal standards, laboratory method blanks, matrix spikes, matrix spike duplicates, post digestion spikes, and surrogates. Empirical Laboratories conducted the laboratory QC in accordance with the SAP (TtNUS, 2008b). TtNUS reviewed the laboratory quality control during the data validation and noncompliances were noted in the data validation memoranda in Appendix B.

3.4 SITE-SPECIFIC GEOLOGY

Geologic conditions at Site 19 were characterized as part of the RI. Surface and subsurface materials at Site 19 were characterized based on acetate liner samples collected during the drilling of soil and well borings during the TtNUS field investigation. The visual classifications were utilized to develop geologic cross-sections for the site. Figure 3-3 presents the locations of the geologic cross sections based on select borings across Site 19. Figures 3-4 and 3-5 show cross-sectional transects A-A' and B-B' respectively, that were developed from the soil boring data collected.

The shallow subsurface lithology of Site 19 from about 1 to 4 feet to a depth of 40 feet bgs consists predominantly of brown silty clay grading to gray clay with occasional interbeds of gravel, sand, or silt. Typically, above the clay is fill material. The southwestern portion of the site included predominately more sand (Figure 3-4 and 3-5 and Table 3-4).

Laboratory sieve analysis of three sample locations from these deposits (Table 3-4) indicates that the Unified Soil Classification System description of these soils ranges from ML (sandy silt) to CL (silty clay).

3.5 SITE-SPECIFIC HYDROGEOLOGY

The hydrogeologic conditions at Site 19 were interpreted from data collected during the subsurface investigation activities at the site, including drilling, groundwater sampling, groundwater level measurements, and aquifer testing.

3.5.1 Hydrogeologic Framework

The shallow water table aquifer was characterized at Site 19. A deeper (confined) aquifer is most likely present (based on previous studies at adjacent areas) but was not part of this investigation. The top of the shallow aquifer ranges from approximately 5.5 to 7.5 feet bgs and is composed primarily of unconsolidated silty clays to clays and minor silts with discontinuous sand and gravel lenses interspersed throughout (see Figures 3-4 and 3-5). Because many unsuccessful attempts were made to complete groundwater wells from borings that penetrated these units, it was determined that the water encountered in these lenses is perched water and is not found in sufficient quantity to sustain a permanent monitoring

well. In general, the water table within these heterogeneous deposits is shallow and was typically encountered at depths ranging from 5.5 to 7.5 feet bgs at the site.

3.5.2 Groundwater Flow Directions

Groundwater flow directions for the shallow water table aquifer were determined based on the synoptic water-level measurements collected on December 8, 2008 (see Table 3-3). Water-level measurements were collected from NTC19MW01 and NTC19MW02 since they were the only wells to successfully produce enough water to do so. NTC19MW03 through NTC19MW07 did not produce water therefore measurements were not obtained from these wells. Groundwater elevations were determined based on the two depths to water measurements, then posted on site maps and evaluated. Figure 3-6 presents the groundwater potentiometric surface for the shallow water table aquifer at the site. Since only two water-level readings were obtained it is difficult to make assumptions about groundwater flow direction.

3.5.3 Aquifer Test Results

A rising-head slug test was conducted in one monitoring well at the site as described in Section 3.2.7. This slug test was performed to generate an estimate of horizontal hydraulic conductivity in the immediate vicinity of the well. The slug test was performed in monitoring well NTC19MW01. The results of the test evaluations are presented in Table 3-5. The calculated horizontal hydraulic conductivity value in NTC19MW01 was 1.79 feet per day. This value is within the typical range for silty sands and sand and gravel lenses in the literature (Fetter, 1980 and Freeze and Cherry, 1979). Conversely, it is not representative of the predominantly clay formation at the remainder of the site.

A falling head slug test was not conducted at this well due to the static water level being within the screened interval.

3.5.4 Groundwater Velocities

The hydraulic gradient for the shallow groundwater at the site was calculated graphically from groundwater elevations found on Figure 3-6, based on the groundwater flow paths presented.

Only two of the seven wells onsite produced water. The other wells were either dry or had only a few inches of water present. It is assumed that ground water is present at the other well locations based on visual observation while advancing soil borings but the porosity of the clay was so low that it did not allow for water to easily move into the well. The wells that produced water were located in the southwestern corner of the site where a sand lens allows one to determine hydraulic head in a well.

TABLE 3-1

SAMPLING RATIONALE
SITE 19 - SMALL ARMS RANGE
NAVAL STATION GREAT LAKES, ILLINOIS

Sample Location	Sampling Rationale
Surface Soil	
NTC19SB001 to NTC19SB20	Utilized PID to determine high concentrations of VOCs. Utilized the XRF to determine high concentrations of lead. Samples were collected for Metals, VOCs, and PAHs. Samples were split between surface soil native and surface soil fill.
Subsurface Soil	
NTC19SB01 to NTC19SB20 (various)	Utilized PID to determine high concentrations of VOCs. Utilized the XRF to determine high concentrations of lead. Sample depth was biased to the higher readings. Sampled were collected for Metals, VOCs, and PAHs.
Groundwater	
NTC19MW01 to NTC19MW02	Samples collected from these wells primarily to determine if lead is migrating into the groundwater. Also collected VOC and PAH to deterimine if solvents from gun cleaning have traveled into the groundwater.

TABLE 3-2

SAMPLING SUMMARY
SITE 19 - SMALL ARMS RANGE
NAVAL STATION GREAT LAKES, ILLINOIS

Sample Name	Depth (feet bgs)	XRF and PID	TCL VOCs	TCL PAHs	TAL Metals and Cyanide	Grain Size	Field Parameters[3]
SURFACE-FILL							
NTC19SB01-SO-0002	0-2	X			X		
NTC19SB03-SO-0001	0-1	X			X		
NTC19SB06-SO-0001	0-1	X			X		
NTC19SB07-SO-0001	0-1	X			X		
NTC19SB08-SO-0103	1-3	X	X	X	X		
NTC19SB09-SO-0002	0-2	X	X	X	X		
NTC19SB10-SO-0002	0-2	X	X	X	X		
NTC19SB11-SO-0002	0-2	X	X	X	X		
NTC19SB12-SO-0002	0-2	X	X	X	X		
NTC19SB17-SO-0002	0-2	X	X	X	X		
NTC19SB19-SO-0002	0-2	X	X	X	X		
NTC19SB20-SO-0002	0-2	X	X	X	X		
SURFACE-NATIVE							
NTC19SB01-SO-0608	6-8	X	X	X	X		
NTC19SB02-SO-0204	2-4	X	X	X	X		
NTC19SB03-SO-0103	1-3	X	X	X	X		
NTC19SB04-SO-0204	2-4	X	X	X	X		
NTC19SB05-SO-0406	4-6	X	X	X	X		
NTC19SB06-SO-0204	2-4	X	X	X	X		
NTC19SB07-SO-0507	5-7	X	X	X	X		
NTC19SB13-SO-0103	1-3	X	X	X	X		
NTC19SB14-SO-0204	2-4	X	X	X	X		
NTC19SB15-SO-0103	1-3	X	X	X	X		
NTC19SB16-SO-0103	1-3	X	X	X	X		
NTC19SB18-SO-0204	2-4	X	X	X	X		
SUBSURFACE							
NTC19SB03-SO-0810	8-10	X	X	X	X		
NTC19SB05-SO-0608	6-8	X	X	X	X	X	
NTC19SB06-SO-0608	6-8	X	X	X	X		
NTC19SB08-SO-0406	4-6	X	X	X	X		
NTC19SB09-SO-0406	4-6	X	X	X	X		
NTC19SB10-SO-0507	5-7	X	X	X	X		
NTC19SB12-SO-0507	5-7	X	X	X	X	X	
NTC19SB14-SO-0507	5-7	X	X	X	X		
NTC19SB15-SO-0406	4-6	X	X	X	X		
NTC19SB16-SO-0507	5-7	X	X	X	X		
NTC19SB17-SO-0406	4-6	X	X	X	X		
NTC19SB18-SO-0406	4-6	X	X	X	X	X	
NTC19SB19-SO-0406	4-6	X	X	X	X		
NTC19SB20-SO-0406	4-6	X	X	X	X		
GROUNDWATER							
NTC19MW01-1208			X	X	X		X
NTC19MW02-1208			X	X	X		X

Field parameters include temperature, pH, specific conductance, turbidity, oxidation-reduction potential, and dissolved oxygen.

Notes:
bgs - below ground surface
TCL - Target Compound List
VOCs - Volatile organic compounds
PAHs - Polynuclear aromatic hydrocarbons
TAL - Target Analyte List
TOC - Total organic carbon
PID - Photoionization detector
XRF - X-Ray Fluorescence Spectrometer

TABLE 3-3

SUMMARY OF MONITORING WELL CONSTRUCTION AND WATER LEVEL DATA
SITE 19 - SMALL ARMS RANGE
NAVAL STATION GREAT LAKES, ILLINOIS

Well ID	Ground Surface Elevation (feet above msl)	Top of Stick-Up Well Casing Elevation (feet above msl)	Monitoring Well Stick-Up Height	Bottom of Boring (feet bgs)	Screened Interval		12/2008	
					Top (feet bgs)	Bottom (feet bgs)	Depth to Water (feet)	Water Level (feet above msl)
NTC19MW01	662.56	665.04	2.48	16.00	5.50	15.50	7.48	655.08
NTC19MW02	661.95	664.89	3.13	18.63	8.13	18.13	12.78	649.17

bgs: Below ground surface.
msl: Mean sea level.
Prior to installation of monitoring wells, exploratory direct push technology boring was performed to determine well depth and screen position.
Above measurements are taken from top of casing.
NA - Not available.

TABLE 3-4

SUMMARY OF SIEVE ANALYSIS RESULTS
SITE 19 - SMALL ARMS RANGE
NAVAL STATION GREAT LAKES, ILLINOIS

Fraction	**NTC19SB05-SO-0608**	**NTC19SB12-SO-0507**	**NTC19SB18-SO-0406**
NO. 40 SIEVE (% passing)	71		
NO. 100 SIEVE (% passing)	50		
NO. 200 SIEVE (% passing)	40	100	100
0.026 mm (% passing)		44	14
0.01 mm (% passing)		32	10
0.0074 mm (% passing)		28	8
0.0052 mm (% passing)		22	6
0.0043 mm (% passing)		22	4
0.0019 mm (% passing)		12	4
USCS SYMBOL	SC	CL	CL
USCS CLASSIFICATION	SAND with Clay	CLAY	CLAY

TABLE 3-5

SUMMARY OF AQUIFER TEST RESULTS
SITE 19 - SMALL ARMS RANGE
NAVAL STATION GREAT LAKES, ILLINOIS

Well	Test	Screen Length (ft)	Saturated Thickness (ft)	K (ft/day)	K (ft/min)	K (cm/sec)
NTC19MW01	Rising-head	10	8.04	1.788	1.2E-3	6.3E-4

Well diameter was 2 inches (0.1667 foot) and wellbore diameter was 8.00 inches (0.667 foot).
Data analyzed using AQTESOLV for Windows using Bouwer-Rice solution (Bouwer, H., and Rice, R.C., 1976).
K = Horizontal hydraulic conductivity.

P:\GIS\GREAT_LAKES_NS\MXD\SITE19_SB-SAMPLES.MXD 06/18/09 JEE

DRAWN BY	DATE
K. MOORE	10/19/07
CHECKED BY	DATE
G. STIEGEL	06/18/09
COST/SCHEDULE AREA	
SCALE AS NOTED	

NAVFAC

SOIL BORING SAMPLE LOCATIONS
SITE 19 - FORMER BUILDING 910
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	
CTO 0468	
APPROVED BY	DATE
RFD	06/19/09
APPROVED BY	DATE
—	—
FIGURE NO. FIGURE 3-1	REV 0

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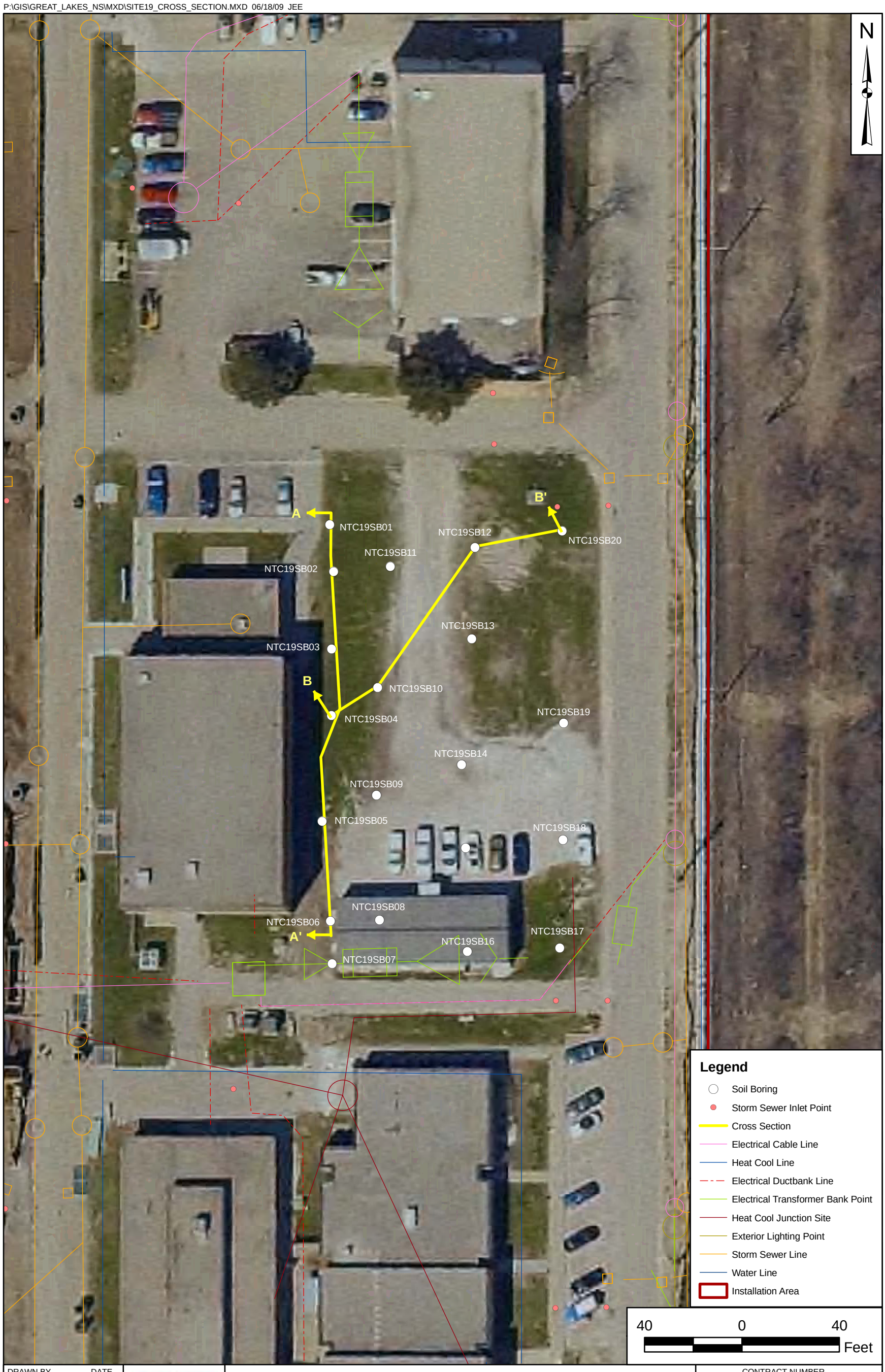
DRAWN BY	DATE
K. MOORE	10/19/07
CHECKED BY	DATE
G. STIEGEL	06/18/09
COST/SCHEDULE AREA	
SCALE AS NOTED	

NAVFAC

MONITORING WELL SAMPLE LOCATIONS
SITE 19 - FORMER BUILDING 910
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER CTO 0468	
APPROVED BY RFD	DATE 06/19/09
APPROVED BY —	DATE —
FIGURE NO. FIGURE 3-2	REV 0

P:\GIS\GREAT_LAKES_NS\MXD\SITE19_CROSS_SECTION.MXD 06/18/09 JEE



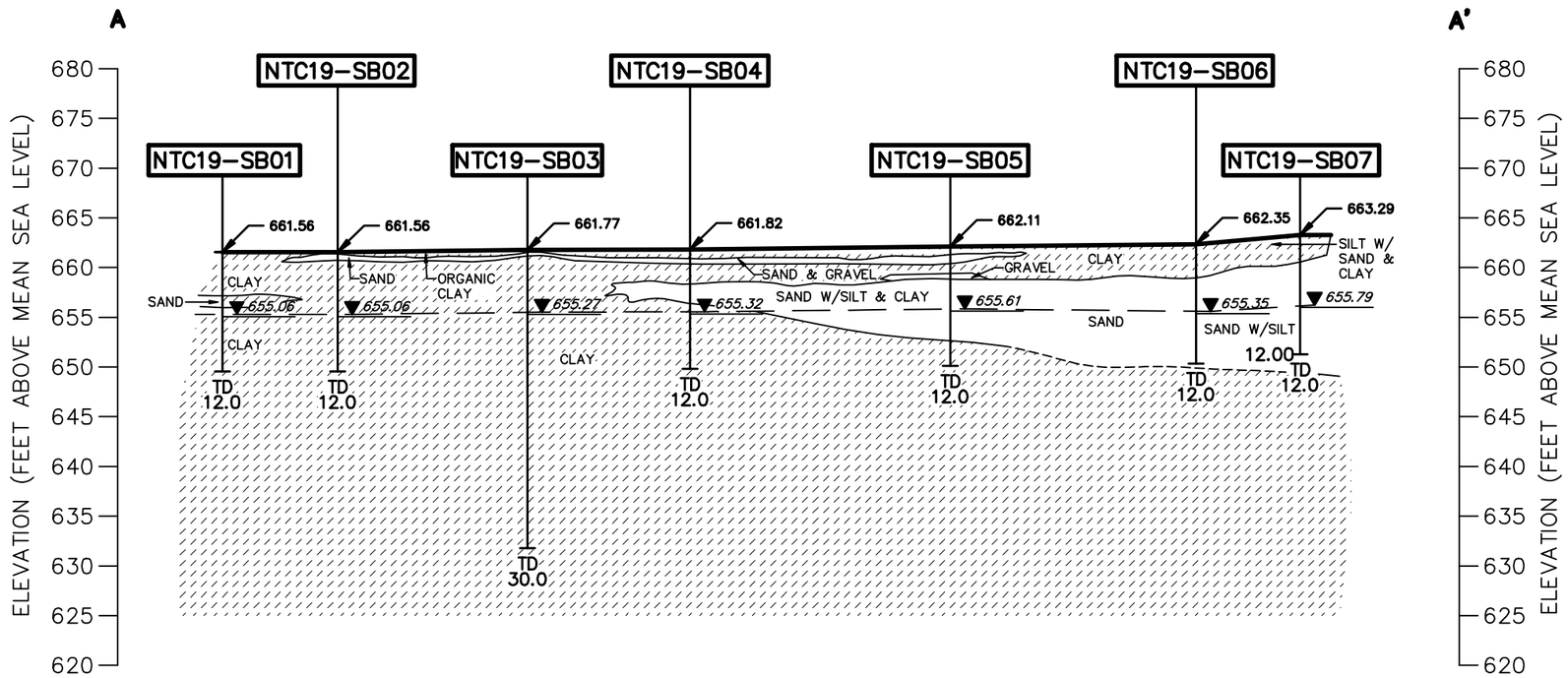
DRAWN BY	DATE
J. ENGLISH	06/18/09
CHECKED BY	DATE
G. STIEGEL	06/18/09
COST/SCHEDULE AREA	
SCALE AS NOTED	

NAVFAC

CROSS-SECTION LOCATION MAP
SITE 19 - FORMER BUILDING 910
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	
CTO 0468	
APPROVED BY	DATE
RFD	06/19/09
APPROVED BY	DATE
—	—
FIGURE NO. FIGURE 3-3	REV 0

ACAD: 0936CX01.dwg 03/09/09 CK PIT



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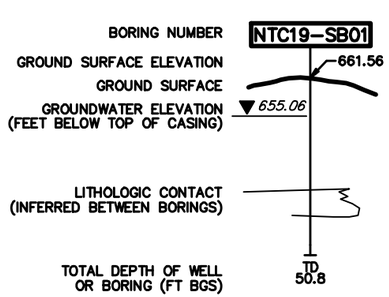
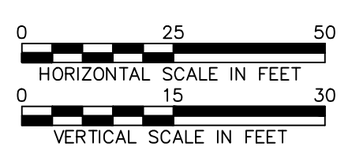




CLAY, SILT, GRAVELLY SAND AND SANDY CLAY AS SHOWN ON THE CROSS–SECTION (UNCONSOILDATED MATERIAL HAVING A LOWER PERMEABILITY)

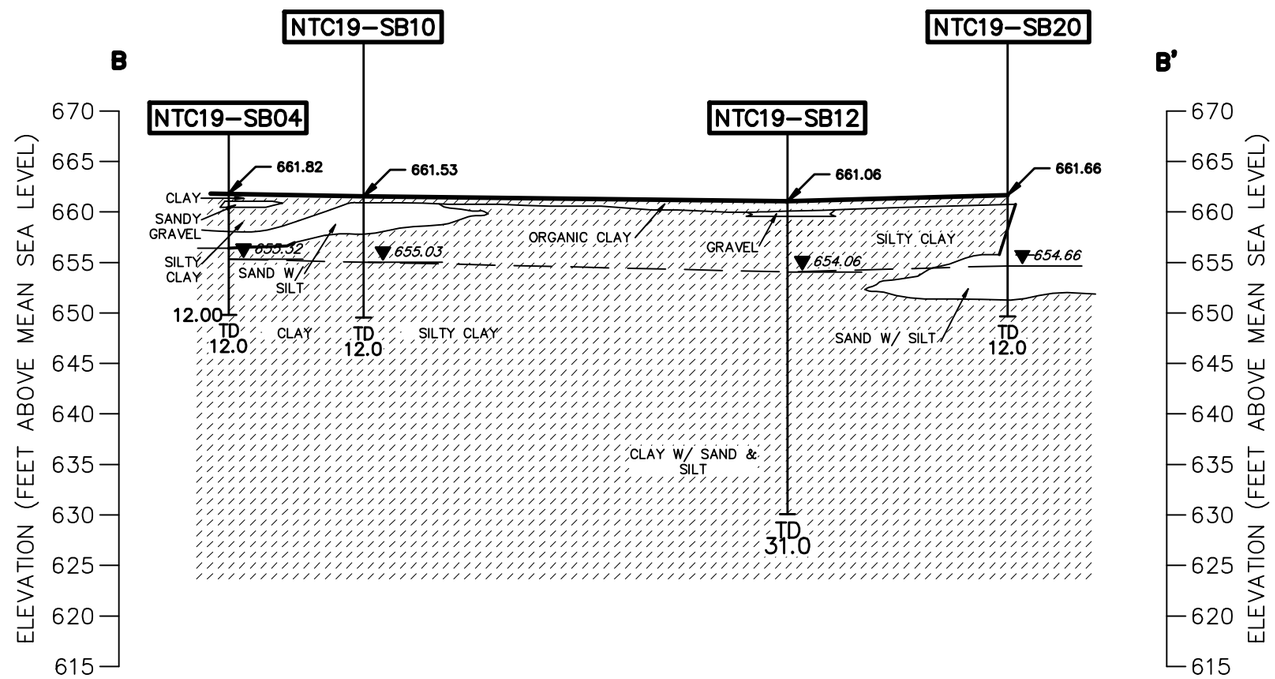
SAND AND SILT, CLAY AS SHOWN ON THE CROSS–SECTION (UNCONSOILDATED MATERIAL HAVING A HIGH PERMEABILITY)

DRAWN BY CK	DATE 3/09/09	GENERALIZED GEOLOGIC CROSS–SECTION A–A' SITE 19 – FORMER BUILDING 910 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NO. 0936
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 3–4 / REV. 0

NAVFAC

FORM CADD NO. SDIV-BH.DWG - REV 2 - 6/19/06

ACAD: 0936CX02.dwg 03/09/09 CK PIT



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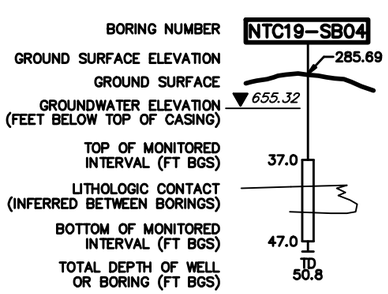
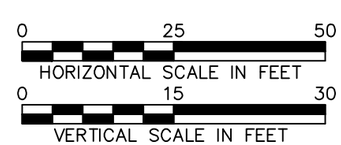




CLAY, SILT, GRAVELLY SAND AND SANDY CLAY AS SHOWN ON THE CROSS–SECTION (UNCONSOILDATED MATERIAL HAVING A LOWER PERMEABILITY)

SAND AND SILT, CLAY AS SHOWN ON THE CROSS–SECTION (UNCONSOILDATED MATERIAL HAVING A HIGH PERMEABILITY)

DRAWN BY CK	DATE 3/09/09	GENERALIZED GEOLOGIC CROSS–SECTION B–B' SITE 19 – FORMER BUILDING 910 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS
CHECKED BY	DATE	
REVISED BY	DATE	
SCALE AS NOTED		

NAVFAC

CONTRACT NO. 0936	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 3–5	REV. 0

FORM CADD NO. SDIV-BH.DWG - REV 2 - 6/19/06

4.0 NATURE AND EXTENT OF CONTAMINATION

This section presents and evaluates the results of the RI sampling and analysis activities described in Section 3.0. Specifically, this section summarizes the nature and extent of contamination in groundwater, surface soil, and subsurface soil samples collected at the locations presented on Figures 3-1 and 3-2. The data quality assessment summary and analytical summary sheets from the subcontract laboratory are presented in Appendices B and C, respectively. The data packages received from the analytical laboratory were validated, and the results of the data validation are summarized in the data validation memoranda presented in Appendix B.

The quality of the chemical analytical data collected during the Site 19 investigation has been documented in the data validation memoranda. The analytical data validation process was completed for laboratory data packages in accordance with the USEPA Region 5 Guidelines for Organic Data Validation (1993a) and USEPA Region 5 Guidelines for Inorganic Data Validation (1993b), with consideration given to the USEPA National Functional Guidelines for Organic Data Review (2008b) and USEPA National Functional Guidelines for Inorganic Data Review (2004a). Half of the samples collected were fully validated, and the remaining samples received a cursory review for false positive and false negative results. The parameters were reviewed using applicable sections of the aforementioned guidelines and the laboratory SOPs. The data set compiled using these guidelines is considered acceptable for use in this RI.

Contaminant sources at Site 19 are discussed in Section 4.1. The nature and extent of contamination in environmental media (groundwater, surface soil, and subsurface soil) are discussed, and detected concentrations are compared to regulatory criteria (Illinois EPA TACO values, USEPA Regional Screening Levels for Chemical Contaminants, etc.), where available, in Sections 4.2, 4.3, and 4.4. A summary of the nature and extent of contamination at Site 19 is presented in Section 4.5.

The discussion of the nature and extent of contamination at Site 19 is structured according to the RI and Feasibility Study guidance (USEPA, 1988). Sources of contamination are discussed first then environmental media sampled during the investigation are discussed in the following order: groundwater, subsurface soil, and surface soil. Within each of these media, analytical fractions are discussed as follows: VOCs, PAHs, and metals.

4.1 SOURCES OF CONTAMINATION

Site 19 is the location of a former indoor rifle range that was in operation for 55 years until the demolition of the building in 2000. VOC, PAH, and inorganic (primarily lead) contamination is suspected in soil and groundwater at the site due to the spent ammunition and use of solvents for gun cleaning operations. An active dry cleaning operation was located approximately 50 feet southwest of Site 19, was in operation for over 50 years, and a RCRA storage unit and tanks for the dry cleaner were located approximately 80 feet southwest of Site 19. Contaminants from these facilities may have impacted the groundwater and soil of Site 19.

4.2 GROUNDWATER CONTAMINATION ASSESSMENT

This section discusses the Site 19 groundwater data collected for the R from two monitoring wells. The Quality A ssurance P roject P lan (TtNUS, 2 008b) s pecified that the s amples be analyzed f or Target Compound List (TCL) VOCs, PAHs, and Target Analytes List (TAL) metals.

Groundwater analytical results are grouped by fraction and discussed below. The analytical results were used to delineate the nature and extent of contamination and to support the HHRA. Table 4-1 presents the anal ytical r esults f or t he two groundwater samples collected dur ing t he R I. Descriptive s tatistics (e.g., frequencies of detection, ranges detected, locations of maximum detections, etc.) are presented in Table 4-2. Additionally, the analytical results were compared to the following standards and criteria, and the r esults o f t hese c omparisons ar e s hown in Table 4 -2. Monitoring w ell l ocations ar e s hown on Figure 4-1 with results for the chemical parameters that exceeded the following regulatory criteria:

- **Illinois EPA Tier 1 Groundwater Remediation Objectives (GROs) for Class 1 Groundwater (Illinois EPA, 2007) – Ingestion -** Class I TACO Tier 1 G ROs ar e enforceable s tandards used t o evaluate chemical concentrations i n groundwater o r s urface w ater t hat m ay be u sed as a dom estic water supply.

- **Illinois EPA GROs for Chemicals Not Listed in TACO Class 1 (Illinois EPA, 2007) – Ingestion -** Class I Non-TACO Tier 1 G ROs a re standards developed by t he I llinois E PA T oxicity A ssessment Unit (TAU) for chemicals not listed in TACO. Although these are not enforceable, they are accepted for use in evaluating chemical concentrations in groundwater or surface water that may be used as a domestic water supply.

- **USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites for Residential Tap Water Screening Levels (USEPA Oak Ridge National Laboratory (ORNL), 2008) –** ORNL Residential Tap Water Screening Levels (SLs) are risk-based concentrations derived by ORNL for evaluating chemicals in groundwater or surface water sources that may be used as a domestic water supply. These SLs were derived from standardized equations that combine exposure information assumptions with USEPA toxicity data. SLs are considered by USEPA to be protective for humans (including sensitive groups) over a lifetime; however, SLs are not always applicable to a particular site and do not address non-human health endpoints such as ecological impacts (USEPA, 2008a).

- **USEPA Maximum Contaminant Levels (MCLs) (USEPA, 2006) –** Primary MCLs are enforceable standards promulgated under the federal Safe Drinking Water Act and are designed for the protection of human health. Primary MCLs are based on laboratory or epidemiological studies and apply to public water systems, defined as systems that provides water to the public for human consumption and that has at least 15 service connections or regularly serves an average of 25 individuals daily at least 60 days per year. Primary MCLs are designed for the prevention of human health effects but also reflect the technical feasibility of removing a contaminant. Primary (i.e., health-based) and secondary (i.e., aesthetic-based) MCLs are promulgated under the Safe Drinking Water Act.

- **USEPA Groundwater Screening Levels for Evaluating the Vapor Intrusion to Indoor Air (USEPA, 2002a) –** SLs for evaluating vapor intrusion to indoor air that may adversely affect the indoor air quality of a building overlying subsurface VOC contamination and are designed for the protection of human health.

4.2.1 VOCs

The following VOCs were detected in groundwater samples collected from Site 19 during the RI:

- Acetone
- Toluene

VOC concentrations were less than Illinois TACO and non-TACO GROs, USEPA ORNL Residential Tap Water levels, and federal MCLs. These VOCs were detected only at sampling location NTC19MW02.

4.2.2 PAHs

Sixteen PAHs were detected in groundwater at location NTC19MW02, and two PAHs were detected at location NTC19MW01. Concentrations of the following PAHs exceeded the minimum screening value (USEPA ORNL Residential Tap Water):

- Benzo(a)anthracene
- Benzo(a)pyrene
- Dibenzo(a,h)anthracene

4.2.3 Metals

Groundwater samples were analyzed for total and dissolved (filtered) metals. Nine total inorganic constituents and six dissolved inorganic constituents were detected in RI groundwater samples from Site 19. None of these constituents were detected at concentrations exceeding the minimum screening criteria (USEPA ORNL Residential Tap Water).

4.3 SURFACE SOIL CONTAMINATION ASSESSMENT

This section discusses the results of Site 19 surface soil samples collected during the RI. Sixteen surface soil samples (plus two duplicate samples) were collected from 15 soil borings, NTC19SB01 through NTC19SB20 (see Figure 4-2) at depths ranging from 0 to 2 feet bgs. No samples were collected from soil borings NTC19SB02, NTC19SB04, NTC19SB05, NTC19SB14, or NTC19SB18. Most of the surface soil samples were analyzed for TCL VOCs, PAHs, and TAL metals in accordance with the Quality Assurance Project Plan (TtNUS, 2008b). Samples from borings NTC19SB01, NTC19SB03 (0 to 1 feet bgs), NTC19SB06, and NTC19SB07 were not analyzed for VOCs or PAHs.

Surface soil analytical results are grouped by fraction and discussed below. The analytical results were used to delineate the nature and extent of contamination and to support the HHRA. Table 4-3 presents the analytical results for the 16 surface soil samples collected during the RI. Descriptive statistics (e.g., frequencies of detection, ranges detected, locations of maximum detections, etc.) are presented in Table 4-4. Additionally, the analytical results were compared to the following criteria, and the results of these comparisons are shown in Table 4-4. Figure 4-2 shows the locations of the soil borings with results for the chemical parameters that exceeded the following criteria:

- **USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites for Residential and Industrial Receptors (USEPA Oak Ridge National Laboratory (ORNL), 2008a) –**

Risk-based concentrations derived by ORNL for evaluating chemicals in soil. These SLs are for human receptors hypothetically exposed to chemicals in soil assuming a residential and industrial land use scenario and assuming that the receptor is exposed as a result of the daily ingestion of a small amount of soil.

- **USEPA Generic Soil Screening Levels for Migration from Soil to Groundwater (USEPA, 2008a) –** ORNL migration-to-groundwater Soil Screening Levels (SSLs) are risk- and MCL-based concentrations derived by ORNL for evaluating chemicals in soil that may impact groundwater. These SSLs are derived from standardized equations that combine exposure information assumptions with USEPA toxicity data. SSLs are considered by USEPA to be protective for humans (including sensitive groups) over a lifetime; however, SSLs are not always applicable to a particular site and do not address non-human health endpoints such as ecological impacts.

- **USEPA Generic SSLs for Migration of Chemicals from Soils to Air –** USEPA SSLs for the migration of chemicals from soil to air are used to identify chemicals detected in soil at concentrations that may impact air quality. The migration-to-air SSLs are calculated using default residential land use exposure factors, infinite source models, and conservative default assumptions for source delineation. Therefore, these values are conservative and are designed to be protective of potential exposure at most sites.

- **Illinois EPA Tier 1 Soil Remediation Objectives (SROs) for Residential, Industrial, and Construction Worker Receptors Properties (Illinois EPA, 2007) – Ingestion and Inhalation -** TACO Tier 1 SROs are risk-based criteria for evaluating chemical concentrations in soil. TACO Tier 1 SROs are available for human receptors hypothetically exposed to chemicals in soil assuming a residential land use scenario and assuming that the receptor is exposed as a result of the daily ingestion of a small amount of soil. In addition, TACO Tier 1 SROs are available for a human receptor hypothetically exposed to chemicals in soil assuming residential and industrial land use scenarios and assuming that the receptor was exposed as a result of the daily inhalation of volatile organic vapors**.**

- **Illinois EPA Tier 1 SRO for Residential Properties for the Soil Component of the Groundwater Ingestion Exposure Route for Class I Groundwater (Illinois EPA, 2007) – Assuming a Dilution Attenuation Factor (DAF) of 20 –** Illinois EPA SSLs for the migration of chemicals from soil to groundwater are used to identify chemicals detected in soil at concentrations that may impact groundwater quality. The migration-to-groundwater SSLs are calculated using default residential land use exposure factors, infinite source models, and conservative default assumptions for source

delineation. Therefore, these values are conservative and are designed to be protective of potential exposure at most sites. SSLs assuming a DAF of 20 were used as conservative screening values in Section 4 text, tables, and figures.

- **Illinois EPA, Class I GROs for Chemicals Not Listed in TACO (May 1, 2007) for Residential, Industrial, and Construction Worker Receptors – Ingestion and Inhalation -** Class I Non-TACO Tier 1 SROs are standards developed by the Illinois EPA TAU for chemicals not listed in TACO. Although these are not enforceable, they are accepted for use in evaluating chemical concentrations in soil.

- **Illinois EPA, Objectives for Chemicals Not Listed in TACO Tier 1 Soil-to-Groundwater SSLs for the Migration of Chemicals from Soil to Groundwater Assuming a DAF of 20 –** Non-TACO Tier 1 soil-to-groundwater SSLs are standards developed by the Illinois EPA TAU for chemicals not listed in TACO. Although these are not enforceable, they are accepted for use in evaluating chemical concentrations in soil that may impact groundwater quality.

4.3.1 VOCs

The following VOCs were detected in surface soil samples collected from Site 19 during the RI:

- 2-Butanone – 1.6 to 2.5 µg/kg in 2 of 12 samples
- Acetone – 4.3 to 29 µg/kg in 6 of 12 samples

None of the VOCs were detected at concentrations exceeding the minimum screening criteria (USEPA ORNL migration-to-groundwater risk-based SSL).

4.3.2 PAHs

Seventeen PAHs were detected in surface soil samples, and concentrations of the following seven exceeded the minimum screening criteria (shown in parentheses):

- Benzo(a)anthracene (USEPA ORNL migration-to-groundwater risk-based SSL)
- Benzo(a)pyrene (USEPA ORNL migration-to-groundwater risk-based SSL)
- Benzo(b)fluoranthene (USEPA ORNL migration-to-groundwater risk-based SSL)
- Chrysene (USEPA ORNL migration-to-groundwater risk-based SSL)
- Dibenzo(a,h)anthracene (USEPA ORNL Residential SSL)

- Indeno(1,2,3-CD)pyrene (USEPA ORNL Residential SSL)
- Naphthalene (USEPA ORNL migration-to-groundwater risk-based SSL)

PAH exceedances were detected in each sample except NTC19SB08, NTC19SB13, and NTC19SB15.

4.3.3 Metals

Twenty-one metals were detected in the surface soil of Site 19, and concentrations of the following 12 exceeded minimum screening criteria (shown in parentheses):

- Aluminum (Non-TACO residential migration-to-groundwater SRO)
- Antimony (USEPA ORNL migration-to-groundwater MCL-based SSL)
- Arsenic (USEPA ORNL migration-to-groundwater risk-based SSL)
- Barium (USEPA ORNL migration-to-groundwater MCL-based SSL)
- Cadmium (USEPA ORNL migration-to-groundwater MCL-based SSL)
- Chromium (TACO Residential migration-to-groundwater)
- Cobalt (USEPA ORNL migration-to-groundwater risk-based SSL)
- Copper (USEPA ORNL migration-to-groundwater MCL-based SSL)
- Iron (Non-TACO residential migration-to-groundwater)
- Lead (USEPA ORNL migration-to-groundwater MCL-based SSL)
- Manganese (USEPA ORNL migration-to-groundwater risk-based SSL)
- Mercury (USEPA ORNL migration-to-groundwater risk-based SSL)

Each surface soil location had exceedances of metals.

4.4 SUBSURFACE SOIL CONTAMINATION ASSESSMENT

This section discusses the results of Site 19 subsurface soil samples collected during the RI. Twenty-two subsurface soil samples (plus one duplicate sample) were collected from 18 soil borings, NTC19SB01 through NTC19SB20 (see Figure 4-3), at depths ranging from 2 to 10 feet bgs. No samples were collected from soil borings NTC19SB11 or NTC19SB13. The subsurface soil samples were analyzed for TCL VOCs, PAHs, and TAL metals in accordance with the Quality Assurance Project Plan (TtNUS, 2008b).

Subsurface soil analytical results are grouped by fraction and discussed below. The analytical results were used to delineate the nature and extent of contamination and to support the HHRA. Table 4-5

presents the analytical results for the 22 subsurface soil samples collected during the RI. Descriptive statistics (e.g., frequencies of detection, ranges detected, locations of maximum detections, etc.) are presented in Table 4-6. Additionally, the analytical results were compared to the following standards and criteria, and the results of these comparisons are shown in Table 4-6. Figure 4-3 shows the locations of the soil borings with the results for chemical parameters that exceeded the criteria identified in Section 4.3.

4.4.1 VOCs

The following three VOCs were detected in subsurface soil samples collected from Site 19 during the RI:

- 4-Methyl-2-pentanone
- Acetone
- Trichlorofluoromethane

None of the VOCs was detected at concentrations exceeding the minimum screening criteria (USEPA ORNL migration-to-groundwater risk-based SSLs).

4.4.2 PAHs

Thirteen PAHs were detected in subsurface soil samples. Two of the 13 PAHs detected had concentrations greater than minimum screening criteria (USEPA ORNL migration-to-groundwater risk-based SSL):

- Benzo(a)anthracene
- Benzo(a)pyrene

Exceedances of both of these PAHs were detected at NTC19SB04, NTC19SB06, and NTC19SB18. Exceedances of only benzo(a)pyrene were detected at NTC19SB18, NTC19SB19, and NTC19SB20.

4.4.3 Metals

Nineteen metals were detected in the subsurface soil of Site 19. Concentrations of the following nine exceeded minimum screening criteria (shown in parentheses):

- Aluminum (Non-TACO residential migration-to-groundwater)
- Arsenic (USEPA ORNL migration-to-groundwater risk-based SSL)
- Cadmium (USEPA ORNL migration-to-groundwater MCL-based SSL)
- Cobalt (USEPA ORNL migration-to-groundwater risk-based SSL)
- Iron (Non-TACO residential migration-to-groundwater)
- Lead (USEPA ORNL migration-to-groundwater MCL-based SSL)
- Manganese (USEPA ORNL migration-to-groundwater risk-based SSL)
- Mercury (USEPA ORNL migration-to-groundwater risk-based SSL)
- Nickel (USEPA ORNL migration-to-groundwater risk-based SSL)

Each sample had exceedances of metals. Lead exceedances were detected at the following locations:

- NTC19SB01
- NTC19SB02
- NTC19SB04
- NTC19SB06
- NTC19SB07
- NTC19SB14
- NTC19SB18

4.5 SUMMARY

The following briefly summarizes the nature and extent of the current contamination in groundwater, surface soil, and subsurface soil at Site 19:

- **Very few VOCs were detected at Site 19.** Low concentrations of VOCs were detected in Site 19 groundwater, surface soil, and subsurface soil, and no VOCs were detected at or greater than concentrations that exceed the minimum screening criteria.

- **PAHs were detected in groundwater, surface soil, and subsurface soil samples collected at Site 19.** Benzo(a)anthracene and benzo(a)pyrene concentrations exceeded the minimum screening criteria in the three media sampled and were the most frequently detected PAH. Exceedances of PAHs at Site 19 do not appear to be confined to any particular area of the site.

- **Several metals were detected in surface soil and subsurface soil (but not groundwater) samples collected at Site 19 at concentrations greater than minimum screening levels.** Lead concentrations exceeded the minimum criteria screening level at most surface soil sampling locations except for NTC19SB15. Exceedances of lead in subsurface soil at Site 19 do not appear to be confined to any particular area of the site. In subsurface soil samples, lead was not detected as frequently in excess of minimum criteria screening level. Lead was detected at 7 of the 18 subsurface soil samples.

TABLE 4-1

SUMMARY OF DETECTED CONCENTRATIONS IN GROUNDWATER SAMPLES
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

PARAMETER	MINIMUM CRITERIA VALUE	MINIMUM CRITERIA	NTC19MW01	NTC19MW02
Volatile Organics (ug/L)				
ACETONE	2200	USEPA ORNL Residential Tap Water	1.8 U	8.5
TOLUENE	230	USEPA ORNL Residential Tap Water	0.14 U	0.22
Polynuclear Aromatic Hydrocarbons (ug/L)				
2-METHYLNAPHTHALENE	15	USEPA ORNL Residential Tap Water	0.0098 J	0.017
ACENAPHTHENE	220	USEPA ORNL Residential Tap Water	0.0058 U	0.02
ACENAPHTHYLENE	210	NON-TACO - Class I Groundwater	0.0048 U	0.016
ANTHRACENE	1100	USEPA ORNL Residential Tap Water	0.0096 U	0.026
BENZO(A)ANTHRACENE	0.029	USEPA ORNL Residential Tap Water	0.012 UJ	0.036 J
BENZO(A)PYRENE	0.0029	USEPA ORNL Residential Tap Water	0.0058 U	0.018
BENZO(B)FLUORANTHENE	0.029	USEPA ORNL Residential Tap Water	0.012 U	0.019
BENZO(G,H,I)PERYLENE	210	NON-TACO - Class I Groundwater	0.0067 U	0.013
BENZO(K)FLUORANTHENE	0.17	TACO - Class I Groundwater	0.0086 U	0.016
CHRYSENE	1.5	TACO - Class I Groundwater	0.01 U	0.035
DIBENZO(A,H)ANTHRACENE	0.0029	USEPA ORNL Residential Tap Water	0.0048 U	0.013
FLUORANTHENE	150	USEPA ORNL Residential Tap Water	0.012 U	0.03
FLUORENE	150	USEPA ORNL Residential Tap Water	0.0067 U	0.028
INDENO(1,2,3-CD)PYRENE	0.029	USEPA ORNL Residential Tap Water	0.0038 U	0.011
PHENANTHRENE	210	NON-TACO - Class I Groundwater	0.0091	0.038
PYRENE	110	USEPA ORNL Residential Tap Water	0.012 U	0.03
Inorganics (ug/L)				
ALUMINUM	3500	NON-TACO - Class I Groundwater	138	272
ARSENIC*	0.045	USEPA ORNL Residential Tap Water	3 U	3 U
BARIUM	730	USEPA ORNL Residential Tap Water	52.9	167
CALCIUM	NA	NA	114000 J	88100 J
IRON	2600	USEPA ORNL Residential Tap Water	182	489
MAGNESIUM	NA	NA	48200	46200
MANGANESE	88	USEPA ORNL Residential Tap Water	37.6	39.6
POTASSIUM	NA	NA	9000	7860
SODIUM	NA	NA	68800	36900
ZINC	1100	USEPA ORNL Residential Tap Water	5 U	9.4
Filtered Inorganics (ug/L)				
BARIUM	730	USEPA ORNL Residential Tap Water	52.4	161
CALCIUM	NA	NA	123000 J	93400 J
MAGNESIUM	NA	NA	48800	45900
MANGANESE	88	USEPA ORNL Residential Tap Water	34.5	31.8
POTASSIUM	NA	NA	8570	7240
SODIUM	NA	NA	65000	33600
Field Parameters				
CONDUCTIVITY MS/CM	NC	NA	1.118	0.868
DISSOLVED OXYGEN MG/L	NC	NA	4.85	6.77
OXIDATION REDUCTION POTENTIAL MV	NC	NA	152	240
PH S.U.	NC	NA	7.4	7.13
TEMPERATURE C	NC	NA	10.37	9.3
TURBIDITY NTU	NC	NA	15.7	7.71

NC = No criterion available.
NA = Not applicable
J= Not detected. Value shown is detection limit.
J =The value is considered a quantitative estimate because it was less than the reporting limit or because of another technical n
Shaded cells indicate that the concentration is greater than the minimum screening criterion.

TABLE 4-2

SUMMARY OF DESCRIPTIVE STATISTICS AND CRITERIA[1] COMPARISONS FOR RI GROUNDWATER DATA
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detect	Sample of Maximum Detect	Minimum Non-Detect	Maximum Non-Detect	Average Positive Result	TACO - Class I Groundwater Criteria	Exceedances of TACO - Class I Groundwater Criteria	NON-TACO - Class I Groundwater Criteria	Exceedances of NON-TACO - Class I Groundwater Criteria	USEPA ORNL Residential Tap Water Criteria		Exceedances of USEPA ORNL Residential Tap Water Criteria	USEPA MCLS Criteria	Exceedances of USEPA MCLS Criteria
Volatile Organics (ug/L)																	
ACETONE	1/2	8.5	8.5	NTC19MW02	NTC19MW021208	1.8	1.8	8.5	6300	0	NA	0	2200	N	0	NA	0
TOLUENE	1/2	0.22	0.22	NTC19MW02	NTC19MW021208	0.14	0.14	0.22	1000	0	NA	0	230	N	0	1000	0
Polynuclear Aromatic Hydrocarbons (ug/L)																	
2-METHYLNAPHTHALENE	2/2	0.0093	0.017	NTC19MW02	NTC19MW021208			0.013	NA	0	28	0	15	N	0	NA	0
ACENAPHTHENE	1/2	0.02	0.02	NTC19MW02	NTC19MW021208	0.0057	0.0058	0.02	420	0	NA	0	220	N	0	NA	0
ACENAPHTHYLENE	1/2	0.016	0.016	NTC19MW02	NTC19MW021208	0.0047	0.0048	0.016	NA	0	210	0	110	N	0	NA	0
ANTHRACENE	1/2	0.026	0.026	NTC19MW02	NTC19MW021208	0.0094	0.0096	0.026	2100	0	NA	0	1100	N	0	NA	0
BENZO(A)ANTHRACENE	1/2	0.036 J	0.036 J	NTC19MW02	NTC19MW021208	0.012	0.012	0.036	0.13	0	NA	0	**0.029**	**C**	**1**	NA	0
BENZO(A)PYRENE	1/2	0.018	0.018	NTC19MW02	NTC19MW021208	0.0057	0.0058	0.018	0.2	0	NA	0	**0.0029**	**C**	**1**	0.2	0
BENZO(B)FLUORANTHENE	1/2	0.019	0.019	NTC19MW02	NTC19MW021208	0.011	0.012	0.019	0.18	0	NA	0	0.029	C	0	NA	0
BENZO(G,H,I)PERYLENE	1/2	0.013	0.013	NTC19MW02	NTC19MW021208	0.0066	0.0067	0.013	NA	0	210	0	110	N	0	NA	0
BENZO(K)FLUORANTHENE	1/2	0.016	0.016	NTC19MW02	NTC19MW021208	0.0085	0.0086	0.016	0.17	0	NA	0	0.29	C	0	NA	0
CHRYSENE	1/2	0.035	0.035	NTC19MW02	NTC19MW021208	0.01	0.01	0.035	1.5	0	NA	0	2.9	C	0	NA	0
DIBENZO(A,H)ANTHRACENE	1/2	0.013	0.013	NTC19MW02	NTC19MW021208	0.0047	0.0048	0.013	0.3	0	NA	0	**0.0029**	**C**	**1**	NA	0
FLUORANTHENE	1/2	0.03	0.03	NTC19MW02	NTC19MW021208	0.012	0.012	0.03	280	0	NA	0	150	N	0	NA	0
FLUORENE	1/2	0.028	0.028	NTC19MW02	NTC19MW021208	0.0066	0.0067	0.028	280	0	NA	0	150	N	0	NA	0
INDENO(1,2,3-CD)PYRENE	1/2	0.011	0.011	NTC19MW02	NTC19MW021208	0.0038	0.0038	0.011	0.43	0	NA	0	0.029	C	0	NA	0
PHENANTHRENE	2/2	0.0091	0.038	NTC19MW02	NTC19MW021208			0.0237	NA	0	210	0	110	N	0	NA	0
PYRENE	1/2	0.03	0.03	NTC19MW02	NTC19MW021208	0.012	0.012	0.03	210	0	NA	0	110	N	0	NA	0
Inorganics (ug/L)																	
ALUMINUM	2/2	134	272	NTC19MW02	NTC19MW021208			204	NA	0	3500	0	3700	N	0	NA	0
ARSENIC*	1/2	330%	330%	NTC19MW01	NTC19MW011208-D	300%	300%	240%	50	0%	NA	0%	**0.045**	**C**	**100%**	10	0%
BARIUM	2/2	51.8	167	NTC19MW02	NTC19MW021208			109.675	2000	0	NA	0	730	N	0	2000	0
CALCIUM	2/2	88100 J	116000 J	NTC19MW01	NTC19MW011208-D			101550	NA	0	NA	0	NA		0	NA	0
IRON	2/2	182	489	NTC19MW02	NTC19MW021208			341	NA	0	5000	0	2600	N	0	NA	0
MAGNESIUM	2/2	46200	48900	NTC19MW01	NTC19MW011208-D			47375	NA	0	NA	0	NA		0	NA	0
MANGANESE	2/2	35.8	39.6	NTC19MW02	NTC19MW021208			38.15	150	0	NA	0	88	N	0	NA	0
POTASSIUM	2/2	7860	9120	NTC19MW01	NTC19MW011208-D			8460	NA	0	NA	0	NA		0	NA	0
SODIUM	2/2	36900	70300	NTC19MW01	NTC19MW011208-D			53225	NA	0	NA	0	NA		0	NA	0
ZINC	1/2	9.4	9.4	NTC19MW02	NTC19MW021208	5	5	9.4	5000	0	NA	0	1100	N	0	NA	0
Filtered Inorganics (ug/L)																	
BARIUM	2/2	48.9	161	NTC19MW02	NTC19MW021208			105.825	2000	0	NA	0	730	N	0	2000	0
CALCIUM	2/2	93400 J	123000 J	NTC19MW01	NTC19MW011208			106700	NA	0	NA	0	NA		0	NA	0
MAGNESIUM	2/2	45900	48800	NTC19MW01	NTC19MW011208			46725	NA	0	NA	0	NA		0	NA	0
MANGANESE	2/2	30.9	34.5	NTC19MW01	NTC19MW011208			32.25	150	0	NA	0	88	N	0	NA	0
POTASSIUM	2/2	7240	8570	NTC19MW01	NTC19MW011208			7772.5	NA	0	NA	0	NA		0	NA	0
SODIUM	2/2	33600	65000	NTC19MW01	NTC19MW011208			48625	NA	0	NA	0	NA		0	NA	0
Field Parameters																	
CONDUCTIVITY ms/cm	2/2	0.868	1.118	NTC19MW01	NTC19MW011208			0.993	NA	0	NA	0	NA		0		0
DISSOLVED OXYGEN mg/L	2/2	4.85	6.77	NTC19MW02	NTC19MW021208			5.81	NA	0	NA	0	NA		0		0
OXIDATION REDUCTION POTENTIAL m	2/2	152	240	NTC19MW02	NTC19MW021208			196	NA	0	NA	0	NA		0		0
PH S.U.	2/2	7.13	7.4	NTC19MW01	NTC19MW011208			7.265	NA	0	NA	0	NA		0		0
TEMPERATURE C	2/2	9.3	10.37	NTC19MW01	NTC19MW011208			9.835	NA	0	NA	0	NA		0		0
TURBIDITY NTU	2/2	7.71	15.7	NTC19MW01	NTC19MW011208			11.705	NA	0	NA	0	NA		0		0

Associated Samples:
NTC19MW011208
NTC19MW011208-AVG
NTC19MW011208-D
NTC19MW021208

NA = Not applicable
J =The value is considered a quantitative estimate because it was less than the reporting limit or because of another technical noncompliance.
C= Carcinogenic
N = Non-carcinogenic
Shaded cells indicate that the concentration is greater than the minimum screening criterion.
* Duplicate sample was detected at a concentration of 3.3 µg/L

TABLE 4-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL SAMPLES
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

PARAMETER	MINIMUM CRITERIA VALUE	**MINIMUM CRITERIA**	NTC19SB01	NTC19SB03	NTC19SB03	NTC19SB06	NTC19SB07	NTC19SB08	NTC19SB09	NTC19SB10	NTC19SB11	NTC19SB12	NTC19
top_depth			0	0	1	0	0	1	0	0	0	0	1
bottom_dep			2	1	3	1	1	3	2	2	2	2	3
Volatile Organics (ug/kg)													
2-BUTANONE	1500	USEPA ORNL SSL Migration to GW Risk-Based			1.5 U			1.3 U	1.4 U	1.8 U	2.5	1.4 U	1.3
ACETONE	4400	USEPA ORNL SSL Migration to GW Risk-Based			2.1 UJ			1.9 U	15	16	29	2 UJ	5.2
Polynuclear Aromatic Hydrocarbons (ug/kg)													
2-METHYLNAPHTHALENE	900	USEPA ORNL SSL Migration to GW Risk-Based			2 U			1.9 U	2.1	2 U	53	5.8	2
ACENAPHTHENE	27000	USEPA ORNL SSL Migration to GW Risk-Based			1.4 U			1.4 U	1.6	1.4 U	240	78	1.5
ACENAPHTHYLENE	27000	USEPA ORNL SSL Migration to GW Risk-Based			1.4			1.3 U	1.3 U	1.3 U	74	12	1.4
ANTHRACENE	450000	USEPA ORNL SSL Migration to GW Risk-Based			0.94 U			0.91 U	3.6	2.1	590	250	0.97
BENZO(A)ANTHRACENE	14	USEPA ORNL SSL Migration to GW Risk-Based			19			2.3	27	7.5	1700	940 J	1.7
BENZO(A)PYRENE	4.6	USEPA ORNL SSL Migration to GW Risk-Based			21			4.2	26	9.6	1200	480	1.2
BENZO(B)FLUORANTHENE	47	USEPA ORNL SSL Migration to GW Risk-Based			18			1.7 U	23	6.7	1400	510	1.9
BENZO(G,H,I)PERYLENE	150000	USEPA ORNL SSL Migration to GW Risk-Based			13			1.7 U	14	7	670	250	1.8
BENZO(K)FLUORANTHENE	460	USEPA ORNL SSL Migration to GW Risk-Based			8.5			1.4 U	8.3	2.7	360	240	1.5
CHRYSENE	1400	USEPA ORNL SSL Migration to GW Risk-Based			19			2.4	28	6.2	1900	740	1.3
DIBENZO(A,H)ANTHRACENE	15	USEPA ORNL Residential Soil			1.8 U			1.7 U	1.8 U	1.8 U	160	1.8 U	1.9
FLUORANTHENE	210000	USEPA ORNL SSL Migration to GW Risk-Based			26			2.2	50	20	5100	1300	2
FLUORENE	33000	USEPA ORNL SSL Migration to GW Risk-Based			1.4 U			1.4 U	1.8	1.4 U	250	93	1.5
INDENO(1,2,3-CD)PYRENE	150	USEPA ORNL Residential Soil			9.5			1.7 U	8.8	4.4	590	230	1.9
NAPHTHALENE	0.55	USEPA ORNL SSL Migration to GW Risk-Based			2.7 U			2.6 U	2.7 U	2.8 U	62	7	2.8
PHENANTHRENE	150000	USEPA ORNL SSL Migration to GW Risk-Based			7			1.9 U	29	9.6	3200	1200	2
PYRENE	150000	USEPA ORNL SSL Migration to GW Risk-Based			29			2.4	44	15	3500	1100	1.9
Inorganics (mg/kg)													
ALUMINUM	55000	USEPA ORNL SSL Migration to GW MCL-Based	14100	15300	15400	19300	8640	6750	8120	7420	17500	11900	14700
ANTIMONY	0.27	USEPA ORNL SSL Migration to GW MCL-Based	1.2 UJ	3.8 UJ	1.2 UJ	3.7 UJ	3.5 UJ	1.1 U	1.2 U	1.2 U	1.2 U	1.2 UR	1.2
ARSENIC	0.0013	USEPA ORNL SSL Migration to GW Risk-Based	12.9	8.5	14.2	8.1	5.7	13.1	16.4	32.2	8.1	6.4	13.7
BARIUM	82	USEPA ORNL SSL Migration to GW MCL-Based	103	100	91.4	188	52.2	37.7	65	90	138	50.5	53.5
BERYLLIUM	3.2	USEPA ORNL SSL Migration to GW MCL-Based	0.95	0.96	1	1.3	0.66	0.5	0.62	0.57	2	0.71	0.86
CADMIUM	0.38	USEPA ORNL SSL Migration to GW MCL-Based	0.43 J	0.54	0.52 J	0.92 J	0.33	0.43	0.44	0.51	0.71	0.24 U	0.38
CALCIUM	NC	NC	12900 J	21500 J	5210 J	7900 J	111000 J	45300	15100	7710	14100	58000 J	48000
CHROMIUM	230	TACO - Residential Soil Ingestion	23.1	24.3	23.7	27.6	13.5	15	18.4	14	23.4	20.8	23.8
COBALT	0.49	USEPA ORNL SSL Migration to GW MCL-Based	9.7	10.4	12.7	10.9	5	8.4	11.1	13.3	11.8	8.9	10.9
COPPER	46	USEPA ORNL SSL Migration to GW MCL-Based	23.1	28.2	23.3	36.2	17.6	30.9	29.2	29.4	32.1	21.5	30.2
IRON	640	USEPA ORNL SSL Migration to GW MCL-Based	31600	24900	34700	31700	14600	26000	32700	36800	27700	20800	33000
LEAD	14	USEPA ORNL SSL Migration to GW MCL-Based	80.9 J	480 J	33.4 J	133 J	89.1 J	20.2	48.3	64.2	49.2	147 J	21.9
MAGNESIUM	325000	TACO - Residential Soil Ingestion	9330	12000	5270 J	6430	62100	27300	10000	5450	5510	32900	31100
MANGANESE	57	USEPA ORNL SSL Migration to GW Risk-Based	954 J	746 J	896	1280 J	466 J	946	1350	1730	673	561	725
MERCURY	0.033	USEPA ORNL SSL Migration to GW Risk-Based	0.084	0.32	0.058	0.47	0.12	0.019	0.026	0.048	0.045	0.029	0.018
NICKEL	48	USEPA ORNL SSL Migration to GW Risk-Based	27.3	25.1	29.8	28.3	14	24.5	28.3	33.6	26.9	26.5	34.1
POTASSIUM	NC	NC	2190	2330	1970 J	2180	1650	1520	1420	1030	2720	2270	2350
SILVER	1.6	USEPA ORNL SSL Migration to GW Risk-Based	0.24 U	0.48	0.23 U	1	0.23 U	0.22 U	0.23 U	0.23 U	0.25 U	0.24 U	0.24
SODIUM	NC	NC	443	256 U	235 U	248 U	231 U	223 U	233 U	231 U	565	239	241
VANADIUM	18	USEPA ORNL Residential Soil Criteria	34	32.4	36.9	37.1	18.5	25.5	26.2	26.1	34.4	21.6	29.4
ZINC	680	USEPA ORNL SSL Migration to GW Risk-Based	128 J	190 J	125 J	250 J	119 J	89.8	113	115	209	76.7	95

TABLE 4-3

SUMMARY OF DETECTED CONCENTRATIONS IN SURFACE SOIL SAMPLES
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

)SB13	PARAMETER	NTC19SB15	NTC19SB16	NTC19SB16	NTC19SB16	NTC19SB17	NTC19SB17	NTC19SB17	NTC19SB19	NTC19SB20
L	top_depth	1	1	1	1	0	0	0	0	0
3	bottom_dep	3	3	3	3	2	2	2	2	2
	Volatile Organics (ug/kg)									
U	2-BUTANONE	1.2 U	1.6 U	1.2	1.6	1.3 U	1.45 U	1.6 U	1.7 U	1.5 U
J	ACETONE	4.3 J	12	14.5	17	1.9 U	2.05 U	2.2 U	2.5 U	2.2 U
	Polynuclear Aromatic Hydrocarbons (ug/kg)									
U	2-METHYLNAPHTHALENE	1.9 U	2.1 U	2	2	6.7	6.3	5.9	2 U	25
U	ACENAPHTHENE	1.4 U	3.2 J	8.6 J	14 J	9.1	11.05	13	2.8	180
U	ACENAPHTHYLENE	1.3 U	1.8	1.225	1.3 U	5	2.825	1.3 U	1.6	46
U	ANTHRACENE	0.9 U	9.2 J	25.6 J	42 J	29	31	33	8.4	560
UJ	BENZO(A)ANTHRACENE	1.6 U	36 J	83 J	130 J	120	115 J	110 J	47	1500
U	BENZO(A)PYRENE	1.1 U	38 J	69 J	100 J	94	81	68	50	1200
U	BENZO(B)FLUORANTHENE	1.7 U	41 J	90.5 J	140 J	89	76.5	64	37	1700
U	BENZO(G,H,I)PERYLENE	3.4	20 J	40 J	60 J	50	43	36	24	940
U	BENZO(K)FLUORANTHENE	1.4 U	11 J	25 J	39 J	33	31	29	13	460
U	CHRYSENE	7.1	29 J	69.5 J	110 J	91	88	85	37	1200
U	DIBENZO(A,H)ANTHRACENE	1.7 U	4.8 J	9.9 J	15 J	12 J	6.425 J	1.7 UJ	5	160
U	FLUORANTHENE	1.9 U	72 J	196 J	320 J	200	170	140	74	3900
U	FLUORENE	1.4 U	3.2 J	9.6 J	16 J	10	11.5	13	2.6	200
U	INDENO(1,2,3-CD)PYRENE	1.7 U	18 J	35.5 J	53 J	48	40.5	33	20	730
U	NAPHTHALENE	2.6 U	2.9 U	2.8 U	2.7 U	5.2	5.05	4.9	2.9 U	28 U
U	PHENANTHRENE	4.2	40 J	130 J	220 J	130	125	120	41	2900
U	PYRENE	4	61 J	155.5 J	250 J	160	140	120	65	3300
	Inorganics (mg/kg)									
	ALUMINUM	8440	10500	9335	8170	6640	6890	7140	16800	10900
UR	ANTIMONY	1.1 UR	1.2 U	1.2 U	1.1 UR	1.2	1.2	1.1 UR	1.2 U	1.2 U
	ARSENIC	5.2	9.9	9	8.1	14.1	14	13.9	7.1	8.9
	BARIUM	31.5	93.4 J	68.75 J	44.1 J	36.3	49.05	61.8	101	66.7
	BERYLLIUM	0.55	0.72	0.625	0.53	0.49	0.68	0.87	1.1	0.69
J	CADMIUM	0.22 U	0.81	0.575 J	0.34 J	0.43	0.435 J	0.44 J	0.25	0.49
J	CALCIUM	63900 J	41000	53600 J	66200 J	78800	86850 J	94900 J	23300	19800
	CHROMIUM	15	16.3	15.4	14.5	13 J	22.8 J	32.6 J	24.3	19.2
	COBALT	7.3	8.7	7.9	7.1	7.3	8	8.7	10.5	10.3
	COPPER	17.5	28.9	25.75	22.6	53.6	47.05	40.5	25.9	31.8
	IRON	16300	29000	24200	19400	22300	24550	26800	25300	23700
J	LEAD	9.5 J	62.7 J	48.45 J	34.2 J	236 J	161.2 J	86.4 J	25.7	74.9
	MAGNESIUM	28800	23400	29750	36100	39700	38950	38200	12900	11500
	MANGANESE	336	1820 J	1294 J	768 J	711 J	1000.5 J	1290 J	613	648
	MERCURY	0.015 U	0.031	0.0265	0.022	0.034	0.0325	0.031	0.055	0.087
	NICKEL	21.4	28.9	24.25	19.6	19.8 J	33.85 J	47.9 J	26.2	22.4
	POTASSIUM	2160	1810	1775	1740	1390	1295	1200	2280	1370
U	SILVER	0.22 U	0.24 U	0.235 U	0.23 U	0.22 U	0.22 U	0.22 U	0.24 U	0.44
U	SODIUM	223 U	240 U	235 U	230 U	220 U	194	278	242 U	233 U
	VANADIUM	17.8	25	22.75	20.5	18.6	17.5	16.4	31.8	28.5
	ZINC	40	97.6	81.9	66.2	109 J	156.5 J	204 J	72.8	127

NC = No criterion available.
U= Not detected. Value shown is detection limit.
J =The value is considered a quantitative estimate because it was less than the reporting limit or because of another technical noncompliance.
Shaded cells indicate that the concentration is greater than the minimum screening criterion.

TABLE 4-4

SUMMARY OF DESCRIPTIVE STATISTICS AND CRITERIA COMPARISONS FOR RI SURFACE SOIL DATA
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detect	Sample of Maximum Detect	Minimum Non-Detect	Maximum Non-Detect	Average Positive Result	ORNL Residential Soil Criteria	Exceedances of ORNL Residential Soil Criteria	ORNL Industrial Soil Criteria	Exceedances of ORNL Industrial Soil Criteria	ORNL Risk Based SSL	Exceedances of ORNL Risk Based SSL	ORNL MCL Based SSL	Exceedances of ORNL MCL Based SSL	ORNL Residential Soil Criteria for Inhalation	Exceedances of ORNL Residential Soil Criteria for Inhalation	ORNL Industrial Soil Criteria for Inhalation	Exceedances of ORNL Industrial Soil Criteria for Inhalation	ORNL SSLs for Inhalation Construction Worker Scenario
Volatile Organics (ug/kg)																					
2-BUTANONE	2/12	1.6	2.5	NTC19SB11	NTC19SB11-SO-0002	1.2	1.8	1.85	2800000	0	19000000	0	1500	0	NA	0	24000000	0	24000000	0	13000000
ACETONE	6/12	4.3 J	29	NTC19SB11	NTC19SB11-SO-0002	1.9	2.5	14.0	6100000	0	61000000	0	4400	0	NA	0	NA	0	NA	0	NA
Polynuclear Aromatic Hydrocarbons (ug/kg)																					
2-METHYLNAPHTHALENE	6/12	2	53	NTC19SB11	NTC19SB11-SO-0002	1.9	2.1	15.7	31000	0	410000	0	900	0	NA	0	NA	0	NA	0	NA
ACENAPHTHENE	7/12	1.6	240	NTC19SB11	NTC19SB11-SO-0002	1.4	1.5	74.6	340000	0	3300000	0	27000	0	NA	0	NA	0	NA	0	NA
ACENAPHTHYLENE	7/12	1.4	74	NTC19SB11	NTC19SB11-SO-0002	1.3	1.4	19.9	340000	0	3300000	0	27000	0	NA	0	NA	0	NA	0	NA
ANTHRACENE	8/12	2.1	590	NTC19SB11	NTC19SB11-SO-0002	0.9	0.97	184	1700000	0	17000000	0	450000	0	NA	0	280000	0	NA	0	NA
BENZO(A)ANTHRACENE	10/12	2.3	1700	NTC19SB11	NTC19SB11-SO-0002	1.6	1.7	444	150	3	2100	0	14	8	NA	0	280000	0	NA	0	NA
BENZO(A)PYRENE	10/12	4.2	1200	NTC19SB19	NTC19SB20-SO-0002	1.1	1.2	314	15	8	210	3	4.6	9	310	3	NA	0	NA	0	280000
BENZO(B)FLUORANTHENE	9/12	6.7	1700	NTC19SB19	NTC19SB20-SO-0002	1.7	1.9	429	150	3	2100	0	47	5	NA	0	NA	0	NA	0	NA
BENZO(G,H,I)PERYLENE	10/12	3.4	940	NTC19SB19	NTC19SB20-SO-0002	1.7	1.8	200	170000	0	1700000	0	150000	0	NA	0	NA	0	NA	0	NA
BENZO(K)FLUORANTHENE	9/12	2.7	460	NTC19SB19	NTC19SB20-SO-0002	1.4	1.5	128	1500	0	21000	0	460	0	NA	0	NA	0	NA	0	NA
CHRYSENE	11/12	2.4	1900	NTC19SB11	NTC19SB11-SO-0002	1.3	1.3	372	15000	0	210000	0	1400	1	NA	0	NA	0	NA	0	NA
DIBENZO(A,H)ANTHRACENE	5/12	4.8 J	160	NTC19SB19	NTC19SB20-SO-0002	1.7	1.9	68.3	15	2	210	0	15	2	NA	0	NA	0	NA	0	NA
FLUORANTHENE	10/12	2.2	5100	NTC19SB11	NTC19SB11-SO-0002	1.9	2	1084	230000	0	2200000	0	210000	0	NA	0	NA	0	NA	0	NA
FLUORENE	7/12	1.8	250	NTC19SB11	NTC19SB11-SO-0002	1.4	1.5	81.2	230000	0	2200000	0	33000	0	NA	0	NA	0	NA	0	NA
INDENO(1,2,3-CD)PYRENE	9/12	4.4	730	NTC19SB19	NTC19SB20-SO-0002	1.7	1.9	185	150	3	2100	0	160	3	NA	0	NA	0	NA	0	NA
NAPHTHALENE	3/12	4.9	62	NTC19SB11	NTC19SB11-SO-0002	2.6	28	24.7	3900	0	20000	0	0.55	3	NA	0	5200	0	270000	0	52000
PHENANTHRENE	10/12	4.2	3200	NTC19SB11	NTC19SB11-SO-0002	1.9	2	765	170000	0	1700000	0	150000	0	NA	0	NA	0	NA	0	NA
PYRENE	11/12	2.4	3500	NTC19SB11	NTC19SB11-SO-0002	1.9	1.9	760	170000	0	1700000	0	150000	0	NA	0	NA	0	NA	0	NA
Inorganics (mg/kg)																					
ALUMINUM	16/16	6640	19300	NTC19SB06	NTC19SB06-SO-0001			11968	77000	13	99000	0	55000	0	NA	0	1100000	0	1100000	0	NA
ANTIMONY	1/13	1.2	1.2	NTC19SB17	NTC19SB17-SO-0002	1.1	3.8	0.93	3.1	0	41	0	0.66	1	0.27	1		0	NA	0	NA
ARSENIC	16/16	5.2	32.2	NTC19SB10	NTC19SB10-SO-0002			11.5	0.39	16	1.6	16	0.0013	16	0.29	16	1440	0	1440	0	58
BARIUM	16/16	31.5	188	NTC19SB06	NTC19SB06-SO-0001			80.4	1500	0	19000	0	300	0	82	7	110000	0	110000	0	**170**
BERYLLIUM	16/16	0.49	2	NTC19SB11	NTC19SB11-SO-0002			0.861	16	0	200	0	58	0	3.2	0	2570	0	2570	0	7.1
CADMIUM	14/16	0.25	0.92 J	NTC19SB06	NTC19SB06-SO-0001	0.22	0.24	0.497	7	0	81	0	1.4	0	0.38	11	3430	0	3430	0	14
CALCIUM	16/16	5210 J	111000 J	NTC19SB07	NTC19SB07-SO-0001			37136	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA
CHROMIUM	16/16	13 J	32.6 J	NTC19SB17	NTC19SB17-SO-0002-D			20.3	280	0	1400	0	NA	0	NA	0	515	0	515	0	NA
COBALT	16/16	5	13.3	NTC19SB10	NTC19SB10-SO-0002			9.82	2.3	16	30	0	0.49	16	NA	0	2210	0	221	0	NA
COPPER	16/16	17.5	53.6	NTC19SB17	NTC19SB17-SO-0002			28.1	310	0	4100	0	51	0	46	1	NA	0	NA	0	NA
IRON	16/16	14600	36800	NTC19SB10	NTC19SB10-SO-0002			26784	5500	16	72000	0	640	16	NA	0	NA	0	NA	0	NA
LEAD	16/16	9.5 J	480 J	NTC19SB03	NTC19SB03-SO-0001			92.9	400	1	80	6	NA	0	14	15	NA	0	NA	0	NA
MAGNESIUM	16/16	5270 J	62100	NTC19SB07	NTC19SB07-SO-0001			20581	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA
MANGANESE	16/16	336	1820 J	NTC19SB16	NTC19SB16-SO-0103			889	180	16	2300	0	57	16	NA	0	11000	0	11000	0	**18**
MERCURY	15/16	0.018	0.47	NTC19SB06	NTC19SB06-SO-0001	0.015	0.015	0.0959	0.67	0	2.8	0	0.033	9	0.1	3	NA	0	2.9	0	110
NICKEL	16/16	14	47.9 J	NTC19SB17	NTC19SB17-SO-0002-D			26.7	160	0	2000	0	48	0	NA	0	25700	0	NA	0	NA
POTASSIUM	16/16	1030	2720	NTC19SB11	NTC19SB11-SO-0002			1907	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA
SILVER	3/16	0.44	1	NTC19SB06	NTC19SB06-SO-0001	0.22	0.25	0.640	39	0	510	0	1.6	0	NA	0	NA	0	NA	0	NA
SODIUM	4/16	239	565	NTC19SB11	NTC19SB11-SO-0002	220	256	360	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA
VANADIUM	16/16	16.4	37.1	NTC19SB06	NTC19SB06-SO-0001			27.5	39	0	520	0	180	0	180	0	NA	0	NA	0	NA
ZINC	16/16	40	250 J	NTC19SB06	NTC19SB06-SO-0001			124	2300	0	31000	0	680	0	NA	0	NA	0	NA	0	NA

TABLE 4-4

SUMMARY OF DESCRIPTIVE STATISTICS AND CRITERIA COMPARISONS FOR RI SURFACE SOIL DATA
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Parameter	Exceedances of ORNL SSLs for Inhalation Construction Worker Scenario	TACO - Residential Soil Ingestion(1)	Exceedances of TACO - Residential Soil Ingestion(1)	TACO - Residential Soil Inhalation(1)	Exceedances of TACO - Residential Soil Inhalation(1)	TACO - Industrial - Commercial Inhalation	Exceedances of TACO - Industrial - Commercial Inhalation	TACO - Industrial - Commercial Ingestion	Exceedances of TACO - Industrial - Commercial Ingestion	TACO - Residential Migration to Groundwater - Class 1 (Soil Comp)	Exceedances of TACO - Residential Migration to Groundwater - Class 1 (Soil Comp)	TACO - Construction Worker Soil Ingestion(2)	Exceedances of TACO - Construction Worker Soil Ingestion(2)	TACO - Construction Worker Soil Inhalation(2)	Exceedances of TACO - Construction Worker Soil Inhalation(2)	NON-TACO - Residential Soil Ingestion(3)	Exceedances of NON-TACO - Residential Soil Ingestion(3)	NON-TACO - Residential Soil Inhalation(3)	Exceedances of NON-TACO - Residential Soil Inhalation(3)
Volatile Organics (ug/kg)																			
2-BUTANONE	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	4700000	0	250000	0
ACETONE	0	7000000	0	10000000	0	10000000	0	NA	0	25000	0	NA	0	10000000	0	NA	0	NA	0
Polynuclear Aromatic Hydrocarbons (ug/kg)																			
2-METHYLNAPHTHALENE	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
ACENAPHTHENE	0	470000	0	NA	0	NA	0	12000000	0	570000	0	12000000	0	NA	0	NA	0	NA	0
ACENAPHTHYLENE	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	230000	0	NA	0
ANTHRACENE	0	2300000	0	NA	0	61000000	0	NA	0	12000000	0	610000000	0	NA	0	NA	0	NA	0
BENZO(A)ANTHRACENE	0	**900**	3	NA	0	NA	0	8000	0	2000	0	170000	0	NA	0	NA	0	NA	0
BENZO(A)PYRENE	0	**90**	3	NA	0	NA	0	800	2	8000	0	17000	0	NA	0	NA	0	NA	0
BENZO(B)FLUORANTHENE	0	**900**	2	NA	0	NA	0	8000	0	5000	0	170000	0	NA	0	NA	0	NA	0
BENZO(G,H,I)PERYLENE	0	230000	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	230000	0	NA	0
BENZO(K)FLUORANTHENE	0	900	0	NA	0	NA	0	78000	0	49000	0	1700000	0	NA	0	NA	0	NA	0
CHRYSENE	0	8800	0	NA	0	NA	0	780000	0	160000	0	17000000	0	NA	0	NA	0	NA	0
DIBENZO(A,H)ANTHRACENE	0	**90**	2	NA	0	NA	0	800	0	2000	0	17000	0	NA	0	NA	0	NA	0
FLUORANTHENE	0	310000	0	NA	0	NA	0	8200000	0	4300000	0	8200000	0	NA	0	NA	0	NA	0
FLUORENE	0	310000	0	NA	0	NA	0	8200000	0	560000	0	8200000	0	NA	0	NA	0	NA	0
INDENO(1,2,3-CD)PYRENE	0	90	0	NA	0	NA	0	8000	0	69000	0	170000	0	NA	0	NA	0	NA	0
NAPHTHALENE	0	160000	0	170000	0	270000	0	41000000	0	12000	0	4100000	0	1800	0	NA	0	NA	0
PHENANTHRENE	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	230000	0	NA	0
PYRENE	0	230000	0	NA	0	NA	0	6100000	0	4200000	0	6100000	0	NA	0	NA	0	NA	0
Inorganics (mg/kg)																			
ALUMINUM	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	7800	0	10000	0
ANTIMONY	0	3.1	0	NA	0	NA	0	82	0	NA	0	8.2	0	NA	0	NA	0	NA	0
ARSENIC	0	**11.3**	7	75	0	1200	0	NA	0	NA	0	61	0	25000	0	NA	0	NA	0
BARIUM	0	550	0	69000	0	91000	0	14000	0	NA	0	1400	0	87000	0	NA	0	NA	0
BERYLLIUM	0	16	0	130	0	210	0	410	0	NA	0	41	0	4400	0	NA	0	NA	0
CADMIUM	0	7.8	0	180	0	280	0	200	0	NA	0	20	0	5900	0	NA	0	NA	0
CALCIUM	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
CHROMIUM	0	230	0	270	0	420	0	6100	0	NA	0	4100	0	690	0	NA	0	NA	0
COBALT	0	470	0	NA	0	NA	0	12000	0	NA	0	1200	0	NA	0	NA	0	NA	0
COPPER	0	290	0	NA	0	NA	0	8200	0	NA	0	820	0	NA	0	NA	0	NA	0
IRON	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	5500	0	NA	0
LEAD	0	**400**	1	NA	0	NA	0	800	0	NA	0	700	0	NA	0	NA	0	NA	0
MAGNESIUM	0	32500	0	NA	0	NA	0	NA	0	NA	0	730000	0	NA	0	NA	0	NA	0
MANGANESE	16	**160**	1	6900	0	9100	0	4100	0	NA	0	410	0	8700	0	NA	0	NA	0
MERCURY	0	2.3	0	1	0	1.6	0	61	0	NA	0	6.1	0	**0.1**	3	NA	0	NA	0
NICKEL	0	160	0	1300	0	2100	0	4100	0	NA	0	410	0	44000	0	NA	0	NA	0
POTASSIUM	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
SILVER	0	39	0	NA	0	NA	0	1000	0	NA	0	100	0	NA	0	NA	0	NA	0
SODIUM	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
VANADIUM	0	55	0	NA	0	NA	0	1400	0	NA	0	140	0	NA	0	NA	0	NA	0
ZINC	0	2300	0	NA	0	NA	0	61000	0	NA	0	6100	0	NA	0	NA	0	NA	0

TABLE 4-4

SUMMARY OF DESCRIPTIVE STATISTICS AND CRITERIA COMPARISONS FOR RI SURFACE SOIL DATA
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Parameter	NON-TACO - Industrial Commercial Soil Ingestion	Exceedances of NON-TACO - Industrial Commercial Soil Ingestion	NON-TACO - Industrial Commercial Soil Inhalation	Exceedances of NON-TACO - Industrial Commercial Soil Inhalation	NON-TACO - Construction Worker Soil Ingestion(4)	Exceedances of NON-TACO - Construction Worker Soil Ingestion(4)	NON-TACO - Construction Worker Soil Inhalation(4)	Exceedances of NON-TACO - Construction Worker Soil Inhalation(4)	NON-TACO - Residential Migration to Groundwater - Class 1(3)	Exceedances of NON-TACO - Residential Migration to Groundwater - Class 1(3)
Volatile Organics (ug/kg)										
2-BUTANONE	NA	0	NA	0	12000000	0	7100	0	17000	0
ACETONE	NA	0	NA	0	NA	0	NA	0	NA	0
Polynuclear Aromatic Hydrocarbons (ug/kg)										
2-METHYLNAPHTHALENE	NA	0	NA	0	NA	0	NA	0	NA	0
ACENAPHTHENE	NA	0	NA	0	NA	0	NA	0	NA	0
ACENAPHTHYLENE	6100000	0	NA	0	6100000	0	NA	0	85000	0
ANTHRACENE	NA	0	NA	0	NA	0	NA	0	NA	0
BENZO(A)ANTHRACENE	NA	0	NA	0	NA	0	NA	0	NA	0
BENZO(A)PYRENE	NA	0	NA	0	NA	0	NA	0	NA	0
BENZO(B)FLUORANTHENE	NA	0	NA	0	NA	0	NA	0	NA	0
BENZO(G,H,I)PERYLENE	6100000	0	NA	0	6100000	0	NA	0	27000000	0
BENZO(K)FLUORANTHENE	NA	0	NA	0	NA	0	NA	0	NA	0
CHRYSENE	NA	0	NA	0	NA	0	NA	0	NA	0
DIBENZO(A,H)ANTHRACENE	NA	0	NA	0	NA	0	NA	0	NA	0
FLUORANTHENE	NA	0	NA	0	NA	0	NA	0	NA	0
FLUORENE	NA	0	NA	0	NA	0	NA	0	NA	0
INDENO(1,2,3-CD)PYRENE	NA	0	NA	0	NA	0	NA	0	NA	0
NAPHTHALENE	NA	0	NA	0	NA	0	NA	0	NA	0
PHENANTHRENE	6100000	0	NA	0	6100000	0	NA	0	200000	0
PYRENE	NA	0	NA	0	NA	0	NA	0	NA	0
Inorganics (mg/kg)										
ALUMINUM	100000	0	10000	0	41000	0	8700	0	NA	0
ANTIMONY	NA	0	NA	0	NA	0	NA	0	NA	0
ARSENIC	NA	0	NA	0	NA	0	NA	0	NA	0
BARIUM	NA	0	NA	0	NA	0	NA	0	NA	0
BERYLLIUM	NA	0	NA	0	NA	0	NA	0	NA	0
CADMIUM	NA	0	NA	0	NA	0	NA	0	NA	0
CALCIUM	NA	0	NA	0	NA	0	NA	0	NA	0
CHROMIUM	NA	0	NA	0	NA	0	NA	0	NA	0
COBALT	NA	0	NA	0	NA	0	NA	0	NA	0
COPPER	NA	0	NA	0	NA	0	NA	0	NA	0
IRON	100000	0	NA	0	14000	0	NA	0	NA	0
LEAD	NA	0	NA	0	NA	0	NA	0	NA	0
MAGNESIUM	NA	0	NA	0	NA	0	NA	0	NA	0
MANGANESE	NA	0	NA	0	NA	0	NA	0	NA	0
MERCURY	NA	0	NA	0	NA	0	NA	0	NA	0
NICKEL	NA	0	NA	0	NA	0	NA	0	NA	0
POTASSIUM	NA	0	NA	0	NA	0	NA	0	NA	0
SILVER	NA	0	NA	0	NA	0	NA	0	NA	0
SODIUM	NA	0	NA	0	NA	0	NA	0	NA	0
VANADIUM	NA	0	NA	0	NA	0	NA	0	NA	0
ZINC	NA	0	NA	0	NA	0	NA	0	NA	0

Associated Samples:

NTC19SB01-SO-0002	NTC19SB07-SO-0001	NTC19SB16-SO-0103	NTC19SB17-SO-0002-AVG
NTC19SB03-SO-0001	NTC19SB08-SO-0103	NTC19SB16-SO-0103-AVG	NTC19SB17-SO-0002-D
NTC19SB03-SO-0103	NTC19SB09-SO-0002	NTC19SB16-SO-0103-D	NTC19SB19-SO-0002
NTC19SB06-SO-0001	NTC19SB10-SO-0002	NTC19SB17-SO-0002	NTC19SB20-SO-0002

NA = Not applicable
J =The value is considered a quantitative estimate because it was less than the reporting limit or because of another technical noncompliance.
Shaded cells indicate that the concentration is greater than the minimum screening criterion.

TABLE 4-5

SUMMARY OF DETECTED CONCENTRATIONS IN SUBSURFACE SOIL SAMPLES
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

PARAMETER	MINIMUM CRITERIA VALUE	MINIMUM CRITERIA	NTC19SB01	NTC19SB02	NTC19SB03	NTC19SB04	NTC19SB05	NTC19SB05	NTC19SB06	NTC19SB06	NTC19SB07	NTC19SB08	NTC19SB09	NTC19SB10
top_depth			6	2	8	2	4	6	2	6	5	4	4	5
bottom_dep			8	4	10	4	6	8	4	8	7	6	6	7
Volatile Organics (ug/kg)														
4-METHYL-2-PENTANONE	440	USEPA ORNL SSL Migration to GW Risk-Based	0.51 U	0.65 U	0.5 U	0.64 U	0.53 U	0.52 U	0.81 U	0.56 U	0.59 U	0.78 U	0.48 U	0.51 U
ACETONE	4400	USEPA ORNL SSL Migration to GW Risk-Based	2.4 J	2.2 UJ	1.7 UJ	2.2 UJ	5.8 J	2.3 J	2.8 UJ	1.9 UJ	3.2	2.7 U	2.6	1.8 U
TRICHLOROFLUOROMETHANE	840	USEPA ORNL SSL Migration to GW Risk-Based	0.83 U	1.1 U	0.81 UJ	1 U	0.87 U	0.85 U	1.3 U	0.92 U	3.9	1.3 U	0.79 U	0.84 U
Polynuclear Aromatic Hydrocarbons (ug/kg)														
2-METHYLNAPHTHALENE	900	USEPA ORNL SSL Migration to GW Risk-Based	2 U	2.1 U	1.9 U	2 U	1.8 U	1.9 U	2 U	5.2	1.8 U	2.2	1.9 U	1.9 U
ACENAPHTHYLENE	27000	USEPA ORNL SSL Migration to GW Risk-Based	1.4 U	1.4 U	1.3 U	1.7	1.2 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U
ANTHRACENE	450000	USEPA ORNL SSL Migration to GW Risk-Based	0.96 U	0.99 U	0.92 U	0.96 U	0.88 U	0.9 U	0.94 U	0.9 U	0.89 U	0.9 U	0.9 U	0.93 U
BENZO(A)ANTHRACENE	14	USEPA ORNL SSL Migration to GW Risk-Based	1.7 U	1.7 U	1.6 U	16	1.5 U	1.6 U	20	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U
BENZO(A)PYRENE	4.6	USEPA ORNL SSL Migration to GW Risk-Based	1.2 U	1.2 U	1.1 U	18	1.1 U	1.1 U	20	1.1 U	1.1 U	1.1 U	1.1 U	1.2 U
BENZO(B)FLUORANTHENE	47	USEPA ORNL SSL Migration to GW Risk-Based	1.8 U	1.9 U	1.8 U	15	1.7 U	1.7 U	18	1.7 U	1.7 U	1.7 U	1.7 U	1.8 U
BENZO(G,H,I)PERYLENE	150000	USEPA ORNL SSL Migration to GW Risk-Based	3.7	2.2	5.6	11	5.8	4	11	3.7	5.4	6	5.8	5.2
BENZO(K)FLUORANTHENE	460	USEPA ORNL SSL Migration to GW Risk-Based	1.5 U	1.6 U	1.4 U	6.1	1.4 U	1.4 U	8.3	1.4 U	1.4 U	1.4 U	1.4 U	1.5 U
CHRYSENE	1400	USEPA ORNL SSL Migration to GW Risk-Based	1.3 U	2.4	1.2 U	17	1.2 U	1.2 U	18	1.2 U	1.2 U	1.2 U	6.7	1.2 U
FLUORANTHENE	210000	USEPA ORNL SSL Migration to GW Risk-Based	2 U	2.1 U	1.9 U	28	1.8 U	1.9 U	24	1.9 U	1.8 U	1.9 U	3.5	3
INDENO(1,2,3-CD)PYRENE	150	USEPA ORNL Residential Soil	1.8 U	1.9 U	1.8 U	6.5	1.7 U	1.7 U	7.3	1.7 U	1.7 U	1.7 U	1.7 U	1.8 U
PHENANTHRENE	150000	USEPA ORNL SSL Migration to GW Risk-Based	5.7	2.1 U	17	16	1.8 U	7.8	12	12	6.7	11	4.8	3.1
PYRENE	150000	USEPA ORNL SSL Migration to GW Risk-Based	4.5	1.9 U	1.8 U	27	5.8	1.7 U	24	5.3	6.8	4.6	4.6	6.3
Inorganics (mg/kg)														
ALUMINUM	55000	USEPA ORNL SSL Migration to GW MCL-Based	14400	14700	9810	7110	4580	4740	8970	5670	5500	4910	4500	10200
ARSENIC	0.0013	USEPA ORNL SSL Migration to GW Risk-Based	13.7	9.3	11.8	20.7	25.1	4	13.4	9.7	7.3	4.4	9.5	6.2
BARIUM	82	USEPA ORNL SSL Migration to GW MCL-Based	66.5	81.9	45	65.1	67.4	10.9	55	13.4	20.3	28.5	21.6	38.4
BERYLLIUM	3.2	USEPA ORNL SSL Migration to GW MCL-Based	0.94	0.94	0.66	0.59	0.39	0.36	0.66	0.43	0.41	0.36	0.37	0.66
CADMIUM	0.38	USEPA ORNL SSL Migration to GW MCL-Based	0.24 J	0.37 J	0.22 U	0.33 J	0.22 U	0.22 U	0.43 J	0.28 J	0.38	0.22 U	0.22 U	0.26
CALCIUM	NC	NC	3010 J	2850 J	85000 J	12000 J	63600 J	62000 J	19200 J	65600 J	73500	78500	65100	81900
CHROMIUM	230	TACO - Residential Soil Ingestion	25.5	25.8	17.3	15.2	9	9.9	19.1	11.5	12.9	9.2	9.6	18.1
COBALT	0.49	USEPA ORNL SSL Migration to GW Risk-Based	18.8	22.1	9.8	9	6.7	5.2	8.9	6.5	6.6	6.9	5.4	9.2
COPPER	46	USEPA ORNL SSL Migration to GW MCL-Based	31.7	34.2	21	22.6	22.3	18.7	22	24.1	24.9	15.4	17.7	21.5
IRON	640	USEPA ORNL SSL Migration to GW MCL-Based	33100	31300	19500	34900	24300	12200	28900	24000	20800	15500	17400	20000
LEAD	14	USEPA ORNL SSL Migration to GW MCL-Based	16.5 J	17.7 J	10.4 J	37 J	12.8 J	8.5 J	54.8 J	13.6 J	15	8.1	10.1	11.6
MAGNESIUM	325000	TACO - Residential Soil Ingestion	6610 J	6440 J	40700 J	8020 J	33400 J	31500 J	12500 J	34400 J	40500	42100	34700	41200
MANGANESE	57	USEPA ORNL SSL Migration to GW Risk-Based	1040	1600	589	1150	802	435	941	534	660	724	520	524
MERCURY	0.033	USEPA ORNL SSL Migration to GW Risk-Based	0.026	0.032	0.017	0.049	0.016	0.013 U	0.041	0.014 U	0.013 U	0.015 U	0.014 U	0.014 U
NICKEL	48	USEPA ORNL SSL Migration to GW Risk-Based	40.8	48.8	25.6	25.7	17.5	14.9	25	20.2	19	18.3	16.5	25.8
POTASSIUM	NC	NC	2860 J	2950 J	2760 J	1370 J	1240 J	1310 J	1510 J	1550 J	1250	1250	1210	2660
SODIUM	NC	NC	241 U	249 U	223 U	243 U	218 U	222 U	233 U	216 U	224 U	241	220 U	224 U
VANADIUM	18	ORNL Residential Soil Criteria	28.2	27.9	19.8	26.5	14	12.7	29.8	16	17.3	13.9	13.7	20.7
ZINC	680	USEPA ORNL SSL Migration to GW Risk-Based	78.6 J	77.7 J	45.3 J	108 J	57.9 J	39.3 J	140 J	80.3 J	87.8	41.4	37.5	48.6

TABLE 4-5

SUMMARY OF DETECTED CONCENTRATIONS IN SUBSURFACE SOIL SAMPLES
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

PARAMETER	NTC19SB12	NTC19SB14	NTC19SB14	NTC19SB15	NTC19SB16	NTC19SB17	NTC19SB18	NTC19SB18	NTC19SB19	NTC19SB20
top_depth	5	2	5	4	5	4	2	4	4	4
bottom_dep	7	4	7	6	7	6	4	6	6	6
Volatile Organics (ug/kg)										
4-METHYL-2-PENTANONE	0.53 U	0.57 U	0.54 U	0.58 U	0.5 U	0.65	0.58 U	0.5 U	0.49 U	0.52 U
ACETONE	5.5 J	6.6 J	5.1 J	8 J	1.7 U	9.1	10	1.7 U	3	1.8 U
TRICHLOROFLUOROMETHANE	0.87 U	0.94 U	0.88 U	0.95 U	0.82 U	0.78 U	0.95 U	0.82 U	0.81 U	0.85 U
Polynuclear Aromatic Hydrocarbons (ug/kg)										
2-METHYLNAPHTHALENE	2 U	1.9 U	1.9 U	2.4	1.9 U	2.8	1.9 U	1.9 U	2 U	2 U
ACENAPHTHYLENE	1.4 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U
ANTHRACENE	0.97 U	0.93 U	0.93 U	0.92 U	0.91 U	0.9 U	4.2	0.93 U	0.94 U	0.95 U
BENZO(A)ANTHRACENE	1.7 UJ	1.6 UJ	1.6 UJ	1.6 U	1.6 U	1.6 U	15	1.6 U	1.6 U	1.7 U
BENZO(A)PYRENE	1.2 U	1.2 U	1.2 U	1.1 U	1.1 U	1.1 U	22	7.6	7.1	12
BENZO(B)FLUORANTHENE	1.8 U	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U	15	1.8 U	1.8 U	1.8 U
BENZO(G,H,I)PERYLENE	1.8 U	2.5	2.6	8.6 J	5.4	4.8	9	2.9	1.7 U	1.7 U
BENZO(K)FLUORANTHENE	1.5 U	1.5 U	1.5 U	1.4 U	1.4 U	1.4 U	4.5	1.5 U	1.5 U	1.5 U
CHRYSENE	1.3 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	12	7.2	1.2 U	1.3 U
FLUORANTHENE	2 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	24	1.9 U	2 U	2 U
INDENO(1,2,3-CD)PYRENE	1.8 U	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U	7.4	1.8 U	1.8 U	1.8 U
PHENANTHRENE	2 U	2.4	6.7	12	8.9	8.2	17	3	2 U	2 U
PYRENE	1.8 U	2	1.8 U	1.8 U	1.7 U	1.7 U	21	2.3	1.8 U	1.8 U
Inorganics (mg/kg)										
ALUMINUM	11000	5820	10000	8610	5050	5780	10300	10600	10400	9250
ARSENIC	4.8	19.1	7.7	5.4	6.6	7.4	7.3	6.7	7.4	7.6
BARIUM	45.5	29.2	44.7	33.6	20.9	18.8	39.9	42.1	45.4	34.3
BERYLLIUM	0.67	0.43	0.66	0.57	0.39	0.41	0.67	0.71	0.7	0.59
CADMIUM	0.24 U	0.39 J	0.29 J	0.23 J	0.28	0.22 U	0.3	0.24	0.23 U	0.24 U
CALCIUM	119000 J	108000 J	85100 J	80300 J	73600	67000	76800	80700	81400	76600
CHROMIUM	20	11.1	17.6	15.5	10	10	17.6	18.6	18	16.3
COBALT	9.3	9.5	11.5	8.6	5.8	6	9.2	10.5	14.7	8.4
COPPER	17.1	25.2	20.5	18.7	21.3	23.6	21.7	21.2	21.6	19.6
IRON	18300	22800	20300	17400	16400	15300	20400	20400	20300	19100
LEAD	10.3 J	19.2 J	10.2 J	9.5 J	12	9.6	25	11.1	11.7	10.6
MAGNESIUM	32800	56300	41300	40400	38800	32600	39100	39800	38600	38700
MANGANESE	421	1220	841	566	675	481	569	604	718	592
MERCURY	0.02	0.043	0.018	0.016 U	0.015 U	0.013	0.029	0.018	0.021	0.014 U
NICKEL	23.3	22.7	33.6	22.6	17.6	17.2	24.5	27.5	31.8	23.5
POTASSIUM	2560	1510	2610	2380	1340	1410	2640	2700	2620	2150
SODIUM	239 U	230 U	228 U	230 U	221 U	249	226 U	228 U	235 U	238 U
VANADIUM	20	15.3	19.9	17.6	14.2	15.3	20.9	20.7	20.6	19.2
ZINC	38.6	57.7	48.3	48.9	54.1	41.3	53.6	50	52.7	39

NC = No criterion available.
U= Not detected. Value shown is detection limit.
J =The value is considered a quantitative estimate because it was less than the reporting limit or because of another technical noncompliance.
Shaded cells indicate that the concentration is greater than the minimum screening criterion.

TABLE 4-6

SUMMARY OF DESCRIPTIVE STATISTICS AND CRITERIA COMPARISONS FOR RI SUBSURFACE SOIL DATA
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Result	Maximum Result	Location of Maximum Detect	Sample of Maximum Detect	Minimum Non-Detect	Maximum Non-Detect	Average Positive Result	ORNL Residential Soil Criteria	Exceedances of ORNL Residential Soil Criteria	ORNL Industrial Soil Criteria	Exceedances of ORNL Industrial Soil Criteria	ORNL Risk Based SSL	Exceedances of ORNL Risk Based SSL	ORNL MCL Based SSL	Exceedances of ORNL MCL Based SSL	ORNL Residential Soil Criteria for Inhalation	Exceedances of ORNL Residential Soil Criteria for Inhalation	ORNL Industrial Soil Criteria for Inhalation	Exceedances of ORNL Industrial Soil Criteria for Inhalation
Volatile Organics (ug/kg)																				
4-METHYL-2-PENTANONE	1/22	0.65	0.65	NTC19SB17	NTC19SB17-SO-0406	0.48	0.81	0.650	530000	0	5200000	0	440	0	NA	0	2700000	0	2700000	0
ACETONE	12/22	2.3 J	12	NTC19SB15	NTC19SB15-SO-0406-D	1.7	2.8	5.47	6100000	0	61000000	0	4400	0	NA	0	NA	0	NA	0
TRICHLOROFLUOROMETHANE	1/22	3.9	3.9	NTC19SB07	NTC19SB07-SO-0507	0.78	1.3	3.90	80000	0	340000	0	840	0	NA	0	1100000	0	1600000	0
Polynuclear Aromatic Hydrocarbons (ug/kg)																				
2-METHYLNAPHTHALENE	4/22	2.2	6.5	NTC19SB15	NTC19SB15-SO-0406-D	1.8	2.1	3.66	31000	0	410000	0	900	0	NA	0	NA	0	NA	0
ACENAPHTHYLENE	1/22	1.7	1.7	NTC19SB04	NTC19SB04-SO-0204	1.2	1.4	1.70	340000	0	3300000	0	27000	0	NA	0	NA	0	NA	0
ANTHRACENE	1/22	4.2	4.2	NTC19SB18	NTC19SB18-SO-0204	0.88	0.99	4.20	1700000	0	17000000	0	450000	0	NA	0	NA	0	NA	0
BENZO(A)ANTHRACENE	3/22	15	20	NTC19SB06	NTC19SB06-SO-0204	1.5	1.7	17.0	150	0	2100	0	14	3	NA	0	NA	0	NA	0
BENZO(A)PYRENE	6/22	7.1	22	NTC19SB18	NTC19SB18-SO-0204	1.1	1.2	14.5	15	3	210	0	4.6	6	310	0	NA	0	NA	0
BENZO(B)FLUORANTHENE	3/22	15	18	NTC19SB06	NTC19SB06-SO-0204	1.7	1.9	16.0	150	0	2100	0	47	0	NA	0	NA	0	NA	0
BENZO(G,H,I)PERYLENE	19/22	2.2	11	NTC19SB04 NTC19SB06	NTC19SB04-SO-0204 NTC19SB06-SO-0204	1.7	1.8	5.44	170000	0	1700000	0	150000	0	NA	0	NA	0	NA	0
BENZO(K)FLUORANTHENE	3/22	4.5	8.3	NTC19SB06	NTC19SB06-SO-0204	1.4	1.6	6.30	1500	0	21000	0	460	0	NA	0	NA	0	NA	0
CHRYSENE	6/22	2.4	18	NTC19SB06	NTC19SB06-SO-0204	1.2	1.3	10.6	15000	0	210000	0	1400	0	NA	0	NA	0	NA	0
FLUORANTHENE	5/22	3	28	NTC19SB04	NTC19SB04-SO-0204	1.8	2.1	16.5	230000	0	2200000	0	210000	0	NA	0	NA	0	NA	0
INDENO(1,2,3-CD)PYRENE	3/22	6.5	7.4	NTC19SB18	NTC19SB18-SO-0204	1.7	1.9	7.07	150	0	2100	0	160	0	NA	0	NA	0	NA	0
PHENANTHRENE	17/22	2.4	17	NTC19SB03 NTC19SB18	NTC19SB03-SO-0810 NTC19SB18-SO-0204	1.8	2.1	8.96	170000	0	1700000	0	150000	0	NA	0	NA	0	NA	0
PYRENE	12/22	2	27	NTC19SB04	NTC19SB04-SO-0204	1.7	1.9	9.52	170000	0	1700000	0	150000	0	NA	0	NA	0	NA	0
Inorganics (mg/kg)																				
ALUMINUM	22/22	4500	14700	NTC19SB02	NTC19SB02-SO-0204			8309	77000	0	99000	0	55000	0	NA	0	7090000	0	11000000	0
ARSENIC	22/22	4	25.1	NTC19SB05	NTC19SB05-SO-0406			9.77	0.39	22	1.6	22	0.0013	22	0.29	22	769	0	1440	0
BARIUM	22/22	10.9	81.9	NTC19SB02	NTC19SB02-SO-0204			39.6	1500	0	19000	0	300	0	82	0	709000	0	1100000	0
BERYLLIUM	22/22	0.36	0.94	NTC19SB02 NTC19SB01	NTC19SB02-SO-0204 NTC19SB01-SO-0608			0.574	16	0	200	0	58	0	3.2	0	1380	0	2570	0
CADMIUM	13/22	0.23 J	0.43 J	NTC19SB06	NTC19SB06-SO-0204	0.22	0.24	0.305	7	0	81	0	1.4	0	0.38	2	1840	0	3430	0
CALCIUM	22/22	2850 J	119000 J	NTC19SB12	NTC19SB12-SO-0507			66344	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
CHROMIUM	22/22	9	25.8	NTC19SB02	NTC19SB02-SO-0204			15.4	280	0	1400	0	NA	0	NA	0	276	0	515	0
COBALT	22/22	5.2	22.1	NTC19SB02	NTC19SB02-SO-0204			9.50	2.3	22	30	0	0.49	22	NA	0	1180	0	2210	0
COPPER	22/22	15.4	34.2	NTC19SB02	NTC19SB02-SO-0204			22.2	310	0	4100	0	51	0	46	0	NA	0	NA	0
IRON	22/22	12200	34900	NTC19SB04	NTC19SB04-SO-0204			21534	5500	22	72000	0	640	22	NA	0	NA	0	NA	0
LEAD	22/22	8.1	54.8 J	NTC19SB06	NTC19SB06-SO-0204			15.7	400	0	80	0	NA	0	14	7	NA	0	NA	0
MAGNESIUM	22/22	6440 J	56300	NTC19SB14	NTC19SB14-SO-0204			33178	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
MANGANESE	22/22	421	1600	NTC19SB02	NTC19SB02-SO-0204			736	180	22	2300	0	57	22	NA	0	70900	0	110000	0
MERCURY	13/22	0.013	0.049	NTC19SB04	NTC19SB04-SO-0204	0.013	0.016	0.03	0.67	0	2.8	0	0.033	3	0.1	0	2.9	0	2.9	0
NICKEL	22/22	14.9	48.8	NTC19SB02	NTC19SB02-SO-0204			24.7	160	0	2000	0	48	1	NA	0	NA	0	NA	0
POTASSIUM	22/22	1210	2950 J	NTC19SB02	NTC19SB02-SO-0204			2005	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
SODIUM	2/22	241	249	NTC19SB17	NTC19SB17-SO-0406	216	249	245	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
VANADIUM	22/22	12.7	29.8	NTC19SB06	NTC19SB06-SO-0204			19.4	39	0	520	0	180	0	180	0	NA	0	NA	0
ZINC	22/22	37.5	140 J	NTC19SB06	NTC19SB06-SO-0204			60.2	2300	0	31000	0	680	0	NA	0	NA	0	NA	0

TABLE 4-6

SUMMARY OF DESCRIPTIVE STATISTICS AND CRITERIA COMPARISONS FOR RI SUBSURFACE SOIL DATA
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Parameter	ORNL SSLs for Inhalation Construction Worker Scenario	Exceedances of ORNL SSLs for Inhalation Construction Worker Scenario	TACO - Residential Soil Ingestion(1)	Exceedances of TACO - Residential Soil Ingestion(1)	TACO - Residential Soil Inhalation(1)	Exceedances of TACO - Residential Soil Inhalation(1)	TACO - Industrial - Commercial Inhalation	Exceedances of TACO - Industrial - Commercial Inhalation	TACO - Industrial - Commercial Ingestion	Exceedances of TACO - Industrial - Commercial Ingestion	TACO - Residential Migration to Groundwater - Class 1 (Soil Comp)	Exceedances of TACO - Residential Migration to Groundwater - Class 1 (Soil Comp)	TACO - Construction Worker Soil Ingestion(2)	Exceedances of TACO - Construction Worker Soil Ingestion(2)	TACO - Construction Worker Soil Inhalation(2)	Exceedances of TACO - Construction Worker Soil Inhalation(2)	NON-TACO - Residential Soil Ingestion(3)	Exceedances of NON-TACO - Residential Soil Ingestion(3)
Volatile Organics (ug/kg)																		
4-METHYL-2-PENTANONE	2700000	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
ACETONE	NA	0	70000000	0	100000000	0	100000000	0	NA	0	25000	0	NA	0	100000000	0	NA	0
TRICHLOROFLUOROMETHANE	310000	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	23000000	0
Polynuclear Aromatic Hydrocarbons (ug/kg)																		
2-METHYLNAPHTHALENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
ACENAPHTHYLENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	2300000	0
ANTHRACENE	NA	0	23000000	0	NA	0	610000000	0	NA	0	12000000	0	610000000	0	NA	0	NA	0
BENZO(A)ANTHRACENE	NA	0	900	0	NA	0	NA	0	8000	0	2000	0	170000	0	NA	0	NA	0
BENZO(A)PYRENE	280000	0	90	0	NA	0	NA	0	800	0	8000	0	17000	0	NA	0	NA	0
BENZO(B)FLUORANTHENE	NA	0	900	0	NA	0	NA	0	8000	0	5000	0	170000	0	NA	0	NA	0
BENZO(G,H,I)PERYLENE	NA	0	2300000	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	2300000	0
BENZO(K)FLUORANTHENE	NA	0	9000	0	NA	0	NA	0	78000	0	49000	0	1700000	0	NA	0	NA	0
CHRYSENE	NA	0	88000	0	NA	0	NA	0	780000	0	160000	0	17000000	0	NA	0	NA	0
FLUORANTHENE	NA	0	3100000	0	NA	0	NA	0	82000000	0	4300000	0	82000000	0	NA	0	NA	0
INDENO(1,2,3-CD)PYRENE	NA	0	900	0	NA	0	NA	0	8000	0	69000	0	170000	0	NA	0	NA	0
PHENANTHRENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	2300000	0
PYRENE	NA	0	2300000	0	NA	0	NA	0	61000000	0	4200000	0	61000000	0	NA	0	NA	0
Inorganics (mg/kg)																		
ALUMINUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	78000	0
ARSENIC	58	0	11.3	6	750	0	1200	0	NA	0	NA	0	61	0	25000	0	NA	0
BARIUM	1700	0	5500	0	690000	0	910000	0	140000	0	NA	0	14000	0	870000	0	NA	0
BERYLLIUM	71	0	160	0	1300	0	2100	0	4100	0	NA NA	0	410	0	44000	0	NA	0
CADMIUM	140	0	78	0	1800	0	2800	0	2000	0	NA	0	200	0	59000	0	NA	0
CALCIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
CHROMIUM	NA	0	230	0	270	0	420	0	6100	0	NA	0	4100	0	690	0	NA	0
COBALT	NA	0	4700	0	NA	0	NA	0	120000	0	NA	0	12000	0	NA	0	NA	0
COPPER	NA	0	2900	0	NA	0	NA	0	82000	0	NA	0	8200	0	NA	0	NA	0
IRON	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	55000	0
LEAD	NA	0	400	0	NA	0	NA	0	800	0	NA	0	700	0	NA	0	NA	0
MAGNESIUM	NA	0	325000	0	NA	0	NA	0	NA	0	NA	0	730000	0	NA	0	NA	0
MANGANESE	180	22	1600	0	69000	0	91000	0	41000	0	NA	0	4100	0	8700	0	NA	0
MERCURY	1100	0	23	0	10	0	540000	0	610	0	NA	0	61	0	0.1	0	NA	0
NICKEL	NA	0	1600	0	13000	0	21000	0	41000	0	NA	0	4100	0	440000	0	NA	0
POTASSIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
SODIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
VANADIUM	NA	0	550	0	NA	0	NA	0	14000	0	NA	0	1400	0	NA	0	NA	0
ZINC	NA	0	23000	0	NA	0	NA	0	610000	0	NA	0	61000	0	NA	0	NA	0

TABLE 4-6

SUMMARY OF DESCRIPTIVE STATISTICS AND CRITERIA COMPARISONS FOR RI SUBSURFACE SOIL DATA
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Parameter	NON-TACO - Residential Soil Inhalation(3)	Exceedances of NON-TACO - Residential Soil Inhalation(3)	NON-TACO - Industrial Commercial Soil Ingestion	Exceedances of NON-TACO - Industrial Commercial Soil Ingestion	NON-TACO - Industrial Commercial Soil Inhalation	Exceedances of NON-TACO - Industrial Commercial Soil Inhalation	NON-TACO - Construction Worker Soil Ingestion(4)	Exceedances of NON-TACO- Construction Worker Soil Ingestion(4)	NON-TACO - Construction Worker Soil Inhalation(4)	Exceedances of NON-TACO - Construction Worker Soil Inhalation(4)	NON-TACO - Residential Migration to Groundwater - Class 1(3)	Exceedances of NON-TACO - Residential Migration to Groundwater - Class 1(3)
Volatile Organics (ug/kg)												
4-METHYL-2-PENTANONE	3100000	0	NA	0	3100000	0	NA	0	340000	0	NA	0
ACETONE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
TRICHLOROFLUOROMETHANE	850000	0	NA	0	NA	0	140000000	0	88000	0	34000	0
Polynuclear Aromatic Hydrocarbons (ug/kg)												
2-METHYLNAPHTHALENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
ACENAPHTHYLENE	NA	0	61000000	0	NA	0	61000000	0	NA	0	85000	0
ANTHRACENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
BENZO(A)ANTHRACENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
BENZO(A)PYRENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
BENZO(B)FLUORANTHENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
BENZO(G,H,I)PERYLENE	NA	0	61000000	0	NA	0	61000000	0	NA	0	27000000	0
BENZO(K)FLUORANTHENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
CHRYSENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
FLUORANTHENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
INDENO(1,2,3-CD)PYRENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
PHENANTHRENE	NA	0	61000000	0	NA	0	61000000	0	NA	0	200000	0
PYRENE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
Inorganics (mg/kg)												
ALUMINUM	1000000	0	1000000	0	1000000	0	410000	0	870000	0	NA	0
ARSENIC	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
BARIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
BERYLLIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA NA	0
CADMIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
CALCIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
CHROMIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
COBALT	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
COPPER	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
IRON	NA	0	1000000	0	NA	0	140000	0	NA	0	NA	0
LEAD	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
MAGNESIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
MANGANESE	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
MERCURY	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
NICKEL	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
POTASSIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
SODIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
VANADIUM	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0
ZINC	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0

Associated Samples:

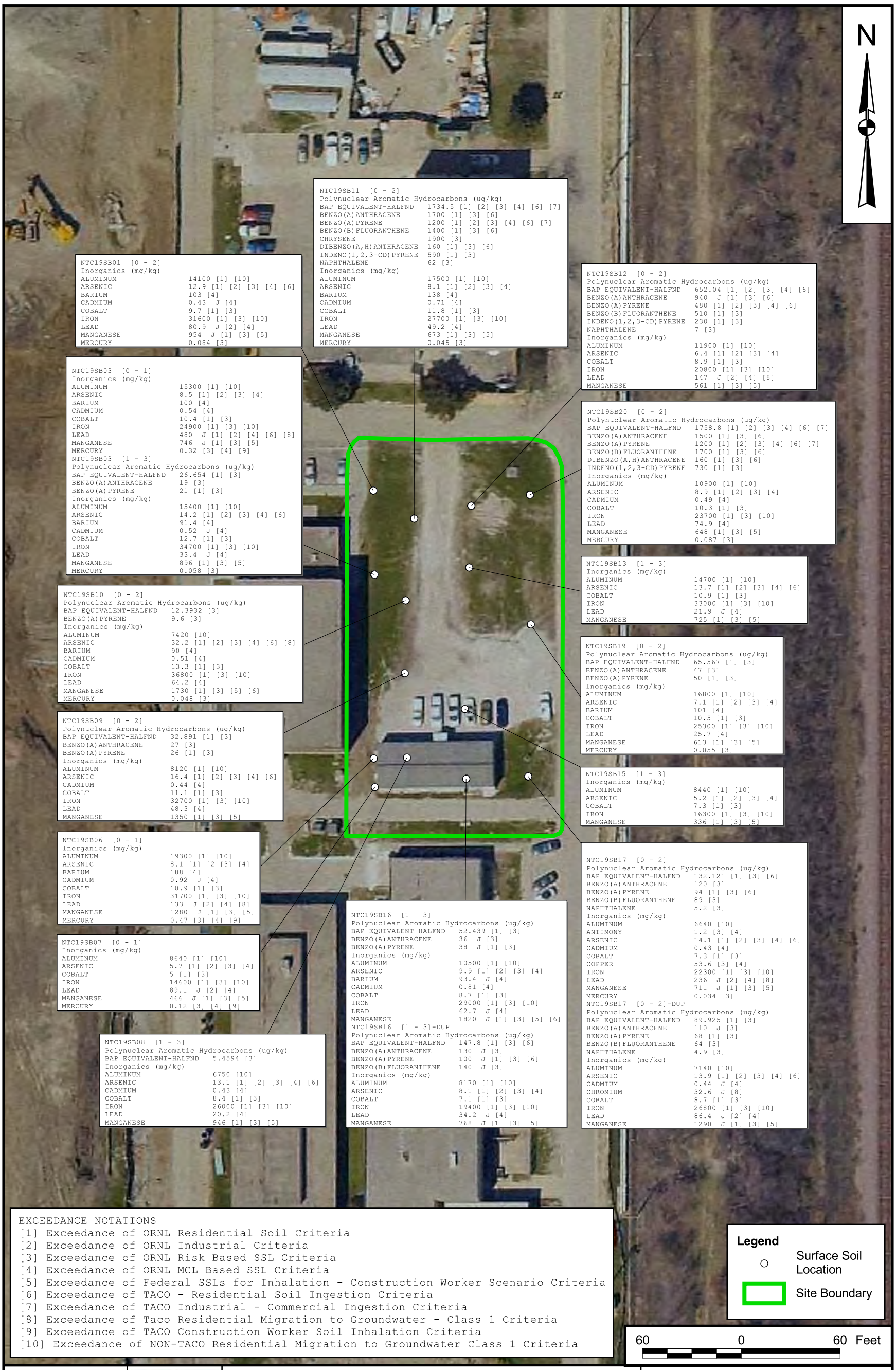
NTC19SB01-SO-0608	NTC19SB05-SO-0406	NTC19SB07-SO-0507	NTC19SB12-SO-0507
NTC19SB02-SO-0204	NTC19SB05-SO-0608	NTC19SB08-SO-0406	NTC19SB14-SO-0204
NTC19SB03-SO-0810	NTC19SB06-SO-0204	NTC19SB09-SO-0406	NTC19SB14-SO-0507
NTC19SB04-SO-0204	NTC19SB06-SO-0608	NTC19SB10-SO-0507	NTC19SB15-SO-0406

NA = Not applicable
J =The value is considered a quantitative estimate because it was less than the reporting limit or because of another technical noncompliance.
Shaded cells indicate that the concentration is greater than the minimum screening criterion.

DRAWN BY J. ENGLISH	DATE 03/26/09	GROUNDWATER SAMPLING EXCEEDANCES SITE 19 - FORMER BUILDING 910 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER CTO 0468
CHECKED BY G. STIEGEL	DATE 06/18/09		APPROVED BY RFD — DATE 06/19/09
COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4-1 REV 0

P:\GIS\GREATLAKES_NS\MAPDOCS\APR\SITE19.APR SITE 19 GW TAG LAYOUT 06/18/09 JEE

P:\GIS\GREATLAKES_NS\MAPDOCS\APR\SITE19.APR SITE 19 SURFACE TAG LAYOUT 06/24/09 JEE



DRAWN BY	DATE
J. ENGLISH	03/26/09
CHECKED BY	DATE
G. STIEGEL	06/24/09
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

SURFACE SOIL EXCEEDANCES

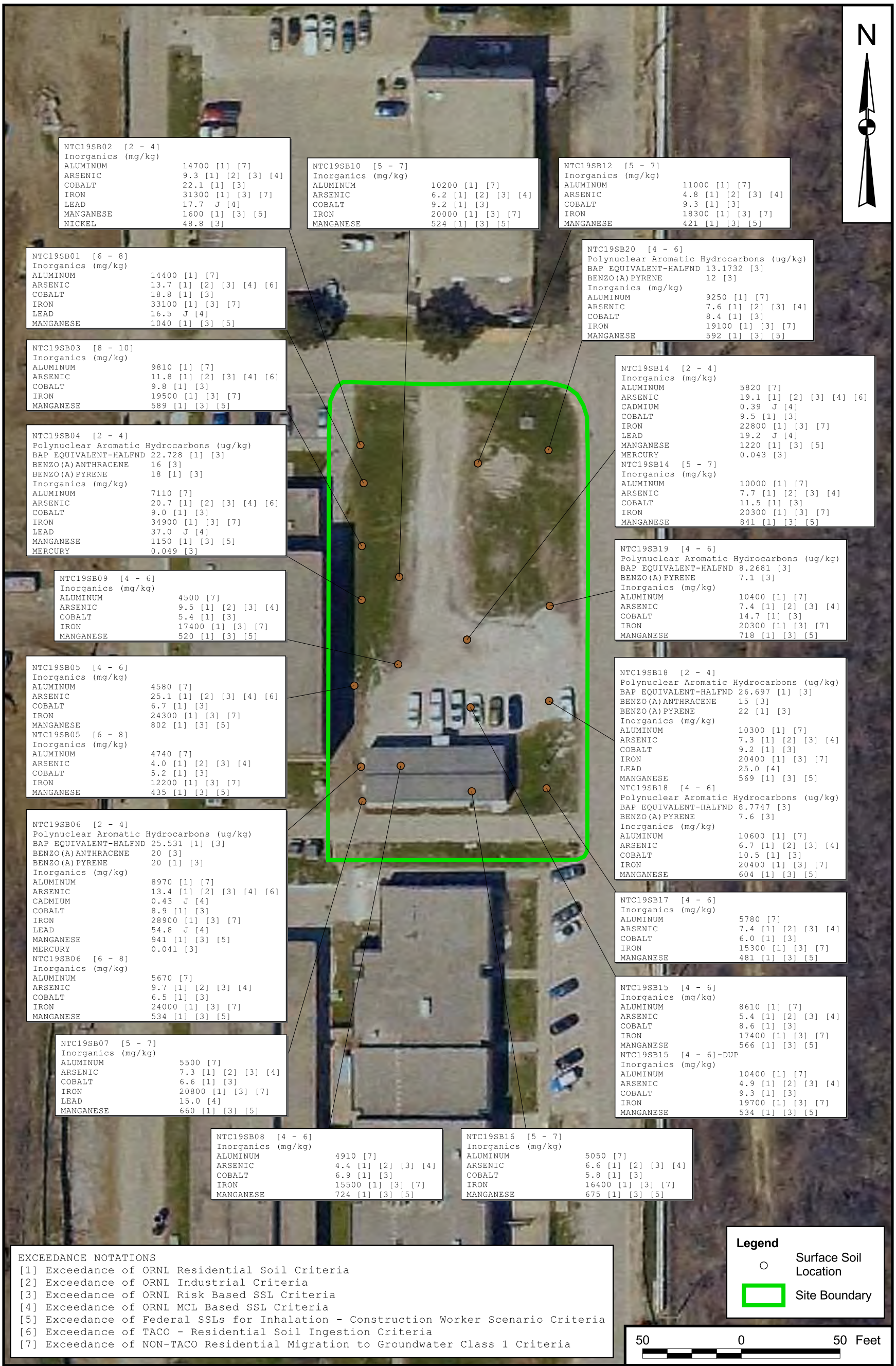
SITE 19 - FORMER BUILDING 910

NAVAL STATION GREAT LAKES

GREAT LAKES, ILLINOIS

CONTRACT NUMBER	
CTO 0468	
APPROVED BY	DATE
RFD	06/19/09
APPROVED BY	DATE
—	—
DRAWING NO.	REV
FIGURE 4-2	0

P:\GIS\GREATLAKES_NS\MAPDOCS\APR\SITE19.APR SITE 19 SURFACE TAG LAYOUT 06/24/09 JEE



EXCEEDANCE NOTATIONS
[1] Exceedance of ORNL Residential Soil Criteria
[2] Exceedance of ORNL Industrial Criteria
[3] Exceedance of ORNL Risk Based SSL Criteria
[4] Exceedance of ORNL MCL Based SSL Criteria
[5] Exceedance of Federal SSLs for Inhalation - Construction Worker Scenario Criteria
[6] Exceedance of TACO - Residential Soil Ingestion Criteria
[7] Exceedance of NON-TACO Residential Migration to Groundwater Class 1 Criteria

DRAWN BY J. ENGLISH	DATE 03/26/09	SUBSURFACE SOIL EXCEEDANCES	CONTRACT NUMBER CTO 0468
CHECKED BY G. STIEGEL	DATE 06/24/09	SITE 19 - FORMER BUILDING 910	APPROVED BY RFD / DATE 06/19/09
COST/SCHEDULE-AREA		NAVAL STATION GREAT LAKES	APPROVED BY — / DATE —
SCALE AS NOTED	NAVFAC	GREAT LAKES, ILLINOIS	DRAWING NO. FIGURE 4-3 / REV 0

5.0 CHEMICAL FATE AND TRANSPORT ANALYSIS

This section contains information on various aspects of contaminant fate and transport and the chemical properties affecting contaminant migration at Site 19. Knowledge of a contaminant's potential to migrate and persist in an environmental medium is critical when evaluating the potential for a chemical to elicit an adverse human health or ecological effect. Section 5.1 contains a general discussion of the various chemical and physical properties of significant contaminants detected in site media. Section 5.2 reviews the various contaminant transport pathways, and Section 5.3 presents a brief discussion of chemical fate and persistence in the environment.

5.1 CHEMICAL AND PHYSICAL PROPERTIES IMPACTING FATE AND TRANSPORT

Table 5-1 presents the physical and chemical properties of organic compounds. Relative mobilities of inorganics, as a function of environmental conditions in soil, are provided in Table 5-2. These properties can be used to determine the environmental mobility and fate of site contaminants. The properties of interest include the following:

- Specific gravity
- Vapor pressure
- Water solubility
- Octanol/water partition coefficient (K_{ow})
- Organic carbon partition coefficient (K_{oc})
- Henry's Law constant
- Bioconcentration factor (BCF)
- Distribution Coefficient (K_d)
- Mobility index (MI)

Empirically determined literature values of water solubility, K_{ow}, K_{oc}, vapor pressure, Henry's Law constant, BCF, and specific gravity are presented in tables at the end of this section, when available. Calculated values, which were obtained using approximation methods are presented in tables at the end of this section when literature values are not available. A discussion of the environmental significance of each of these parameters follows.

5.1.1 Specific Gravity

Specific gravity is the ratio of the weight of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a given temperature. Its primary use is to determine whether a chemical will have a tendency to float or sink in water. If present as pure chemicals or at very high concentrations, chemicals with a specific gravity greater than 1 tend to sink and chemicals with a specific gravity less than 1 tend to float. This parameter becomes important in discussions regarding the potential presence of free product in non-aqueous-phase liquids.

5.1.2 Vapor Pressure

Vapor pressure provides an indication of the rate at which a chemical volatilizes from both soil and water. It is of primary importance at environmental interfaces such as surface soil/air and surface water/air. Volatilization is not as important when evaluating contaminated groundwater and subsurface soil that are not exposed to the atmosphere. Vapor pressures for ketones, monocyclic aromatics, and halogenated aliphatics (VOCs) are generally many times higher than vapor pressures for PAHs. Chemicals with higher vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures. Volatilization is a significant loss process for VOCs in surface water or surface soil but is not significant for inorganics.

5.1.3 Water Solubility

The rate at which a chemical is leached from a waste deposit by infiltrating precipitation is proportional to its water solubility. More soluble chemicals are more readily leached than less soluble chemicals. The water solubilities presented in Table 5-1 indicate that VOCs are usually several orders of magnitude more water soluble than PAHs.

The solubility of inorganics is strongly influenced by their valence state(s) and forms (hydroxides, oxides, carbonates, etc.) and is also dependent on pH, Eh (redox potential), temperature, and other ionic species in solution (the Debye-Huckel theory). The solubility products reported in the literature vary with the type of complex formed, but generally it can be noted that, for example, cadmium and copper complexes are more soluble than lead and nickel complexes.

5.1.4 Octanol/Water Partition Coefficient

K_{ow} is a measure of the equilibrium partitioning of chemicals between octanol and water. A linear relationship between K_{ow} and the uptake of chemicals by fatty tissues of animal and human receptors (the

bioconcentration factor) has been established. It is also useful in characterizing the sorption of compounds by soil where experimental values are not available. PAHs are several orders of magnitude more likely to partition to fatty tissues than the more soluble VOCs. K_{ow} values are also used to estimate BCFs in aquatic organisms.

5.1.5 Organic Carbon Partition Coefficient

K_{oc} values indicate the tendency of a chemical to adhere to soil particles containing organic carbon. Chemicals with high K_{oc} values generally have low water solubilities and vice versa. This parameter may be used to infer the relative rates at which the more mobile chemicals (ketones, monocyclic aromatics, and halogenated aliphatics [VOCs]) are transported in groundwater. Chemicals such as PAHs are relatively immobile in soil and are preferentially bound to soil. These compounds are not subject to groundwater transport to the extent that compounds with higher water solubilities are. However, these immobile chemicals are easily transported by erosional processes when they are present in surface soil.

5.1.6 Henry's Law Constant

Both vapor pressure and water solubility are of use in determining volatilization rates from surface water bodies and from groundwater. The ratio of these two parameters (the Henry's Law constant) is used to calculate the equilibrium chemical concentrations in the vapor (air) phase versus the liquid (water) phase for the dilute solutions commonly encountered in environmental settings. In general, a chemical with a Henry's Law constant less than 1×10^{-5} atm-m^3/mole, such as PAHs, should volatilize very little and be present only in minute amounts in the atmosphere or soil gas. For a chemical with a Henry's Law constant greater than 5×10^{-3} atm-m^3/mole, including many of the halogenated aliphatics (VOCs), volatilization and diffusion in soil gas could be significant.

5.1.7 Bioconcentration Factor

The BCF represents the ratio of aquatic animal tissue concentration to water concentration. The ratio is both contaminant and species specific. When site-specific values are not measured, literature values are used or the BCF is derived from the K_{ow}. Many of the PAHs will bioconcentrate at concentrations three to five orders of magnitude greater than those concentrations found in water, but VOCs are not as readily bioconcentrated.

5.1.8 Distribution Coefficient

K_d is a measure of the equilibrium distribution of a chemical or ion in soil/water systems. The distribution of organic chemicals is a function of both the K_{oc} and the amount of organic carbon in the soil. For ions (e.g., metals), K_d is the ratio of the concentration adsorbed on soil surfaces to the concentration in water. Distribution coefficients for metals vary over several orders of magnitude because the K_d is dependent on the size and charge of the ion and the soil properties governing exchange sites on soil surfaces. Coulomb's Law predicts that the ion with the smallest hydrated radius and the largest charge will be preferentially accumulated over ions with larger radii and smaller charges.

5.1.9 Mobility Index

The MI is a quantitative assessment of mobility that uses water solubility (S), vapor pressure (VP), and K_{oc}. It is defined as follows:

$$MI = \log ((S*VP)/K_{oc})$$

A typical scale for evaluating MI is:

Relative MI	Mobility Description
> 5	extremely mobile
0 to 5	very mobile
-5 to 0	slightly mobile
-10 to -5	immobile
< -10	very immobile

VOCs generally have MIs greater than 5 and are considered extremely mobile. Lighter molecular weight PAHs, such as naphthalene, have MIs ranging from -5 to 0 and are considered slightly mobile, and the heavier molecular weight PAHs (e.g., benzo(a)pyrene) are classified as very immobile, having MIs less than -10. The MIs for organic chemicals detected at Site 19 are presented in Table 5-1.

5.2 CONTAMINANT TRANSPORT PATHWAYS

This section presents a brief overview of contaminant fate and transport issues at Site 19. Based on the evaluation of existing conditions at the site, the following potential contaminant transport pathways may exist at Site 19:

- Leaching of soil contaminants to groundwater
- Migration of groundwater contaminants
- Migration of chemicals in soil to ambient air
- Erosion and runoff of contaminated particles from soil

5.2.1 Leaching of Soil Contaminants to Groundwater

VOCs, PAHs, and metals were detected in soil at Site 19. PAHs and metals generally adhere to soil particles and move by erosional processes. VOCs are more likely to volatilize or to leach and migrate vertically to groundwater as a result of infiltration and/or precipitation. The rate and extent of this leaching are influenced by the depth of the water table, amount of precipitation, rate of infiltration, physical and chemical properties of the soil, and physical and chemical properties of the contaminant.

5.2.2 Migration of Groundwater Contaminants

Contaminants can migrate in either a dissolved phase or as an immiscible liquid. A contaminant that is present in water at a concentration greater than its solubility concentration will form an immiscible liquid. Based on the specific gravity of the contaminant, the immiscible liquid will either float or sink in water. In the case of chlorinated solvents (e.g., tetrachloroethene), the contaminant will sink in groundwater because it has a higher specific gravity than water. Subsurface transport of immiscible contaminants is governed by a set of factors different from those of dissolved contaminants. However, none of the chemicals detected in soil or groundwater at Site 19 were present at concentrations exceeding solubility levels. Therefore, transport of chemicals at the site (if it occurs) is likely to occur in the dissolved phase. Contaminants in the dissolved phase may volatilize from groundwater to air, evaporate directly into air, or sorb from groundwater to solid surfaces.

Chemical concentrations may be affected by one or more mechanisms during transport. Volatilization or precipitation may physically transform the chemicals or they may be chemically transformed through photolysis, hydrolysis, or oxidation/reduction. Chemicals may also be biologically transformed by biodegradation. Additionally, contaminants may accumulate in one or more media. Of the chemicals detected at Site 19, PAHs and metals are more likely to accumulate in environmental media than the VOCs.

After a chemical is dissolved in groundwater, three general processes govern the migration of dissolved constituents: advection, dispersion, and retardation. Advection is a process by which solutes are carried by groundwater movement. Dispersion is a mixing of contaminated and uncontaminated water during

advection. Retardation is a slowing of contaminant migration caused by the reaction of the solute with the aquifer soil.

5.2.3 Migration of Chemicals in Soil to Ambient Air

Chemicals in soil can migrate into ambient air either as vapors or by adhering to particulate matter (dusts). Chemicals that have a significant volatility are likely to enter ambient air as vapors. These chemicals are generally considered to be compounds with Henry's Law Constants greater than 1.0×10^{-5} and molecular weights less than 200. Chemicals with lower Henry's Law Constants and higher molecular weights are more likely to enter ambient air on particulate matter carried by winds, which means that VOCs will be more likely to migrate, and PAHs and metals are more likely to adhere to the soil and are therefore less likely to migrate.

5.2.4 Erosion and Runoff of Contaminated Particles from Soil

In addition to VOCs, PAHs and metals were detected in Site 19 soil. The fate and transport characteristics of these chemicals are similar because they are not considered to be very mobile in the environment. PAHs are generally large molecules with high K_{oc}s and low solubilities. When found in the soil, they do not migrate vertically to a great extent. They are more likely to adhere to soil particles and be removed via surface runoff (e.g., in rainwater) and erosional processes.

5.3 CHEMICAL PERSISTENCE

The persistence of various classes of chemicals is discussed in this section. Several transformation mechanisms affect chemical persistence, such as hydrolysis, biodegradation, photolysis, and oxidation/reduction reactions. The following general classes of compounds detected at Site 19 are discussed:

- VOCs
  - Ketones
  - Monocyclic aromatics (e.g., toluene)
  - Halogenated aliphatics
- PAHs
- Metals

5.3.1 Ketones

Three ketones, acetone, 2-butanone (methyl ethyl ketone), and 4-methyl-2-pentanone (methyl isobutyl ketone) were detected in soil and/or groundwater at Site 19. Ketones are highly volatile and soluble, and these two characteristics dominate the fate of these compounds in the environment. Hydrolysis is generally not a significant fate process for this class of chemicals, nor is bioconcentration expected to be significant.

Acetone is completely miscible in water and is unlikely to adsorb to soil or sediment or bioaccumulate. It has a high vapor pressure and, once released to the air, is subject to photolysis and reaction with hydroxyl radicals.

2-Butanone may be removed from soil by direct photolysis, volatilization, or aerobic biodegradation. It is also susceptible to leaching and may be found in groundwater. If released to surface water, it has estimated volatilization half-lives of 19 hours (in rivers) to 197 hours (in lakes) and is also subject to direct photolysis. This compound does not significantly bioconcentrate, oxidize, hydrolyze, or adsorb to soil.

4-Methyl-2-pentanone, unlike the other common ketone solvent acetone, has quite low solubility in water, making it useful for liquid-liquid extraction. It has a similar polarity to ethyl acetate, but greater stability towards aqueous acid and base.

5.3.2 Monocyclic Aromatics

Monocyclic aromatic compounds are not considered to be persistent in the environment, particularly compared to chemicals such as PAHs. Monocyclic aromatics are subject to degradation via the actions of both soil and aquatic microorganisms. The biodegradation of these compounds in the soil matrix is dependent on the abundance of microflora, macronutrient availability, soil reaction (pH), temperature, etc.

Although these compounds are amenable to microbial degradation, it is not anticipated that degradation will occur at an appreciable rate, although macronutrient availability is not known. In the event that these compounds discharge to surface water bodies, volatilization and biodegradation may occur relatively rapidly. For example, a reported first-order biodegradation rate constant for benzene is 0.11 day^{-1} in aquatic systems (Lyman et al., 1982). This corresponds to an aquatic half life of approximately 6 days. Other monocyclic aromatics are subject to similar degradation processes in aquatic environments (USEPA, 1982).

Additional environmental degradation processes such as hydrolysis and photolysis are considered to be insignificant fate mechanisms for monocyclic aromatics in aquatic systems (USEPA, 1982). However, some monocyclic aromatics such as toluene have been shown to undergo clay-, mineral-, and soil-catalyzed oxidation (Dragun, 1988).

5.3.3 Halogenated Aliphatics

Halogenated aliphatic hydrocarbons were detected in soil or groundwater at Site 19. In general, halogenated aliphatic hydrocarbons are subject to abiotic dehydrohalogenation, which is an elimination reaction that results in the formation of an ethene from a saturated halogenated compound. Hydrolysis, photolysis, and oxidation are generally not considered to be significant fate processes for the chlorinated ethanes. Chlorinated **aliphatics** do not **sorb** strongly to most solids.

Under certain conditions, volatilization is a significant fate process for these compounds, although only at the air-soil or air-water interface. Compounds with low soil adsorption volatilize rapidly to the atmosphere from soil or surface water. Adsorption to soil particles is not considered as an important fate for these types of compounds when compared to more hydrophobic compounds (e.g., PAHs). BCFs indicate that these compounds should not bioaccumulate.

5.3.4 PAHs

PAHs have very low solubilities, vapor pressures, and Henry's Law constants and high K_{oc}s and K_{ow}s. The low molecular weight PAHs (e.g., acenaphthene, anthracene, fluorene, phenanthrene, etc.) may volatilize from water, and the high molecular weight PAHs (e.g., benzo(a)pyrene, benz(a)anthracene, chrysene, etc.) are less likely to volatilize. PAHs in soil are much more likely to bind to soil and be transported via mass transport mechanisms than to go into solution or volatilize. PAHs are subject to degradation via aerobic bacteria but may be relatively persistent in the absence of microbial populations or macronutrients such as phosphorus and nitrogen.

Bioconcentration of PAHs in aquatic organisms is greater for the higher molecular weight compounds than the lower molecular weight compounds. PAHs can bioaccumulate from water, sediments, or lower organisms in the food chain.

Landspreading applications have indicated that PAHs are highly amenable to microbial degradation in soil, with the rate of degradation influenced by temperature, pH, oxygen concentrations, initial chemical

concentrations, and moisture. Photolysis, hydrolysis, and oxidation are not important fate processes for the degradation of PAHs in soil (ATSDR, 1995).

PAHs are degraded in water by photo-oxidation, chemical oxidation, and biodegradation. PAHs do not contain functional groups that are susceptible to hydrolytic action, and hydrolysis is considered to be an insignificant degradation mechanism. The rate of photodegradation is influenced by water depth, turbidity, and temperature. Benzo(a)pyrene and chrysene are reported to be resistant to photodegradation. PAHs may also be oxidized by chlorination and ozonation and may be metabolized by microbes under oxygenated conditions (ATSDR, 1995).

5.3.5 Metals

Metals are highly persistent environmental contaminants; they do not biodegrade, photolyze, hydrolyze, etc. The major fate mechanisms for metals are adsorption to the soil matrix (as compared to being part of the soil structure) and bioaccumulation.

The mobility of metals is influenced primarily by their physical and chemical properties, in combination with the physical and chemical characteristics of the soil matrix. Factors that assist in predicting the mobility of inorganic species are soil/pore water pH, soil/pore water Eh, and cation exchange capacity. The mobility of metals generally increases with decreasing soil pH and cation exchange capacity (Table 5-2).

5.4 CONTAMINANT FATE AND TRANSPORT

This section focuses on some of the fate and transport issues associated with the major types of contaminants detected at Site 19.

5.4.1 VOCs

VOCs are typically considered to be fairly soluble with a low capacity for retention by soil organic carbon; therefore, these are the organic compounds most frequently detected in groundwater and surface water. VOCs may migrate through the soil column as infiltrating precipitation solubilizes them after they were released through a spill or subsurface waste burial. Some fraction of these chemicals is retained by the soil, but most continues migrating downward to the water table. In groundwater, VOCs migrate primarily laterally with the hydraulic gradient. Again, some portion may be retained by the saturated soil.

Compounds such as toluene have specific gravities less than that of water. Therefore, instead of going into solution, the majority of a release may remain as a discrete layer on top of the water table, with some going into solution at the water/contaminant interface.

Compounds with specific gravities greater than that of water are often used in industrial applications such as degreasing. If a spill of these solvents is large enough, they may also migrate as bulk liquids but will not stop at the water table (i.e., they will mix and sink into the aquifer).

5.4.2 PAHs

PAHs are generally considered to be fairly immobile in the environment; they are large molecules with high K_{oc}s and low solubilities when compared to VOCs. These compounds generally do not migrate vertically through soil to a great extent. Instead, they are more likely to adhere to soil particles and be transported with the soil particles via surface runoff and erosional processes.

5.4.3 Inorganics

Because inorganics are naturally occurring, frequently incorporated into the soil matrix, and remain bound to particulate matter, they migrate from source areas via erosion. There are some instances, however, where inorganics are found at such concentrations or in such forms (i.e., oxidation states) that they may migrate in solution. First, it is possible that uncontrolled industrial activities could saturate the available exchange sites in soil in the immediate vicinity of the activity and result in an inorganic being mobilized. Secondly, inorganics are more mobile under acidic conditions, which are possibly present in environments where metal plating-type activities occurred. Finally, inorganic solutions may be used in some industrial applications. In these cases, it is possible for inorganics to migrate vertically through the soil column and reach groundwater.

Inorganics are naturally occurring substances; therefore, it is not unusual that they were detected in soil and groundwater at Site 19. Because inorganics tend to adhere to particulate matter (similar to PAHs), their release and migration patterns are similar to these chemicals.

TABLE 5-1

ENVIRONMENTAL FATE AND TRANSPORT PARAMETERS FOR ORGANIC CHEMICALS
SITE 19
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical	Specific Gravity (@ 20/4°C)[1]	Vapor Pressure (mm Hg @ 20°C)[1]	Solubility (mg/L @ 20°C)[1]	K_{ow} = Octanol/Water Partition Coefficient[1]	K_{oc} = Organic Carbon Partition Coefficient[2]	Henry's Law Constant (atm-m3/mole)[1]	Bioconcentration Factor (mg/L/mg/kg)[2]	Mobility Index log((solubility*VP)/K_{oc})
KETONES								
2-Butanone	0.8054	1.0E+2 (25°C)	2.75E+05	1.82E+00	4.44E+0(3)	4.66E-5 (25°C)	9.3E-1(4)	6.79E+00
Acetone	0.7899	2.66E+2 (25°C)	Miscible	5.75E-01	7.08E+03 (5)	4.276E-5 (25°C)	3.81E-1(4)	NA
2-Hexanone								
4-Methyl-2-pentanone	0.7978 (20°C)	1.0E+1 (30°C)	1.91E+04	1.23E+01	5.30E+0(9)	1.49E-5 (25°C)	3.9E+0(6)	4.56E+00
MONOCYCLIC AROMATICS								
Benzene	0.8765	9.5E+01[1]	1.75E+03	1.35E+02	5.89E+01	5.55E-03	3.70E+01	3.45E+00
Chlorobenzene	1.11	1.18E+01	4.72E+02	7.24E+02	2.19E+02	3.70E-03	3.10E+01	1.41E+00
Ethylbenzene	0.867	9.60E+00	1.69E+02	1.38E+03	3.63E+02	7.88E-03	4.70E+02	6.50E-01
Isopropylbenzene	0.862	4.50E+00	6.13E+01[2]	3.16E+03[1]	2.29E+03	1.15E-02[1]	2.70E+02	-9.19E-01
Toluene	0.8669	2.84E+01	5.26E+02	5.62E+02	1.82E+02	6.64E-03	1.48E+02	1.91E+00
1,2,4-Trichlorobenzene	1.459	4.60E-01	3.00E+02	1.02E+04	1.78E+03	1.42E-03	6.50E+02	-1.11E+00
1,4-Dichlorobenzene	1.29	1.20E+00	7.38E+01	1.00E+00	6.16E+02	2.43E-03[6]	2.3E+02[7]	0.0031611
1,3-Dichlorobenzene	1.2884	2.15E+00	1.33E+02	3.24E+03	7.21E+02	2.83E-03	3.20E+02	-4.02E-01
1,2-Dichlorobenzene	1.3059	1.36E+00	1.56E+02	2.40E+03	6.17E+02	1.50E-03	2.30E+02	-4.64E-01
HALOGENATED ALIPHATICS								
Bromodichloromethane	2.38	5.45E+00 (25°C)	2.70E+03	2.16E+00	6.31E+01	7.83E-04	9.00E+00	2.37E+00
Bromoform	2.894	5.00E+00	3.10E+03	2.40E+00	8.70E+01	5.60E-04	3.20E+00	0.048164732
Bromomethane	1.73 (0/0°C)	1.824E+03 (25°C)	9.00E+02	1.10E+00	2.10E+00	6.24E-03	4.70E+00	5.89E+00
Carbon tetrachloride	1.594	1.13E+02 (25°C)	8.00E+02	5.37E+02	1.74E+02 (10)	2.93E-2 (25°C)	2.11E+02	2.72E+00
Chloroethane	0.92 (0/4°C)	1.00E+03	5.74E+03	1.54E+00	1.52E+00	8.48E-3 (25°C)	6.7E-01-8.6E-01	6.58E+00
Chloromethane	0.9159	4.30E+03	6.36E+03[1]	8.13E+00[1]	4.30E+00	8.82E-03[2]	3.2E+00[6]	6.80E+00
Chloroform	1.4832	1.60E+02	9.3E+3 (25°C)	9.33E+01	3.98E+01 (5)	3.39E-3 (25°C)	2.60E+01	4.57E+00
cis-1,2-Dichloroethene	1.2837	201(6)	3.50E+03	7.24E+01	3.55E+01	4.08E-03	8.1E+00[6]	4.30E+00
Chlorodibromomethane	1.405	1.36E+03	NA	3.55E+01	1.06E+03	9.20E+02	3.50E+01	NA
Methylene chloride	1.3266	4.29E+2 (25°C)	1.67E+4 (25°C)	1.78E+01	1.17E+01 (5)	3.19E-3 (25°C)	6.00E+00	5.79E+00
1,1,1-Trichloroethane	1.339	1.00E+02	4.40E+03	2.95E+02	1.10E+02 [10]	4.08E-3 (25°C)	8.10E+01	3.60E+00
1,1,2,2-Tetrachloroethane	1.60 (15/4°C)	6.50E+01	2.77E+02	2.45E+02	9.33E+01	3.45E-04	3.90E+01	2.29E+00
1,1,2-Trichloroethane	1.4397	2.50E+01	4.42E+02	1.12E+02	5.01E+01	9.13E-04	1.90E+01	2.34E+00
1,1,2-Trichlorotrifluoroethane	1.57	2.94E+02	insoluble	1.45E+03	9.14E+02	3.33E-01	< 100	NA
1,1-Dichloroethene	1.218	5.91E+2 (25°C)	2.1E+2 (25°C)	3.02E+01	5.89E+01 [10]	2.286E-2 (25°C)	5.30E+01	3.32E+00
1,2-Dibromo-3-chloropropane	2.093	5.80E-01	1.23E+03	1.82E+02	1.48E+02	1.47E-04	1.12E+01	0.019292313
1,2-Dibromoethane	2.18	1.10E+01	4.15E+03	8.60E+01	6.60E+01	8.20E-04	1.00E+01	0.070597588
1,2-Dichloroethane	1.2351	7.90E+01	8.52E+02	2.95E+01	1.74E+01	9.79E-04	8.10E+00	3.59E+00
1,2-Dichloropropane	1.159	5.00E+01	2.80E+02	9.33E+01	4.37E+01	2.80E-03	1.90E+01	2.51E+00
cis-1,3-Dichloropropene	1.224 @ 20 deg C	3.00E+01	2.70E+03	1.15E+02	2.30E+01	2.71x10-3	NA	0.213412392
trans-1,3-Dichloropropene	1.217 (at 20° C)	2.20E+01	2.80E+03	1.07E+02	2.60E+01	8.71x10-4	~21	0.184214643
Dichlorodifluoromethane (difluorodichloromethane or freon 12)	1.49	4.33E+03	280 at 25oC	1.45E+02	5.80E+01	2.25E-01	range = 11-86	0.104893905
Styrene	0.906	6.12E+00	3.10E+02	8.71E+02	7.76E+02	2.75E-03	9.40E+01	3.88E-01
trans-1,2-Dichloroethene	1.2565	3.31E+02	6.30E+03	1.17E+22	5.25E+01	9.38E-03	4.80E+01	4.60E+00
Trichlorofluoromethane	1.494	8.03E+02	1.10E+03	3.39E+02	1.58E+02	2.39E+00	4.70E+01	3.75E+00
Tetrachloroethene	1.6227	1.9E+1 (25°C)	1.5E+2 (25°C)	3.39E+02	1.55E+02 [5]	2.685E-2 (25°C)	2.52E+02	1.26E+00
Trichloroethene	1.4624	7.10E+01	1.10E+03	5.13E+02	1.66E+02	1.03E-02	9.70E+01	2.67E+00
Vinyl chloride	0.9106	2.58E+03	1.1E+3 (25°C)	3.98E+00	1.86E+01 [5]	2.78E-2 (25°C)	5.70E+00	5.18E+00
Xylenes (Total)	0.86104-0.8801	1E+1 (27.3-32.1°C)	1.6E+2-1.75E+2[6]	5.89E+2-1.58E+3	3.63E+02-4.07E+02	4.184E-3-6.662E-3 (25°C)	7.5E+1-1.59E+2[10]	0.644-0.633

TABLE 5-1

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SITE 19
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical	Specific Gravity (@ 20/4°C)[1]	Vapor Pressure (mm Hg @ 20°C)[1]	Solubility (mg/L @ 20°C)[1]	K_{ow} = Octanol/Water Partition Coefficient[1]	K_{oc} = Organic Carbon Partition Coefficient[2]	Henry's Law Constant (atm-m3/mole)[1]	Bioconcentration Factor (mg/L/mg/kg)[2]	Mobility Index log((solubility*VP)/K_{oc})
POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs)								
2-Methylnaphthalene	1.0058	1E+1 (105°C)	2.6E+1 (25°C)	7.24E+03	7.27E+2 [3]	4.99E-4 (25°C)	5.1E+2 [4]	-4.47E-01
Acenaphthene	1.07	5.00E-03	4.24E+02	8.32E+03	7.08E+03	2.41E-04 (25°C)	1.10E+03	-3.52
Anthracene	1.283 (25/4°C)	1.95E-4 (25°C)	1.29E+0 (25°C)	2.82E+04	2.95E+04 [5]	8.6E-5 (25°C)	4.70E+03	-8.07E+00
Benzo(a)anthracene	1.274	5.00E-09	1E-2 (24°C)	4.07E+05	3.98E+05 [5]	6.60E-07	5.30E+04	-1.59E+01
Benzo(a)pyrene	1.351	5.00E-09	3.8E-3 (25°C)	9.55E+05	1.02E+06 [5]	4.9E-7 (25°C)	1.40E+05	-1.67E+01
Benzo(b)fluoranthene	NA	5.00E-07	1.2E-3 (25°C)	3.72E+06	1.23E+06 [5]	1.20E-05	1.40E+05	-1.53E+01
Benzo(g,h,i)perylene	1.35	1.00E-10	2.6E-4 (25°C)	1.70E+07	1.60E+06	1.4E-7 (25°C)	3.50E+05	-1.98E+01
Benzo(k)fluoranthene	NA	9.59E-11	5.5E-4 (25°C)	6.92E+06	1.23E+06 [5]	1.04E-03	1.40E+05	-1.94E+01
Chrysene	1.274 (20°C)	6.3E-9 (25°C)	6E-3 (25°C)	4.07E+05	3.98E+05 [5]	1.05E-6 (25°C)	5.30E+04	-1.60E+01
Dibenzo(a,h)anthracene	1.282	1.00E-10	5E-4 (25°C)	9.33E+05	3.80E+06 [5]	7.3E-8 (25°C)	6.90E+05	-1.99E+01
Fluoranthene	1.252	5.0E-6 (25°C)	2.65E-1 (25°C)	2.14E+05	1.07E+05 [5]	6.5E-6 (25°C)	1.20E+04	-1.09E+01
Fluorene	1.202	1.00E+01	1.98E+00	1.62E+04	1.38E+04	6.36E-05	3.80E+03	-2.84E+00
Indeno(1,2,3-cd)pyrene	NA	1E-10 (25°C)	6.20E-02	4.57E+07	3.47E+06 [5]	6.95E-8 (25°C)	3.50E+05	-1.77E+01
Naphthalene	1.162	8.2E-2 (25°C)	3E+1 (25°C)	2.34E+03	2.00E+03 [5]	4.83E-4 (25°C)	4.20E+02	-2.91E+00
Phenanthrene	0.980 (4°C)	1E+0 (118.2°C)	8.16E-1 (21°C)	2.88E+04	1.40E+04	3.93E-5 (25°C)	4.70E+03	-4.23E+00
Pyrene	1.271 (23/4°C)	2.5E+0 (200°C)	1.6E-1 (26°C)	1.51E+05	1.05E+05 [5]	5.1E-6 (25°C)	1.20E+04	-5.42E+00
MISCELLANEOUS VOLATILE ORGANICS								
Carbon Disulfide	1.2632	2.98E+02[1]	1.19E+03	1.00E+02	4.57E+01	3.03E-02	6.2E+00[6]	3.89E+00
Cyclohexane	0.7781(13)	9.69E+01	5.5E+01[13]	2.75E+03[13]	1.6E+02[14]	2.0E+-01[14]	8.9E+01[13]	1.52E+00
Methyl Cyclohexane	0.7694(13)	4.60E+01	1.4E+01[13]	4.07E+03[13]	2.68E+02[11]	4.3E-01[13]	1.2E+02[11]	3.81E-01
Methyl Acetate								
Methyl tert butyl ether	0.7405	2.50E+02	5.10E+04	8.71E+00	1.12E+01	5.87E-04	3.10E+00	6.06E+00

NA - Not available.
1 USEPA, September 1992, Handbook of RCRA Groundwater Monitoring Constituents: Chemical and Physical Properties.
2 USEPA, December 1982, Aquatic Fate Process Data for Organic Priority Pollutants.
3 Lyman et al., 1990; Equation 4-5.
4 Lyman et al., 1990, Eq. 5-2.
5 USEPA, July 1996, Soil Screening Guidance.
6 Lyman et al., 1990; Equation 5-3, Handbook of Chemical Property Estimation Methods.
7 Chlordane data used.
8 Endosulfan II data used.
9 Mabey et al., 1982
10 Syracuse Research Corporation. Online Database: Interactive Physical Properties Database Demo. http://www.syrres.com/esc/chemfate.htm. Web site last updated October 17, 2001.
11 ORNL Risk Assessment Information System.
12 USEPA, August 1999. Screening Level Ecological Risk Assessment Protocol for Hazardous Waster Combustion Facilities, Appendix C Media-to-Receptor Bioconcentration Factors (BCFs).
13 TOXNET (Hazardous Substance Data Bank). Http://toxnet.nlm.nih.gov, July 2006.
14 USEPA Region 9 Preliminary Remediation Goal Tables (July 2006).

TABLE 5-2

PHYSICAL AND CHEMICAL PROPERTIES OF INORGANIC CHEMICALS
SITE 19
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical	Molecular Weight (g/mol) [1]	Specific Gravity (20/4 C) [1]	Vapor Pressure (25 C) (mm Hg) [1]	Solubility (25 C) (mg/L) [1]	Henry's Law Constant (25 C) (atm-m^3/mol) [1]	Bioconcentration Factor (L/kg) [2]
Inorganics						
Antimony	121.75	6.684 (25°C)	1 (886°C)	insoluble	NA	NA
Barium	137.33	3.51 (20°C)	10 (1049°C)	hydrolyzes	NA	NA
Cadmium	112.41	8.642 (UT)	NA	insoluble	NA	7400
Calcium	40.08	1.55 (20°C)	254 Pa at 1112 K	soluble	NA	1
Chromium	51.996	7.2 (28°C)	1 (1616°C)	insoluble	NA	1
Lead	207.2	11.2960 (16°C)	1(970°C)	insoluble	NA	1700
Magnesium	24.30	1.738	361Pa@649°C	highly soluble	NA	1
Manganese	54.938 [4]	7.2 [4]	NA	decomposes [4]	NA	NA
Mercury	200.59	13.5939	100 (260°C)	0.056	1.14E-02 [UT]	3133 [3]
Nickel	58.69	8.9 (UT)	1 (1800°C)	insoluble	NA	110
Potassium	39.098	0.86(20°C)	0.4416 at 945°K	insoluble	NA	1
Selenium	78.96	4.81 (20/4+1°C)	NA	NA	NA	5700
Thallium	204.383	11.85 (UT)	1 (825°C)	insoluble	NA	130
Zinc	65.38	7.14 (UT)	1 (487°C)	insoluble	NA	970

1 USEPA, 1992
2 USEPA, Superfund Chemical Data Matrix, 1997.
3 Lyman, W., Reehl, W., and Rosenblatt, D., 1990
4 Clement Associates, Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites, September 1985.
5 The Condensed Chemical Dictionary, 1971.
UT There is no reference temperature available.
NA Not available.

6.0 HUMAN HEALTH RISK ASSESSMENT

This baseline HHRA was performed to characterize and quantify potential health risks at Site 19 at Naval Station Great Lakes, Great Lakes, Illinois. The objective of the RA was to determine whether detected concentrations of chemicals within the study area pose a significant threat to potential human receptors under current and/or future land use. The RA for Site 19 is based on chemical data for surface soil, subsurface soil, and groundwater. The potential risks to human receptors are estimated based on the assumption that no actions are taken to control contaminant releases.

Section 6.1 provides an overview of the RA process, and Sections 6.2 through 6.5 outline the methodology and results of the HHRA. Appendix F presents supporting materials for the HHRA. An analysis of the uncertainties is presented in Section 6.6. Section 6.7 summarizes the HHRA for Site 19. Tables documenting the HHRA were prepared following the standard format in accordance with Risk Assessment Guidance for Superfund Part D (USEPA, 2001) and are presented in Appendix F.

The RA conducted for this RI follows guidance documents from USEPA (1989, 1991, 1993c, 1996, 1997, 2001, 2002b, 2002c, 2004b, and 2009), Navy (2001b and 2004) and state of Illinois (Illinois EPA, 2007). All methodologies used in this RA complied with scientifically acceptable RA practices and USEPA guidance, including but not limited to the following documents:

- USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response, Washington, D.C.

- USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03. Washington, D.C.

- USEPA, 1993c. Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. OSWER, Washington, D.C.

- USEPA, 1996. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. Office of Solid Waste and Emergency Response. Washington, D.C.

- USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002Fa. OSWER, Washington, D.C.

- Navy, 2001b, Conducting Human Health Risk Assessments under the Environmental Restoration Program. Ser N453E/1U595168. Washington, D.C.

- USEPA, 2001. Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments).

- USEPA, December 2002b. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. Washington, D.C.

- USEPA, December 2002c. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10. Washington, D.C.

- USEPA, 2004b. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final Guidance.

- USEPA, 2009. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), Final.

- Navy, 2004. Navy Final Policy on the Use of Background Chemical Levels.

- Illinois EPA, 2007. TACO. Illinois Environmental Protection Agency, Bureau of Land, available online at http://www.epa.state.il.us/land/taco/.

The quantitative risk estimates are based on a number of assumptions about exposure and toxicity. Thus, the risk estimates may over- or underestimate the level of potential human health risks associated with a site. The Uncertainty Analysis (Section 6.7) describes in qualitative and semi-quantitative terms the sources of uncertainty in the RA. Section 6.8 presents the summary and conclusions of the RA.

6.1 OVERVIEW OF RISK ASSESSMENT PROCESS

A RA provides the framework for developing information necessary to determine the need for remediating and developing potential remedial alternatives for a site. A baseline HHRA consists of five major components, as follows:

- Data evaluation and identification of chemicals of potential concern (COPCs)
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Characterization of uncertainty in the risk estimates

To assess potential public health risks, four major aspects of chemical contamination and exposure must be considered: contaminants with toxic characteristics must be found in environmental media; contaminants must be released by either natural processes or by human action; potential exposure points must exist either at the source or via migration pathways if exposure occurs at a remote location other than the source; and human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the requirements listed above is absent for a specific site, the exposure route is regarded as incomplete, and no potential risks are considered for human receptors.

The data evaluation component of the HHRA is primarily concerned with selecting COPCs and calculating exposure point concentrations (EPCs). Current study area data are considered in developing a list of COPCs. The medium and area-specific data are analyzed and COPCs are selected that are representative of the type of expected potential human health exposure. The EPCs provide the chemical input for each of the exposure pathways. A summary of the data evaluation process is contained in Section 6.2.

The selection of COPCs was based on chemical-specific concentrations, occurrence, distribution, and toxicity. COPCs were selected to represent site contamination and to provide the framework for the quantitative HHRA. A discussion of COPC selection is included in Section 6.3.

The exposure assessment identifies potential human exposure pathways. Exposure routes are identified by medium (i.e., soil and groundwater) based on information on study area chemical concentrations, chemical release mechanisms, human activity patterns, and other pertinent information, to develop a conceptual site model. A discussion of the exposure assessment is contained in Section 6.4.

The toxicity assessment presents the available human health criteria for all the selected COPCs. This assessment is contained in Section 6.5. Quantitative toxicity indices are presented where they are available. A discussion of health effects and dose-response parameters such as Reference Doses (RfDs), Reference Concentrations (RfCs), Cancer Slope Factors (CSFs), and Unit Risks, is presented.

The risk characterization section (Section 6.6) describes how the estimated intakes are combined with the toxicity information to estimate risks. Uncertainties associated with the RA process are discussed qualitatively in Section 6.7. Section 6.8 summarizes the HHRA for Site 19.

6.2 DATA EVALUATION

Information associated with data usability for Site 19 is provided in this section. The HHRA presented in this report is based on the most recent analytical data collected at Site 19 during the most recent field activities which occurred from December 1 to 10, 2008.

Data utilized in this RA include validated analytical results of known and sufficient quality for use in quantitative risk calculations. The data used have been validated in accordance with USEPA Tier II or higher validation levels and determined to be of adequate quality for use in the RA. Fixed-base laboratory analytical results for target analytes from the field investigation were used in the quantitative risk evaluation. Unfiltered results for groundwater were used to assess risks associated with this medium. Field measurements and data regarded as unreliable (i.e., qualified as "R" during the data validation process) were not used in the quantitative RA. Analytical data qualified as estimated ("J", or "UJ") were used, even though the reported concentrations or sample-specific quantitation limits may be somewhat imprecise. The use of estimated data adds to the uncertainty associated with the RA; however, the associated uncertainty is expected to be negligible compared to the other uncertainties inherent in the risk evaluation process (i.e., uncertainties associated with land uses, exposure scenarios, toxicological criteria, etc.). All compounds that were detected at least once were included in the summary tables for that medium. Non-detects were evaluated as one-half the sample quantitation limit (SQL). For a compound within a medium, if one-half of the SQL was greater than the maximum detected concentration, one-half of the SQL value was eliminated from the analysis (USEPA, 1989).

Analytical results for samples used in this HHRA are presented in Appendix F. Section 3.0 of this RI Report discusses sample collection and fixed-based laboratory analysis by standard USEPA methods. Geologic and well construction logs from RI field activities are presented in Appendix A. Sample analytical results are presented in Section 4 of this report.

6.3 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The selection of COPCs is a qualitative screening process used to limit the number of chemicals and exposure routes quantitatively evaluated in the HHRA to those site-related constituents that dominate

overall potential risks. Screening of site data against risk-based concentrations (RBCs) is used to focus the RA on meaningful chemicals and exposure routes.

In general, a chemical is selected as a COPC and retained for further quantitative risk evaluation in the HHRA if the maximum detection in a sampled medium exceeds a conservative screening value(s). Chemicals eliminated from further evaluation at this time are assumed to present minimal risks to potential human receptors.

6.3.1 Derivation of Screening Criteria

Several screening criteria were used to identify COPCs for Site 19. Screening concentrations based on risk-based cleanup objectives developed by Illinois EPA (2007) and RBCs developed by USEPA Oak Ridge National Laboratory (2008) were used, as well as other USEPA criteria. The risk-based screening concentrations correspond to a systemic hazard quotient (HQ) of 0.1 for non-carcinogens or an incremental lifetime cancer risk (ILCR) of $1x10^{-6}$ for carcinogens. Note that the Illinois EPA and USEPA RSLs for non-carcinogens are based on a HQ of 1.0 but screening concentrations for this HHRA will be based on a HQ of 0.1 so that additive non-carcinogenic risks do not exceed 1.0. The screening levels used for each medium in the RA are briefly discussed below.

Screening Levels for Soil

The following criteria were used to select COPCs for surface and subsurface soil:

- Illinois EPA Tier 1 SROs for Residential Properties (Illinois EPA, 2007). These include remediation objectives for the soil ingestion exposure route and the inhalation exposure route. The lowest Tier I objective of the receptors (i.e., residential, industrial/commercial, or construction worker) listed in the Tier 1 Tables will be used for screening.

- SROs for Chemicals Not Listed in TACO (Illinois EPA, January, 2009)

- SROs for Residential Properties, Non-TACO Chemicals (Illinios EPA, January, 2009).

- SROs for Industrial/Commercial Properties, Non-TACO Chemicals (Illinois EPA, January, 2009)

- ORNL RSLs online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

- USEPA Generic Residential and Industrial SSLs for Inhalation of Volatiles and Fugitive Dusts, USEPA Soil Screening Guidance online at http://www.epa.gov/superfund/health/conmedia/soil/pdfs/ssg_appa-c.pdf (USEPA, 2002b)

- USEPA Soil Screening Levels for the Construction Worker Scenario developed using methodology and equations presented in the Supplemental Guidance For Developing Soil Screening Levels for Superfund Sites (USEPA, 2002b)

If the maximum concentration of a constituent exceeded any of these criteria, and if the constituent is considered to be present at concentrations greater than the concentrations of chemicals in background soil, the chemical was selected as a COPC.

The comparison of site soil data to USEPA inhalation SSLs for transfers from soil to air was used to identify whether a quantitative analysis of this exposure pathway was warranted. If the maximum soil concentration of a chemical exceeded the Inhalation SSL, a quantitative evaluation of potential risks from inhalation was performed. Otherwise, the risks associated with the inhalation pathway were considered insignificant, and the exposure pathway was eliminated from further evaluation.

To evaluate the potential for chemicals detected in soil to impact groundwater, maximum chemical concentrations were compared to SSLs for migration to groundwater. The comparisons are presented in separate tables (from the direct contact COPC tables) and were used to select COPCs for soil. Migration-to-Groundwater SSLs were not used to select COPCs for quantitative risk evaluation because quantitative RAs are typically based on direct contact with soil or inhalation of vapors for VOCs and particulates. There is no methodology available for quantitative risk evaluation of indirect exposure based on migration to groundwater; therefore, it is not appropriate to select COPCs for quantitative risk evaluation for direct exposure on the basis of the indirect soil-to-groundwater pathway. The soil-to-groundwater SSLs provide an indication of potential impacts of contamination in soil on groundwater quality but are not indicators of quantitative risk.

The migration from soil to groundwater comparisons were made using the following criteria:

- Illinois EPA Tier 1 SROs for Residential Properties for the Soil Component of the Groundwater Ingestion Exposure Route for Class I Groundwater (Illinois EPA, 2007).

- USEPA Generic SSLs for Migration from Soil to Groundwater calculated online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm (USEPA, 2008a).

Results of the soil-to-groundwater comparisons are qualitatively discussed later in this RA in Sections 6.3.4 and 6.7.

COPCs were identified for surface and subsurface soil because of the different associated exposure scenarios for potential human receptors, Surface soil is defined as soil collected from 0 to 6 inches bgs. If an area was determined not to have been covered with post-demolition topsoil or gravel, samples were collected from 0 to 6 inches bgs. Otherwise, the samples were collected from the determined depth of pre-demolition ground surface (plus an additional 6 inches below the pre-demolition ground surface). Subsurface soil is defined as soil collected from depths greater than 6 inches bgs. Future residents and construction workers were assumed to be exposed to surface soil and subsurface soil. Maintenance workers and trespassers were assumed to be exposed to surface soil only. Exposure to subsurface soil for future residents was evaluated to account for the possibility that subsurface soil may be brought to the surface in a future excavation project.

Screening Concentrations for Groundwater

Direct exposure to groundwater at Site 19 is not expected to occur under current and/or future land uses because the facility and surrounding area are supplied by public water, the facility has a groundwater use restriction in place, and there are no drinking water wells located immediately downgradient of the site. However, the residential groundwater scenario was evaluated based on the assumption that groundwater at the site will be used as a source of domestic drinking water in the future, and industrial exposure to groundwater was evaluated to account for the possibility that future construction workers may come into contact with groundwater during excavation or construction activities. Groundwater screening levels for evaluating vapor intrusion to indoor air were evaluated to identify chemical concentrations in groundwater that may adversely affect the indoor air quality of a building overlying subsurface VOC contamination. If concentrations of a chemical(s) detected in groundwater had exceeded the vapor intrusion screening levels, risks for the chemical(s) would have been quantitatively evaluated using the Johnson and Ettinger Vapor Intrusion Model (USEPA, 2004b); however no VOC concentrations exceeded the screening levels.

Although site groundwater is not a source of drinking water, the following criteria were conservatively used to select COPCs for groundwater:

- Illinois EPA Tier GROs for Class 1 Groundwater (Illinois EPA, 2009)
- ORNL RSLs for Chemical Contaminants at Superfund Sites online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
- USEPA MCLs (USEPA, 2006)
- Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (USEPA, 2002).
- USEPA Groundwater Screening Levels for Evaluating the Vapor Intrusion to Indoor Air (USEPA, 2002)
- GROs for Chemicals Not Listed in TACO (Illinois EPA, 2009).

If the maximum concentration of a constituent exceeded any of these criteria, the chemical was selected as a COPC and carried through to the quantitative RA.

Surface Water and Sediment

Potential risks from exposure to surface water and sediment at Site 19 were not evaluated because surface water bodies do not exist on the site.

Essential Nutrients, Metals, and Chemicals Without Toxicity Criteria

The essential nutrients calcium, magnesium, potassium, and sodium were not selected as human health COPCs for Site 19. These inorganic chemicals are naturally abundant in environmental matrices and are only toxic at high doses. In addition, because of the lack of toxicity criteria, risk-based COPC screening levels are not available for some chemicals (e.g., benzo(g,h,i)perylene, etc.). Appropriate surrogates were selected for some of these chemicals based on similar chemical structures and are noted when used.

Determination of Site-Related Chemicals - Background Evaluation

The procedures for the elimination of chemicals as COPCs on the basis of background concentrations followed current U.S. Navy policy provided in the Navy Policy on the Use of Background Chemical Levels (U.S. Navy 2004). At the present time, facility background concentrations for naturally occurring or anthropogenic chemicals have not been determined for Naval Station Great Lakes. Therefore, maximum soil concentrations were compared to the concentrations of inorganic chemicals provided by Illinois EPA in Appendix A, Table G of TACO.

Chemicals in site media found at concentrations indicative of background concentrations were not considered to be site-related contaminants and were not retained as COPCs for the quantitative RA. To determine whether inorganic and anthropogenic organic chemicals are present at concentrations greater than background, maximum detected concentrations of inorganic chemicals in soil were compared to background levels provided by Illinois EPA.

Navy policy as it applies to RAs requires the following:

1. A clear and concise understanding of chemicals released from a site, thus making sure the Navy is focusing on remediating the release.

2. The use of background data in the screening-level RA.
   a. The comparison of site chemical levels to risk-based screening criteria.
   b. The comparison of site chemical levels to background concentrations.
   c. The identification of site-related COPCs based on screening criteria comparisons and background comparisons. Site-related COPCs are those chemicals with concentrations exceeding risk-based screening criteria and background concentrations. To the extent possible, site-related COPCs are further evaluated quantitatively in the RA.

3. The consideration of background in the RA.
   a. The calculation of risk estimates for site-related COPCs only.
   b. The further evaluation of non-site-related COPCs in the risk characterization section (e.g., the evaluation of chemicals detected at concentrations exceeding screening criteria but less than background concentrations). The Navy considers this comparison to be consistent with USEPA's Role of Background in the CERCLA Cleanup Program (USEPA, 2002d). The uncertainty associated with elimination of chemicals on the basis of background values will be discussed in the uncertainty section of the RA.

4. The selection of site cleanup remedial goals at concentrations not less than background levels. Additionally, cleanup levels should not be developed for chemicals not identified as chemicals of concern (COCs). As defined in the Navy guidance, COCs are site-related COPCs found to be the risk drivers in the RA.

Screening Concentrations for Lead

Limited criteria are available to evaluate the potential risks associated with lead. There are no risk-based concentrations for this chemical because the USEPA has not derived toxicity values for lead. However, recommended screening levels available for lead in soil are used to indicate the need for response activities. Guidance from both the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and the Office of Solid Waste and Emergency Response (OSWER) recommend 400 mg/kg as the lowest screening level for lead-contaminated soil in a residential setting where children are frequently present (USEPA, 1994). OPPTS identifies 2,000 to 5,000 mg/kg as an appropriate range for areas where contact with soil by children in a residential setting is less frequent. The Illinois EPA groundwater standard of 7.5 µg/L was used as the screening level for lead in groundwater.

Constituents detected in environmental media at maximum concentrations greater than at least one of the screening concentrations were retained as COPCs for quantitative evaluation in the RA.

A discussion of the chemicals identified as COPCs and the rationale for their selection are provided in the following sections.

6.3.2 COPC Selection for Surface Soil

This section presents the results of the COPC selection process for surface soil. Table 6-1 shows the results of the comparison of maximum detected surface soil concentrations to screening criteria. The following chemicals were retained as COPCs for surface soil:

- Semivolatiles – benzo(*a*)pyrene (BAP) equivalents - The BaP equivalent concentration is the sum of the weighted potency factor of each compound in the mixture multiplied by the concentration of the compound in the mixture. The carcinogenic risks associated with exposure to BaP equivalents averaged over a lifetime are calculated and compared to screening levels. Total BaP equivalents were calculated for comparative purposes. The concentrations of each individual PAH were multiplied by its Toxic Equivalent Factor (TEF) to yield the concentration of BaP toxic equivalents

represented by each PAH. The BaP approaches are used because an EPA derived cancer slope factor is available only for BaP. Benzo(a)pyrene is one of the most potent of the PAHs and TEFs are quantitative indicators of the comparative potency of a PAH compound compared to the potency of BaP (Kosteki et al, 1993).

- Inorganics – aluminum, arsenic, chromium, cobalt, iron, lead, and manganese

These constituents were identified as COPCs in surface soil because maximum concentrations exceeded the USEPA ORNL RSLs and/or Illinois TACO risk-based screening levels for residential soil.

Maximum concentrations were also compared to USEPA Generic SSLs for migration from soil to air (inhalation), when available. As shown in Table 6-1, the maximum concentrations of all constituents were less than the inhalation SSLs for residential and industrial exposures. Therefore, potential risks from inhalation of chemicals detected in soil are expected to be minimal, and this pathway was not evaluated further in the RA. The maximum concentrations of arsenic, barium, chromium, cobalt, manganese, and nickel exceeded the inhalation SSLs for the construction worker scenario; therefore, risks from inhalation of these metals on dusts/particulates were quantitatively evaluated for construction workers.

Background Surface Soil Concentrations

Maximum surface soil concentrations were compared to concentrations in the background data set established for use by the Illinois EPA, which are included in Table 6-1. No contaminants in surface soil were excluded as COPCs based on background conditions.

The media-specific data and data summaries for all chemicals analyzed are presented in Appendix C.

6.3.3 COPC Selection for Subsurface Soil

This section presents the results of the COPC selection process for subsurface soil. The COPC screening process for subsurface soil and the results of the screening are presented in Table 6-2. The subsurface soil data set consists of samples collected from depths greater than 6 inches bgs during the field investigation. The following chemicals were retained as COPCs for subsurface soil:

- Semivolatiles – BAP equivalents
- Inorganics – aluminum, arsenic, chromium, cobalt, iron, and manganese

These constituents were identified as COPCs in subsurface soil because maximum concentrations exceeded USEPA ORNL RSLs and Illinois TACO risk-based screening levels for residential soil.

The maximum concentrations were also compared to USEPA Generic SSLs for migration from soil to air (inhalation), when available. As shown in Table 6-2, the maximum concentrations of all constituents were less than the inhalation SSLs for residential and industrial exposures. Therefore, potential risks from inhalation of chemicals detected in soil are expected to be minimal, and this pathway was not evaluated further in the RA. The maximum concentrations of aluminum, arsenic, chromium, cobalt, manganese, and nickel exceeded the inhalation SSLs for the construction worker scenario; therefore, risks from inhalation of these metals on dusts/particulates were quantitatively evaluated for construction workers.

Background Subsurface Soil Concentrations

Maximum subsurface soil concentrations were compared to concentrations in the background data set established for use by the Illinois EPA, which are included in Table 6-1. No contaminants in subsurface soil were excluded as COPCs based on background conditions.

6.3.4 Migration of Chemicals from Soil to Groundwater

A quantitative evaluation of the migration of chemicals from soil to groundwater was not included in this RA. However, soil data were compared to Illinois EPA Tier 1 SROs for Residential Properties for the Soil Component of the Groundwater Ingestion Exposure Route for Class I Groundwater and USEPA Generic SSLs for migration from soil to groundwater, calculated online at http://rais.ornl.gov/calc_start.shtml based on methodology from the USEPA's Soil Screening Guidance (USEPA, 1996). The soil-to-groundwater SSLs were not used to select COPCs for quantitative risk evaluation but to provide an evaluation of the potential impact of chemicals detected in soil on groundwater. Exceedances of the soil-to-groundwater SSLs and a qualitative discussion of this pathway are included in the uncertainty section, Section 6.7 of this HHRA.

6.3.5 COPC Selection for Groundwater

A comparison of maximum detected groundwater concentrations to ORNL RSLs for ingestion of tap water, USEPA MCLs, and Illinois EPA GROs is presented in Table 6-3. The following chemicals were retained as COPCs for groundwater:

- Semivolatiles – BAP equivalents
- Inorganics - arsenic

The COPCs exceeded the screening criteria based on USEPA ORNL residential tap water criteria but were less than USEPA MCLs and Illinois EPA GROs.

Vapor Intrusion Pathway from Groundwater to Soil

Vapor intrusion is the migration of volatile chemicals from the subsurface into overlying buildings. Volatile chemicals in buried wastes and/or contaminated groundwater can emit vapors that may migrate through subsurface soil and into indoor air spaces of overlying buildings (USEPA, 2002a). Because the concentrations of no volatiles exceeded vapor intrusion screening levels, the vapor intrusion pathway was not evaluated further in this RA.

6.3.6 Summary

Table 6-4 summarizes the chemicals retained as COPCs for surface soil, subsurface soil, and groundwater at Site 19.

6.4 EXPOSURE ASSESSMENT

The exposure assessment estimates the extent of human contact with COPCs by characterizing potentially exposed populations of individuals (i.e., receptors), identifying actual or potential pathways of exposure that are appropriate for each potential receptor, and estimating the extent of human exposure.

An exposure pathway identifies the exposure routes for potentially complete pathways at the site and describes the mechanism by which human receptors may come into contact with site-related COPCs. Exposure pathways are dependent on both current and future land use. An exposure pathway is defined by the following four elements (USEPA, 2005b):

- A source material and mechanism of constituent release to the environment.
- An environmental migration or transport medium (e.g., soil) for the COPCs.
- A point of potential human contact with the medium of interest (e.g., potential exposure to the contaminated soil).
- An exposure route (e.g., ingestion, dermal contact) at the point of contact.

An exposure pathway is considered "complete" if all elements are present. If complete and significant, these pathways are quantitatively evaluated in the RA.

The potential for exposure at Site 19 is based on several factors including current and future land uses, human activity patterns, site access controls, chemical behavior in the environment, and the presence of human receptors. Based on these variables, exposure scenarios were developed that characterize the potential for human exposure under both current and future site conditions. The future scenario accounts for potential or anticipated changes in land use and site characteristics that may alter exposure conditions at the site. The exposure assessment assumes that, in general, chemical compositions for environmental media are identical under current and future site conditions.

The exposure assessment presented in this section of the report describes the physical site setting and potential receptors of concern, identifies the potential contaminant migration and exposure pathways, defines the contaminant concentrations at the point of exposure, and presents the equations used to quantify exposure in terms of contaminant intake (dose). Appendix F presents summary calculations of the chemical-specific intakes for all receptors and exposure pathways and also contains example calculations of the chemical intakes.

6.4.1 Site Background, Land Use, and Site Access

Naval Station Great Lakes is located in Lake County, Illinois, along the shore of Lake Michigan. It is bounded on the north by the City of North Chicago, on the south by the Veterans Administration Hospital and Shore Acres Golf Course and Country Club, on the east by Lake Michigan, and on the west by U.S. Route 41 (Skokie Highway). Current land uses in Lake County include agricultural, industrial, and residential. Farmland and lake resorts characterize the western portions of the county, and industrial, urban, and suburban areas follow the 24 miles of Lake Michigan shoreline on the east. There are also three state parks in Lake County.

Naval Station Great Lakes administers base operations and provides facilities and related support to training activities (including the U.S. Navy's only boot camp) as well as a variety of other military commands located on base. There are a variety of land uses that currently surround Naval Station Great Lakes. Along the northern boundary of the base are the most highly urbanized and industrial areas. Much of the land beyond the northwestern site boundary comprises unincorporated lands of Lake County and is vacant except for scattered retail and residential properties. Adjacent to the western boundary are primarily industrial properties, and along the southern boundary is a mixture of public open space and residential land.

Site 19 is the location of a former RTC Rifle Range housed within Building 910. VOC, PAH, and metals (primarily lead) contamination was suspected in soil and groundwater at the site due to spent ammunition and use of solvents for gun cleaning operations. A former dry cleaning operation is in close proximity to Site 19, and contaminants from this operation may have migrated into groundwater and soil of Site 19.

6.4.2 Conceptual Site Model

The development of a Conceptual Site Model (CSM) is an essential component of the exposure assessment. The CSM integrates information regarding the physical characteristics of the site, exposed populations, sources of contamination, and contaminant mobility (fate and transport) to identify potential exposure routes and receptors to be evaluated in the RA. A well-developed CSM will allow a better understanding of the risks at a site and will aid risk managers in identifying the potential need for both environmental sampling and remediation. The site-specific CSM for Site 19 is presented in this section and illustrated on Figure 6-1. Table 6-5 presents a summary of the exposure pathways that were addressed quantitatively for each human receptor. The CSM depicts the relationships among the following elements:

- Site sources of contamination and potential COPCs
- Contaminant release mechanisms
- Transport pathways
- Exposure routes/pathways
- Potential receptors

These elements of the CSM for Site 19 are discussed in the following sections.

6.4.2.1 Site Sources of Contamination

The most prominent topographic features at Naval Station Great Lakes are glacial moraines and other unconsolidated glacial deposits that cover most of the base. The terrain of Naval Station Great Lakes consists of relatively flat glacial drift deposits bordered by steep lake-facing bluffs cut with vertical sloping ravines that are under continual erosion. The topography creates poorly defined drainage patterns consisting of swales that enter depressions and marshes. Intensive development has replaced most of the oak, hickory, maple, and other hardwood forests that originally covered the area.

Site 19 was an indoor rifle range that operated between 1942 and 1997 and was demolished in 2000. It is estimated that 19 million pounds of ammunition were generated by this facility, providing the potential for lead to have impacted site soil and groundwater. Chemicals used at the Rifle Range include CLP brand cleaner and standard issue bore cleaner, primarily composed from petroleum products and distillates (i.e.,VOCs and PAHs). The use of these chemicals provides the potential for VOCs and PAHs to have impacted site soil and groundwater.

A dry cleaning facility was located just southwest of former Building 910. Dry cleaning operations were active for over 50 years. Soil contamination associated with the dry cleaning operation has been documented, and these contaminants (i.e., chlorinated VOCs and their byproducts) may be present in soil and groundwater at Site 19. It is suspected that the shooting and dry cleaning activities have impacted Site 19 soil and groundwater.

Site 19 is currently open space composed of both a grassy area and gravel driveway/parking area. Access to the site is not limited.

Based on historical site data, the following parameters are among the site-related chemical contaminants known to be present in environmental media at Site 19:

- VOCs
- PAHs
- Metals

6.4.2.2 Contaminant Release Mechanisms and Migration Pathways

Chemicals could be released from the source area by a variety of mechanisms including:

- Transport of chemicals deposited on surface soil to subsurface soil and groundwater via infiltration, percolation, and migration within the shallow groundwater aquifer.

- Migration of fugitive dusts and VOCs from surface and subsurface soil to ambient air if construction/excavation activities occur in the future.

- Volatilization of VOCs from groundwater into the indoor air of future residential and commercial buildings.

Receptors may be exposed either directly or indirectly to contaminants in environmental media via a variety of mechanisms. The exposure mechanisms considered included recreation, working outdoors, etc. These exposure mechanisms generally act along one or more exposure routes such as ingestion, inhalation, or direct dermal contact.

Figure 6-1 shows the Site 19 CSM , which illustrates these potential contaminant migration pathways.

6.4.2.3 Exposure Mechanisms/Exposure Routes

The potential for exposure to contamination at Site 19 is based on several factors, including current and future land uses, human activity patterns, site access controls, and contaminant behavior in the environment. Based on these variables, different scenarios were developed to characterize the potential for human exposure under current and future site conditions. The future scenario accounts for potential changes in land use and site characteristics that may alter exposure and of COPCs in a given medium, in addition to exposures that may result from current uses of the site.

The exposure assessment is based on the assumption that, in general, chemical compositions for various environmental media are identical under current and future site conditions. The exposure routes through which receptors may be exposed are: incidental ingestion and dermal contact with contaminated soil and inhalation of dust; inhalation of volatile contaminants in groundwater that may volatilize into future indoor air spaces; incidental ingestion and dermal contact with contaminated groundwater; and inhalation of volatile contaminants in groundwater that may volatilize into construction trenches.

6.4.2.4 Potential Receptors

Site 19 covers approximately two-thirds of an acre in an area that is mainly open space consisting of both a grassy area and a gravel area used as a parking lot. The site has been identified as having potential for exposure by trespassers. The HHRA considered potential receptor exposure under residential, industrial (construction worker, maintenance worker, and occupation worker exposure) and trespasser/recreational user land use scenarios. Based on current and potential future land use, the following potential receptors below and in Table 6-5 may be exposed to contaminated environmental media within the study area:

- **Maintenance Workers** - Potential receptors under current or future land uses. Maintenance workers include adult military or civilian personnel assigned to groundskeeping or similar activities at the site. This receptor could potentially be exposed to COPCs in surface soil (0 to 1 foot bgs) by ingestion,

dermal contact, and inhalation of fugitive dust and vapors. The exposure parameters for the maintenance worker are presented in Tables 6-6 and 6-7.

- **Trespassers (Ages 7 to 16)** - Potential receptor under future land uses. Older children and teenagers (civilians or family of military personnel living outside the site boundaries) trespassing on or near the site while exploring, playing, etc. were evaluated. This receptor could potentially be exposed to COPCs in surface soil by ingestion, dermal contact, and inhalation of fugitive dust and vapors. The exposure parameters for the trespassing teenager are presented in Tables 6-6 and 6-7.

- **Construction Workers** - Potential receptors under future land uses. Construction workers are assumed to be civilian personnel who may be involved in a short-term one-time construction project. Excavation and ground-intrusive activities may occur on the site in the future, and if these excavation projects occur, construction workers could potentially be exposed to surface and subsurface soil to an estimated depth of 10 feet bgs (conservative estimate based on available site information) by ingestion and dermal contact, and to groundwater (estimated depth to groundwater at the site ranges from 4 to 10 feet bgs) by dermal contact. Construction workers may also be exposed by inhaling dusts from soil or vapors emitted from soil or groundwater during excavation. The exposure parameters for the construction workers are presented in Tables 6-6 and 6-7.

- **Future Occupational Workers -** Potential receptors under future land uses. Occupational workers were evaluated to account for the possibility that Naval Station Great Lakes might be developed for commercial/industrial uses at some future time and to provide information that may be necessary for risk management decisions. Future occupational workers were assumed to be exposed to surface soil by ingestion, dermal contact, and inhalation of fugitive dust and vapors. To account for the possibility that future workers might work inside buildings constructed on the site and inhale vapors emitted from groundwater that migrate through cracks in building foundations and walls, these receptors were also evaluated for inhalation of vapors inside buildings. The exposure parameters for the future occupational worker are shown in Tables 6-6 and 6-7.

- **Future Military Residents (Adults/Children)** - Potential receptor under future land uses. Military residents are not potential receptors under current land use because they do not live on the site. They were evaluated primarily for decision-making (risk management) purposes based on the assumption that the site could support military residential use in the future. Future military residents were assumed to be exposed to surface soil by ingestion, dermal contact, and inhalation of fugitive dust and vapors and to groundwater by ingestion, dermal contact, and inhalation. Risks to military

residents were evaluated by reference to future civilian residents because risks for these receptors are the same or slightly less than civilian residents.

- **Future Civilian Residents (Adults/Children)** - Potential receptor under future land uses. Hypothetical future residents are not potential receptors under current land use but were evaluated to aid in risk management decisions by providing an indication of potential risks if the facility were to close and be developed for residential use. Future on-site residents were assumed to be exposed to surface soil by ingestion, dermal contact, and inhalation of fugitive dust and vapors and to groundwater by ingestion, dermal contact, and inhalation. The future residents were also evaluated for exposure to vapors from groundwater inside hypothetical future dwellings. The exposure parameters for future civilian residents are shown in Tables 6-6 and 6-7.

- **Navy Recruits** - Also considered as potential receptors at Site 19. However, exposure for recruits was assumed to be negligible because of the physical characteristics of the site (i.e., covered with clean soil), because of the limited time (i.e., 12 weeks) recruits spend at Naval Station Great Lakes, and because of the lack of idle time allocated to recruits during training. Therefore, risks to Navy recruits were not evaluated in the RA.

6.4.3 Central Tendency Exposure versus Reasonable Maximum Exposure

Traditionally, exposures evaluated in the HHRA were based on the concept of a Reasonable Maximum Exposure (RME) only, which is defined as "the maximum exposure that is reasonably expected to occur at a site" (USEPA, 1989). However, more recent RA guidance (USEPA, 1993) indicates the need to address an average case or Central Tendency Exposure (CTE).

To provide a full characterization of potential exposure, both RME and CTE were evaluated in the RA for Site 19. The available guidance (USEPA, 1993c) concerning the evaluation of CTE is limited; therefore, professional judgment was used when defining CTE conditions for a particular receptor at the site. Exposure factors and assumptions for the CTE are presented and discussed in Section 6.4.5.

6.4.4 Exposure Point Concentrations

The EPC, which is calculated for COPCs only, is a reasonable maximum estimate of the chemical concentration that is likely to be contacted over time by a receptor and is used to calculate estimated exposure intakes.

The following guidelines were used to calculate EPCs:

- If a soil data set for an exposure unit (EU) contained fewer than 10 samples, the EPCs for the RME and CTE cases were defined as the maximum detected concentrations.

- If a soil data set for an EU contained 10 or more samples, the 95-percent upper confidence limits (UCLs) on the arithmetic mean, based on the distribution of the data set, were selected as the EPCs for the RME and CTE cases. EPCs were calculated following USEPA's Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002c) using the USEPA's ProUCL software and guidance (USEPA, 2007a). The individual cases were examined by a statistician who made a decision on the appropriate value to use as the exposure concentration. Typically, recommendations made in Section 3 (Data Evaluation) of the ProUCL guidance or methods specified in Gilbert were used by the statistician.

- For groundwater, Section 742.225a of TACO indicates that contaminant concentrations of discrete samples at each sample point should be evaluated. Based on this guidance, risks for groundwater were characterized by assuming exposure to the well with the maximum groundwater concentrations for each chemical.

- As per USEPA guidance for the child and adult lead models, the EPCs for lead were the average concentrations for each medium evaluated.

Duplicate analytical results were not used for EPC calculations. Data values less than sample-specific detection limits were substituted with one-half the detection limit. Rejected values ("R") flagged during data validation) were eliminated from further consideration because they were regarded as unreliable. Estimated and biased values (flagged "J") were used at the reported value with the knowledge that some uncertainty is associated with the reported numerical result.

The EPCs for the chemicals identified as COPCs in environmental media at Site 19 are presented in Table 6-8 and the RAGS Part D Tables in Appendix F.

6.4.5 Intake Estimation Methods and Exposure Parameters

To determine potential human health risks associated with Site 19, an estimate of chemical intake was made in accordance with current USEPA guidance. Exposure parameters and exposure concentrations were used to derive estimates of chemical intake for each exposure route, pathway, and receptor. The

resulting chemical intakes were integrated with the toxicity factors discussed in Section 6.5 to develop quantitative risk estimates for potential receptors at the site. Intakes for the identified potential receptor groups were calculated using current EPA RA guidance (USEPA, 1989, 2004b, and 2009) and presented in the RA spreadsheets (Appendix F). In accordance with current USEPA guidance, chemical intakes (and risks) were estimated for both the CTE and RME conditions. Values of exposure parameters used to quantify exposure for each receptor are presented in Tables 6-6 and 6-7 for the RME and CTE, respectively.

The following sections present the equations used to estimate chemical intakes for the exposure routes identified for quantitative evaluation. Example calculations for estimated intakes and calculations of estimated intakes for all potential receptors are contained in Appendix F.

6.4.5.1 Exposure to COPCs in Soil

The HHRA assumed that trespassers (adolescents), construction workers, maintenance workers, occupational workers, and potential future residents (military and civilian; child and adult) may come into contact with chemicals detected in soil (surface and/or subsurface) at the site. Soil exposure routes evaluated were incidental ingestion, dermal contact, and inhalation. A description of the methods and assumptions used to quantify soil exposure follows.

Dermal Contact with Soil

Doses for dermal contact with soil were estimated using the following equation (USEPA, 2004b):

$$DEX = \frac{C \times SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT}$$

where:

DEX	=	dermal dose (mg/kg-day)
C	=	chemical concentration in soil (mg/kg)
SA	=	skin surface area available for contact (cm^2/day)
AF	=	soil-to-skin adherence factor (mg/cm^2)
ABS	=	absorption factor (unitless)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
CF	=	conversion factor (1×10^{-6} kg/mg)
BW	=	body weight (kg)

AT = averaging time (days)
for non-carcinogens: ED x 8,760 hours
for carcinogens: 365 days/year x 70 years

Exposed skin surface areas available for dermal contact were determined for each receptor based on assumed human activities and clothing worn during exposure events. USEPA guidance (USEPA, 1997 and 2004b) was used to develop the default assumptions concerning the amount of skin surface area available for contact for a receptor. The skin surface areas used in RA calculations and the rationale for the selection of the surface areas are as follows:

- For adolescent trespassers, 25 percent of the total body surface area (aged 7 to 16) was assumed to be available for contact with soil. The RME value (3,820 cm^2) is derived from the 95th percentile surface area data, and the CTE value (3,100 cm^2) is derived from the 50th percentile data, as provided in Table 6-6 of the Exposure Factors Handbook (USEPA, 1997).

- Maintenance workers, occupational workers, and construction/excavation workers were assumed to be exposed on the head, hands, and forearms assuming that they wear a short-sleeved shirt, long pants, and shoes. As recommended in RAGS Part E (USEPA, 2004b), this skin surface area is assumed to be 3,300 cm^2 for the RME and CTE scenarios. This value represents the average of the 50th percentile areas of males and females more than 18 years old.

- For future military and civilian adult residents assumed to be exposed to soil, the exposed surface area available for contact was the value for the adults skin surface area for exposure to soil recommended in RAGS Part E (USEPA, 2004b), 5,700 cm^2 for both RME and CTE. This skin area assumes that head, hands, forearms, and lower legs of the adult are available for contact. For child residents assumed to be exposed to soil, the exposed surface area available for contact was the value for child skin surface area for exposure to soil recommended in RAGS Part E (USEPA, 2004b), 2,800 cm^2 for both RME and CTE. This skin area assumes that head, hands, forearms, lower legs, and feet of the child are available for contact.

Values of soil adherence factors and chemical-specific dermal absorption factors provided in RAGS Part E (USEPA, 2004b) were used to evaluate risks from exposure to soil. The following soil adherence factors were used for the RME and CTE exposure scenarios:

- Maintenance and Occupational Workers – 0.2 mg/cm^2 for the RME and 0.02 mg/cm^2 for the CTE (Exhibit 3.5).
- Construction Workers – 0.3 mg/cm^2 for the RME and 0.1 mg/cm^2 for the CTE (Exhibit 3.3).
- Adolescent Trespassers – 0.2 mg/cm^2 for the RME and 0.04 mg/cm^2 for the CTE (Exhibit 3.5).
- Future Adult Residents – 0.07 mg/cm^2 for the RME and 0.01 mg/cm^2 for the CTE (Exhibit 3.5)
- Future Child Residents – 0.2 mg/cm^2 for the RME and 0.04 mg/cm^2 for the CTE (Exhibit 3.5)

For the constituents identified as COPCs in soil, the following absorption factors were used (USEPA, 2004b):

- Arsenic – 0.03
- Cadmium – 0.001
- PAHs – 0.13
- Other semivolatiles – 0.1
- Other inorganics and volatile organics – not evaluated for dermal contact with soil (USEPA, 2004b)

Exposure parameters for the dermal exposure route are summarized in Tables 6-6 and 6-7, for RME and CTE respectively.

Incidental Ingestion of Soil

Intakes associated with soil ingestion were estimated using the following equation (USEPA, 1989):

$$\text{Intake} = \frac{C \times IR \times FI \times EF \times ED \times CF}{BW \times AT}$$

where:

Intake	=	ingestion intake
C	=	chemical concentration in soil (mg/kg)
IR	=	soil/sediment ingestion rate (mg/day)
FI	=	fraction ingested from contaminated source (unitless)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
CF	=	conversion factor (1×10^{-6} kg/mg)
BW	=	body weight (kg)

AT = averaging time (days)
for non-carcinogens: 365 days/year x ED
for carcinogens: 365 days/year x 70 years

Exposure frequencies and durations for the incidental ingestion of soil are summarized in Tables 6-6 and 6-7, for RME and CTE respectively. A default value of 1.0 (USEPA, 1989) was used for the fraction ingested from the contaminated source for the RME and CTE scenarios. For the RME scenario, the ingestion rate was set at 330 mg/day for the construction worker (USEPA, 2002b), 200 mg/day for the future child resident, and 100 mg/day for the other potential receptors (the maintenance worker, occupational worker, future adult resident, and adolescent trespasser) (USEPA, 1993c). Ingestion rates for the CTE are assumed to be one-half of the RME values.

Exposure parameters for the soil ingestion route are summarized in Tables 6-6 and 6-7 for RME and CTE respectively.

Inhalation of Air Containing Fugitive Dust/Volatiles Emitted from Soil

As mentioned previously, a qualitative evaluation of exposure to fugitive dust/volatile emissions from soil (i.e., comparison of maximum site soil concentrations to USEPA Generic SSLs for chemical transfers from soil to air) under residential and construction worker scenarios was used to identify whether a quantitative analysis of the inhalation exposure pathway was warranted. No maximum surface soil or subsurface soil concentration exceeded the residential SSLs; therefore, a quantitative analysis of the inhalation exposure pathway was not performed for hypothetical future residents. However, maximum detected concentrations of several metals in surface and subsurface soil exceeded construction worker SSLs. Consequently, construction workers were evaluated for inhalation of fugitive dusts. The amount of a chemical that a receptor takes in as a result of respiration was determined using the concentration of the contaminant in air. Intakes of particulates were calculated using following equation (USEPA, 2009):

$$Intake_{ai} = \frac{(C_{ai})(ET)(EF)(ED)}{(AT)}$$

where: $Intake_{ai}$ = intake of chemical "i" from air via inhalation (mg/kg/day)
C_{ai} = concentration of chemical "i" in air (mg/m^3)
ET = exposure time
EF = exposure frequency

ED = exposure duration

AT = averaging time (days);

for non-carcinogens, AT = ED x 365 days/year x 24 hrs/day = ED x 8,760 hrs

for carcinogens, AT = 70 years x 365 days/year x 24 hrs/day = 613,200 hrs

The concentrations of chemicals in air resulting from emissions from soil were developed following procedures presented in USEPA Soil Screening Guidance (USEPA, 2002b). The chemical concentration in air was calculated as follows:

$$C_{air} = C_{soil} \times \left[\frac{1}{PEF} + \frac{1}{VF} \right]$$

where:

C_a = chemical concentration in air, mg/m^3

C_s = chemical concentration in soil, mg/kg

PEF = particulate emission factor, m^3/kg

VF = volatilization factor, m^3/kg

The particulate emissions factor (PEF) relates the concentration of a chemical in soil with the concentration of dust particles in air. The PEF for construction workers (1.27 x 10^6 m^3/kg) was calculated using the equations presented in the supplemental SSL guidance document (USEPA, 2002b). A sample calculation for the PEF is presented in Appendix F. It was not necessary to calculate VFs for inhalation from soil because only metals were identified as COPCs for this exposure scenario.

6.4.5.2 Exposure to Groundwater

Future residential, occupational worker, and construction worker scenarios were developed for exposure to groundwater primarily using current RA guidance (USEPA, 1989 and 2004b). The applicable groundwater exposure frequencies, exposure durations, and body weights for residents and construction workers were identical to those previously identified for soil contact.

Dermal Contact with Groundwater

Dermal contact with groundwater was evaluated by methods and equations provided in RAGS Part E (USEPA, 2004b). Direct contact with groundwater at Site 19 was assumed to be limited to exposure that would occur under hypothetical future residential and construction/excavation scenarios. Hypothetical future on-site residential receptors are assumed to use groundwater for domestic purposes (i.e., bathing, showering, and dish washing) that can result in dermal exposure. Short-term dermal exposure was

assumed to occur for the construction worker during excavation activities. Groundwater at Site 19 is not currently used as a source of potable water and based on expected uses, is not expected to be used for this purpose in the future.

The following equation was used to assess exposures resulting from dermal contact with water (USEPA, 2004b):

$$DAD_{wi} = (DA_{event})(EV)(ED)(EF)(A)/(BW)(AT)$$

where:

DAD_{wi}	=	dermally absorbed dose of chemical "i" from water (mg/kg/day)
DA_{event}	=	absorbed dose per event (mg/cm^2-event)
EV	=	event frequency (events/day)
ED	=	exposure duration (year)
EF	=	exposure frequency (days/year)
A	=	skin surface area available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for non-carcinogens, AT = ED x 365 days/year;
		for carcinogens, AT = 70 yrs x 365 days/year

The exposed surface area of construction workers is based on assumed activities and on the assumptions outlined for dermal contact with soil. Current guidance (USEPA, 2004b) was used to develop the following default assumptions concerning the amount of skin surface area available for contact for a receptor:

- For construction workers assumed exposed to groundwater, the surface area for RME and CTE was assumed to be 3,300 cm^2, the value recommended for soil contact in USEPA's dermal guidance (USEPA, 2004b).

- Dermal intakes for residents were assumed total body exposure, 6,600 cm^2 for children (0 to 6 years of age) and 18,000 cm^2 for adults (USEPA, 2004b).

The absorbed dose per event (DA_{event}) was estimated using a non steady-state approach for organic compounds and a traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{event} < t^{*}, \text{ then: } DA_{event} = (2FA)(Kp)(C_{gw})(CF)\left(\sqrt{\frac{6\,\tau\, t_{event}}{\pi}}\right)$$

$$\text{If } t_{event} > t^{*}, \text{ then: } DA_{event} = (FA)(K_p)(C_{gw})(CF)\left(\frac{t_{event}}{1+B} + 2\,\tau\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right)$$

where:

t_{event}	=	duration of event (hours/event)
t^{*}	=	time it takes to reach steady-state conditions (hours)
FA	=	fraction absorbed (dimensionless)
K_p	=	permeability coefficient from groundwater through skin (cm/ hours)
C_{gw}	=	concentration of chemical "i" in groundwater (mg/L)
τ	=	lag time (hours)
π	=	constant (dimensionless; equal to 3.1416)
CF	=	conversion factor ($1x10^{-3}$ L/cm^3)
B	=	partitioning constant derived by Bunge Model (dimensionless)

The estimated length of time for a shower or bath is 10 minutes for CTE and 15 minutes for RME. Receptors are assumed to spend an additional 5 minutes in the bathroom following their shower or bath. Construction/excavation workers were assumed to be exposed to shallow groundwater in a trench 4 hours per day for the RME and 2 hours per day for CTE. An event frequency of one per day is assumed for CTE and RME (i.e., residents were assumed to take one shower or bath per day).

Values for the chemical-specific parameters (t^{*}, K_p, τ, and B) were obtained from the current dermal guidance (USEPA, 2004b).

The following steady-state equation was used to estimate DA_{event} for inorganics:

$$DA_{event} = (K_p)\,(C_{gw})\,(t_{event})$$

The recommended default value of $1x10^{-3}$ was used for the dermal permeability of inorganic constituents, unless a chemical-specific value was provided in USEPA guidance. For most metals, dermal absorption is not a significant pathway because penetration through the skin is minimal.

Ingestion of Groundwater

Residents may be exposed to groundwater via direct ingestion and intakes associated with ingestion of groundwater were evaluated using the following equation (USEPA, 1989):

$$Intake_{wi} = \frac{(C_{wi})(IR_w)(EF)(ED)}{(BW)(AT)}$$

where:

$Intake_{wi}$	=	intake of chemical "i" from water (mg/kg/day)
C_{wi}	=	concentration of chemical "i" in water (mg/L)
IR_w	=	ingestion rate for ground water (L/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (year)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for non-carcinogens, AT = ED x 365 days/year;
		for carcinogens, AT = 70 years x 365 days/year

Water ingestion rates for the adult resident were specified as 1.4 liters per day (CTE) and 2.0 liters per day (RME). For the child resident, water ingestion rates were 0.66 liters per day (CTE) and 1.5 liters per day (RME). The same exposure times, frequencies, and durations used to assess dermal exposure to water were used to estimate intakes for ingestion of water.

Exposure parameters for exposure to groundwater are summarized in Tables 6-6 and 6-7, for RME and CTE respectively.

Inhalation of Volatiles in Groundwater

Groundwater exposure may also result in chemical intake through inhalation if the water resource is used as a domestic water supply or is exposed during construction activities, and VOCs are present in the

groundwater. This exposure route is plausible for residential receptors that may be exposed while showering, bathing, washing dishes, etc. or for construction workers contacting shallow groundwater during excavation activities. However, no VOCs were retained as COPCs at this site; therefore, it was determined that a quantitative evaluation was not required because the potential risks associated with this pathway were regarded as minimal, and no further evaluation was performed.

Inhalation of Volatiles via Vapor Intrusion from Groundwater into Indoor Air

Volatilization of chemicals from groundwater into indoor air may occur, thereby exposing individuals inside buildings or dwellings. However, no VOCs were retained as COPCs for vapor intrusion at this site; therefore, it was determined that a quantitative evaluation was not required because the potential risks associated with this pathway were regarded as minimal, and no further evaluation was performed.

Exposure of Workers to Volatiles in a Construction/Utility Trench

Construction workers may be exposed to COPCs that have volatilized from groundwater when excavation exposes the shallow groundwater table. However, no VOCs were retained as COPCs at this site; therefore, it was determined that a quantitative evaluation was not required because the potential risks associated with this pathway were regarded as minimal, and no further evaluation was performed.

6.4.5.3 Exposure to Lead

Lead was identified as a COPC for surface soil at Site 19. The equations and methodology presented in the previous section cannot be used to evaluate exposure to lead because of the absence of published dose-response parameters. Exposure to lead was assessed using the latest version of USEPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead (USEPA, 2007b). This model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure.

Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead, and considerable behavioral and developmental impairments have been noted in children with elevated blood lead levels. The threshold for toxic effects from this chemical is believed to be in the range of 10 to 15 µg/dL. Blood lead levels greater than 10 µg/dL are considered to be a "concern."

The IEUBK Model for lead was used to address exposure to lead in children where detected groundwater concentrations exceeded the Illinois EPA groundwater standard/federal Action Level (7.5 µg/L)

promulgated under the Safe Drinking Water Act or where detected soil concentrations exceeded the OSWER soil screening level of 400 mg/kg for residential land use (USEPA, 1994). Average chemical concentrations, as well as default values for some input parameters, were employed.

Adult exposure to lead in soil was quantified by the adult lead model provided by USEPA's Technical Review Workgroup for Lead (USEPA, 2003). In this model, adult exposure to lead in soil is addressed by an evaluation of the relationship between site soil lead concentrations and blood lead concentrations in the developing fetuses of adult women. The adult lead model generates a spreadsheet for each exposure scenario evaluated (i.e., workers and adult residents). The spreadsheets calculate a range of 95th percentile fetal blood lead concentrations from central estimates of blood lead concentrations in pregnant adult women. The spreadsheets also calculate 95th percentile blood lead concentrations in fetuses born to women exposed to lead in soil.

No models are currently available to evaluate the periodic exposure of adolescent trespassers to lead; therefore, guidance provided in USEPA's Assessing Intermittent or Variable Exposures to Lead Sites (USEPA, 2003) was used to evaluate the periodic exposure expected for this receptor. This guidance uses such options as time weighting, varying intensity of exposure, and seasonal variability, in conjunction with the IEUBK Model and Adult Lead Model (ALM) models, to estimate exposure to lead in soil.

6.5 TOXICITY ASSESSMENT

Oral and inhalation RfDs and CSFs used in the HHRA for Site 19 were obtained from the following primary literature sources (USEPA, 2003):

- Integrated Risk Information System (IRIS) (online at http://www.epa.gov/iris/subst/index.html).

- USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs) – The Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by the USEPA's Superfund program.

- Annual Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b) for chronic and subchronic toxicity values.

- Other Toxicity Values – These sources include but are not limited to California Environmental Protection Agency (Cal EPA) toxicity values

- The Risk Assessment Information System (RAIS) (online at http://rais.ornl.gov/tox/toxvals.shtml) for subchronic toxicity values.

Although RfDs and CSFs can be found in several toxicological sources, USEPA's IRIS online database is the preferred source for toxicity values. ORNL RSLs were used as sources of toxicity criteria and guidance provided in RAGS-Part C (USEPA, 1991b) was used when evaluating subchronic risks for the construction worker. RfDs and CSFs for the constituents selected as COPCs for Site 19 are presented in Tables 6-9 through 6-12.

6.5.1 Toxicity Criteria for Dermal Exposure

RfDs and CSFs found in literature are typically expressed as administered doses; therefore, these values are considered inappropriate for estimating the risks associated with dermal routes of exposure. Oral dose-response parameters based on administered doses must be adjusted to absorbed doses before the evaluation of estimated dermal exposure intakes is made.

The adjustment from administered to absorbed dose was made using chemical-specific absorption efficiencies published in available guidance (i.e., USEPA, 2004 [the primary reference], IRIS, ATSDR toxicological profiles, etc.) and the following equations:

$$RfD_{dermal} = (RfD_{oral})(ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) / (ABS_{GI})$$

where: ABS_{GI} = absorption efficiency in the gastrointestinal tract

Absorption efficiencies used in the Site 19 RA reflect USEPA's current dermal assessment guidance (USEPA, 2004b).

6.5.2 Toxicity Criteria for Chromium

Toxicity criteria are available for two different forms of chromium, the trivalent state and the hexavalent state, of which the latter is considered to be more toxic. The screening of chromium was conducted assuming that 100 percent of the reported total chromium is hexavalent. The uncertainty associated with

the assumption that all chromium is hexavalent chromium will be discussed in the uncertainty section of the RA.

6.5.3 Toxicity Criteria for Carcinogenic Effects of PAHs

Limited toxicity values are available to evaluate the carcinogenic effects from exposure to PAHs. The most extensively studied PAH is BaP, which is classified by USEPA as a probable human carcinogen. Although CSFs are available for BaP, insufficient data are available to calculate CSFs for other carcinogenic PAHs. Toxic effects for these chemicals were evaluated using the concept of estimated orders of potential potency, which relate the potency of the other potentially carcinogenic PAHs to the potency of benzo(a)pyrene, as presented in current USEPA guidance (USEPA, 1993d). The equivalent oral and inhalation CSFs for these chemicals were derived by multiplying the CSFs for BaP by the orders of potential potency. Inhalation unit risk values for non-BaP carcinogenic PAHs were obtained from the California EPA.

USEPA currently incorporates the use of age-dependent adjustment factors (ADAFs) for carcinogens that act via a mutagenic mode of action. Carcinogenic PAHs were evaluated following USEPA's Guidelines for Carcinogen Risk Assessment (USEPA, 2005c) and Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005d).

6.6 RISK CHARACTERIZATION

The baseline HHRA evaluated potential health risks associated with human exposure to chemicals present at Site 19. Quantitative risk estimates are based on the conservative assumption that an individual is exposed to multiple COPCs by multiple exposure pathways. In accordance with USEPA guidance, chemical- and pathway-specific risks were summed to provide estimates of total risk for a given receptor. Risk estimates were developed by integrating chemical intake levels with chemical-specific toxicity factors. Risk example calculations are provided in Appendix F.

ILCR estimates were generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$\text{ILCR} = \text{Estimated Exposure Intake} \times \text{CSF}$$

An ILCR of $1x10^{-6}$ indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million people.

Non-carcinogenic risks are assessed using the concept of HQs and hazards indexes (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows:

HQ = (Estimated Exposure Intake)/(RfD)

An HI for a given exposure route is generated by summing the individual HQs for all COPCs. The HI is not a mathematical prediction of the severity of toxic effects and is therefore not a true risk. It is simply a numerical indicator of the possibility of the occurrence of non-carcinogenic (threshold) effects.

6.6.1 Comparison of Quantitative Risk Estimates to Benchmarks

To interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates were compared to typical benchmarks. USEPA has defined the range of $1x10^{-4}$ to $1x10^{-6}$ as the ILCR target range for hazardous waste facilities addressed under CERCLA. The Illinois EPA goal for carcinogenic risks, as specified in TACO, is $1x10^{-6}$.

An HI exceeding unity (1.0) indicates that there may be potential non-carcinogenic health risks associated with exposure. If an HI exceeds unity, target organ effects associated with exposure to COPCs are segregated (and the HI is calculated on a target organ/target effect basis). Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) are regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1.0, but no adverse health effects are anticipated if the COPCs do not affect the same target organ or exhibit the same critical effect. Individual target organ HIs for all receptors are presented in the RAGS Part D tables (Table 9s) presented in Appendix F.

6.6.2 Risk Assessment Results

The baseline HHRA conducted for Site 19 evaluated the risks potentially incurred by site maintenance workers, occupational workers, construction workers, adolescent trespassers, and hypothetical future residents. Adolescent trespassers and maintenance workers were evaluated for exposure to COPCs in soil. Construction workers, occupational workers, and residents were evaluated for exposure to soil and groundwater. Both RME and CTE scenarios were evaluated. Tables 6-13 and 6-14 contain a summary

of the estimated risks for Site 19 for the RME and CTE, respectively. Calculations of the detailed chemical-specific risks for Site 19 are included in Appendix F. The following sections discuss the results of the risk characterization.

6.6.2.1 Carcinogenic Risks - RME

Quantitative estimates of carcinogenic effects are presented in the form of ILCRs. The target risk range for carcinogenic effects, as defined by the USEPA, is between $1x10^{-4}$ and $1x10^{-6}$. The Illinois EPA goal for carcinogenic risks, as specified in TACO, is $1x10^{-6}$. Estimated ILCRs for Site 19 are discussed in the following subsections. The carcinogenic risks calculated for the RME case are presented in Table 9s in Appendix F and summarized in Table 6-13.

Carcinogenic Risks for Exposure to Surface Soil - RME

The ILCR for construction workers ($8x10^{-7}$) was less than the target risk goal of $1x10^{-6}$. The ILCRs for maintenance workers ($1x10^{-5}$), occupational workers ($1x10^{-5}$), and adolescent trespassers ($2x10^{-6}$) were within the USEPA target risk range for carcinogenic effects of $1x10^{-4}$ and $1x10^{-6}$ but greater than the Illinois EPA goal of $1x10^{-6}$. The elevated risks in all receptors are due to PAHs and arsenic in groundwater and soil.

The total ILCR for hypothetical future residents (adult + child) was $1x10^{-4}$, is within the USEPA target risk range for carcinogenic effects but greater than the Illinois EPA goal of $1x10^{-6}$. The residential risk is primarily due to exposure to PAHs and arsenic by ingestion of surface soil.

Carcinogenic Risks for Exposure to Subsurface Soil - RME

The ILCR for construction workers ($6x10^{-7}$) was less than the target risk goal of $1x10^{-6}$.

Carcinogenic Risks for Exposure to Groundwater - RME

The ILCR for construction workers ($1x10^{-9}$) was less than the target risk goal of $1x10^{-6}$.

The total residential ILCR ($1x10^{-4}$) was within the USEPA target risk range for carcinogenic effects but greater than the Illinois EPA goal of $1x10^{-6}$. The residential risk is primarily due to exposure to PAHs and arsenic in groundwater.

Chemical-specific risks are presented in the tables in Appendix F.

6.6.2.2 Non-Carcinogenic Effects - RME

Quantitative estimates of non-carcinogenic (toxic) effects are presented in the form of HQs and HIs. As discussed above, the risk benchmark for HQs and HIs (calculated on a target organ-specific basis) is 1 (USEPA, 1989). Estimated HQs and HIs for Site 19 are discussed below, presented in Appendix F, and summarized in Table 6-13.

Non-Carcinogenic Risks for Exposure to Surface Soil - RME

The cumulative surface soil HIs for maintenance workers (HI = 0.2), occupational workers (HI = 0.2), adolescent trespassers (HI = 0.03), and future adult residents (HI = 0.2) were less than unity (1.0), indicating that adverse non-carcinogenic health effects are not anticipated for these receptors under the defined RME conditions. The cumulative HI for the future child resident (HI = 2) exceeded unity; however, the cumulative target organ HIs for the child resident were less than or equal to unity for exposure to surface soil.

The cumulative HI for construction workers (HI = 5) exceeded unity. The major contributor to the construction worker HI was manganese by inhalation of particulates (HQ = 4).

Non-Carcinogenic Risks for Exposure to Subsurface Soil - RME

The cumulative HI for construction workers (HI = 4) exceeded unity. The major contributor to the construction worker HI was manganese by inhalation of particulates (HQ = 3).

Non-Carcinogenic Risks for Exposure to Groundwater - RME

The cumulative groundwater HIs for construction workers (HI = 0.001), future child residents (HI = 0.4), and adult residents (HI = 0.1) were less than or equal to unity (1.0), indicating that adverse non-carcinogenic health effects are not anticipated for this receptor under the defined RME condition. The groundwater risks were based on assumed exposure to maximum detected concentrations.

6.6.3 CTE Evaluation

As discussed previously, an evaluation of the potential risks associated with the CTE scenario is included to provide a measure of the central or average case exposure.

Carcinogenic Risks for Exposure to Surface Soil - CTE

The ILCRs for construction workers ($4x10^{-7}$) and adolescent trespassers ($2x10^{-7}$) were less than the target risk goal of $1x10^{-6}$. The ILCRs for maintenance workers ($2x10^{-6}$) and occupational workers ($2x10^{-6}$) were within the USEPA target risk range for carcinogenic effects of $1x10^{-4}$ and $1x10^{-6}$ but greater than the Illinois EPA goal of $1x10^{-6}$.

The total ILCR for hypothetical future residents (adult + child) was $5x10^{-6}$, within the USEPA target risk range for carcinogenic effects but greater than the Illinois EPA goal of $1x10^{-6}$.

Carcinogenic Risks for Exposure to Subsurface Soil - CTE

The ILCR for construction workers ($3x10^{-7}$) was less than the target risk goal of $1x10^{-6}$.

Carcinogenic Risks for Exposure to Groundwater - CTE

The ILCR for construction workers ($5x10^{-10}$) was less than the target risk goal of $1x10^{-6}$.

The total residential ILCR ($1x10^{-5}$) was within the USEPA target risk range for carcinogenic effects of $1x10^{-4}$ and $1x10^{-6}$ but greater than the Illinois EPA goal of $1x10^{-6}$.

Chemical-specific risks are presented in the tables in Appendix F.

6.6.3.2 Non -Carcinogenic Effects - CTE

Estimated HQs and HIs for the CTE scenario for Site 19 are discussed below, presented in Appendix F, and summarized in Table 6-14.

Non-Carcinogenic Risks for Exposure to Surface Soil - CTE

The cumulative surface soil HIs for maintenance workers (HI = 0.07), occupational workers (HI = 0.07), adolescent trespassers (HI = 0.007), future child residents (HI = 0.7) and future adult residents (HI = 0.07) were less than unity (1.0), indicating that adverse non-carcinogenic health effects are not anticipated for these receptors under the defined CTE conditions.

The cumulative HI for construction workers (HI = 2) exceeded unity. The major contributor to the construction worker HI was manganese by inhalation of particulates.

Non-Carcinogenic Risks for Exposure to Subsurface Soil - CTE

The cumulative HI for construction workers (HI = 3) exceeded unity. The major contributor to the construction worker HI was manganese by inhalation of particulates.

Non-Carcinogenic Risks for Exposure to Groundwater - CTE

The cumulative groundwater HIs for construction workers (HI = 0.0007), future child residents (HI = 0.09), and future adult residents (HI = 0.1) were less than or equal to unity (1.0), indicating that adverse non-carcinogenic health effects are not anticipated for this receptor under the defined CTE conditions.

6.6.4 Lead Assessment Results

As discussed in the previous section, the IEUBK Model and ALM were used to evaluate potential health risks from lead to potential future residents, construction workers, and maintenance/occupational workers. The USEPA significance level for blood lead is 10 µg/dL, and USEPA has set a criterion of no more than a 5% chance that any child will have a blood lead value greater than 10 µg/dL (CDC, 1994; USEPA 1998, and 2005a).

Child Lead Model Results

The lead RA results from the IEUBK Model are presented in the output data summary graph in Appendix F. The estimated percent chance that any child will have a blood lead value greater than 10 µg/dL was calculated to be 0.136 percent, which is less than the USEPA acceptable target of 5 percent.

Adult Lead Model Results

ALM results indicate that the central estimate blood-lead levels for construction workers and maintenance/occupational workers and their fetuses were less than the established level of concern (10 µg/dL) and the probabilities that receptor blood-lead levels would be less than the U.S. EPA's goal of limiting exposure to lead so that no more than 5 percent of the exposed receptors have an estimated blood-lead level greater than the established level of concern. The estimated percent that the receptor will have a blood lead value greater than 10ug/DL was 1.1 percent and 1.0 percent respectively. The ALM results are presented in Appendix F.

6.7 UNCERTAINTY ANALYSIS

The baseline HHRA for Site 19 was performed in accordance with current USEPA and Illinois EPA guidances. However, there are varying degrees of uncertainty associated with the baseline HHRA. This section presents a brief summary of uncertainties inherent in the RA and includes a discussion of how they may affect the quantitative risk estimates and conclusions of the risk analysis.

6.7.1 General Uncertainty in Risk Assessment

Uncertainty in the selection of COPCs is related to the current status of the predictive databases, grouping of samples, and procedures used to include or exclude constituents as COPCs. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route or scenario, assumptions made to determine EPCs, and predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose-response relationships and weight of evidence used to determine the carcinogenicity of COPCs. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier steps of the RA process.

Whereas there are various sources of uncertainty, the direction of uncertainty can be influenced by the assumptions made throughout the RA, including selection of COPCs and selection of values for dose-response relationships. To account for uncertainties in the development of a RA, conservative estimates must be made to make sure that the particular assumptions made are protective of sensitive subpopulations and maximum exposed individuals. Therefore, throughout the entire RA, assumptions that consider safety factors are made so that the final calculated risks are overestimated, and consequentially, very conservative.

The major sources of uncertainty associated with this RA are discussed below.

6.7.2 Uncertainty in Selection of COPCs

A minor amount of uncertainty is associated with the selection of COPCs that may affect the numerical risk estimates presented in the RA. The most significant issues related to uncertainty in COPC selection are the existing database (i.e., the use of validated or unvalidated sample results), inclusion of chemicals potentially attributable to background, screening levels used, exclusion of historical data from the RA, and absence of screening levels for a few chemicals detected in the site media. A brief discussion of each of these issues is provided in the remainder of this section.

6.7.2.1 Existing Databases

The data used in the RA were based on the most recent analytical data collected at Site 19 during RI field activities. No historical data were used for RA purposes. The analytical data were validated according to the methodologies specified in the Site 19 RI Work Plan. The qualification of data during the formal data validation process is not expected to compromise the results of the HHRA. Analytical data qualified as estimated were utilized, even though the reported concentrations or sample-specific quantitation limits may be somewhat imprecise. The use of estimated data adds to the uncertainty associated with the RA. However, the associated uncertainty is expected to be negligible compared to the other uncertainties inherent in the risk evaluation process (i.e., uncertainties with land uses, exposure scenarios, toxicological criteria, etc.). When determining exposure concentrations via statistical procedures, chemicals not detected were conservatively assumed to be present at concentrations equal to the sample-specific quantification limits. Analytical results for chemicals qualified “R," rejected, were not used in the risk assessment.

6.7.2.2 Exclusion of Historical Data from the Risk Assessment

Data collected from the most recent sampling events were used to evaluate potential risks for Site 19. Data from historical soil and groundwater investigations were not used in this assessment. Exclusion of historical data from the RA may result in uncertainty in COPC selection and in the exposure concentrations used to quantify risks. However, because the most recent data were used to assess risks, the uncertainty associated with the omission of historical data should be minimal, and conclusions of the RA were probably not affected by the exclusion of the historical data from the RA.

6.7.2.3 Chemicals Potentially Attributable to Background

No chemicals in soil and groundwater were eliminated as COPCs on the basis of comparisons to background concentrations. All of the metals selected as COPCs based on comparison to risk-based screening criteria exceeded background concentrations. However, most of the PAHs selected as COPCs in exposed surface soil were detected at maximum concentrations that did not exceed surface soil background data. These PAHs present at concentrations consistent with background levels were included as COPCs in this medium.

In addition, the Illinois EPA has conducted a recent study in association with the Electric Power Research Institute (EPRI) to determine background concentrations for some common PAHs in urban areas. TACO defines background concentrations as follows:

> "Area Background means concentrations of regulated substances that are consistently present in the environment in the vicinity of a site that are the result of natural conditions of human activities, and not the result solely of releases at the site."

Based on this study, the Illinois EPA "recommends that the lognormal 95th percentiles of the data set should be values used for comparison purposes." The 95th Background Carcinogenic PAH Percentile Concentrations (µg/kg) for the Metropolitan Statistical Area (MSA) for benzo(a)anthracene, benzo(b)fluoranthene, BaP, dibenzo(a,h)anthracene, and ideno(1,2,3-c,d)pyrene were 1,800, 2,000, 2,100, 420, and 1600 µg/kg, respectively. All of the maximum PAH concentrations at Site 19 greater than COPC screening criteria were less than these background concentrations (1,700, 1,700, 1,200, 160, and 730 µg/kg, respectively) in surface soil. Based on this information and Illinois EPA determination of PAH background urban concentrations, it is possible that these PAHs could be attributed to background conditions and inclusion of these chemicals as COPCs may result in an overestimation of total risks for this site.

Illinois EPA has also published a Summary of Selected Background Conditions for Inorganics in Soil which contains information about background conditions for inorganic chemicals in surface soil in Illinois. According to Illinois EPA, background concentrations for the MSA for arsenic and manganese are 13 mg/kg and 636 mg/kg, respectively. The range of detected concentrations at Site 19 for arsenic and manganese were 5.2 to 32.2 mg/kg and 363 to 1,820 mg/kg, respectively, and the average of all detections were 11.7 mg/kg with a standard deviation of 6.5 mg/kg and 888.66 mg/kg with a standard deviation of 372 mg/kg, respectively. Taking into account the range and standard deviation, it is possible that the arsenic and manganese concentrations could be attributed to background conditions and the inclusion of these chemicals may result in an overestimation of total risks for this site.

6.7.2.4 COPC Screening Levels

The use of risk-based screening levels for soil and groundwater based on conservative residential land use scenarios corresponding to ILCRs of $1x10^{-6}$ and HIs of 0.1 should make certain that the significant contributors to risk from a site are evaluated. The elimination of chemicals that are present at concentrations that correspond to ILCRs less than $1x10^{-6}$ and HIs less than 0.1 should not affect the final conclusions of the RA because these chemicals are not expected to cause a potential health concern at the concentrations detected.

6.7.2.5 Absence of COPC Screening Levels

Because of the lack of toxicity criteria, risk-based screening levels are currently not available for several constituents detected at Site 19 (e.g., benzo(g,h,i)perylene, etc.). Therefore, screening levels available for surrogate chemicals were used as screening levels for these constituents. The use of these surrogates may increase the uncertainty in the RA. The direction of bias cannot be determined.

6.7.3 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment can arise because of the methods used to calculate EPCs, determination of land use conditions, selection of receptors and scenarios, and selection of exposure parameters. Each of these is discussed below.

6.7.3.1 Exposure Point Concentrations

Uncertainty is associated with the use of the 95-percent UCL on the mean concentration as the EPC, as was done in the evaluation of the soil data. As a result of using the 95-percent UCL, the estimations of potential risk are most likely to be overestimated because this is a representation of the upper limit to which potential receptors would be exposed over the entire exposure period. The maximum concentration is also used when the UCL is greater than the maximum concentration and in the groundwater data evaluation for the RME scenario. The use of the maximum concentration as the EPC tends to overestimate potential risks because receptors are assumed to be exposed continuously to the maximum concentration for the entire exposure period, which is unlikely. Uncertainty is also introduced when non-detected results are assigned a value of the quantification limit when calculating the EPC. This may either overestimate or underestimate the risks to potential receptors.

6.7.3.2 Land Use

Uncertainty and conservatism may be introduced into the RA when estimated risks are not based on current land use patterns. The risks calculated in this HHRA are based on current and projected future land use at Site 19. Based on the site's proximity to a public access, the site has been identified as having potential for exposure by trespassers. For this reason, trespassers (adolescent) were evaluated in the RA. Much of the uncertainty in this RA is related to groundwater usage (some elevated risks calculated for Site 19 are partly due to exposure to groundwater). The RA assumes that groundwater is used as a source of domestic drinking water. However, groundwater is not currently used for this purpose, and it is unlikely that groundwater at the site would be used as a source of potable water in the future.

6.7.3.3 Exposure Parameters

Each exposure factor selected for use in the RA contains some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, USEPA guidelines (e.g., USEPA, 1991b) for the RME receptor were used, if applicable, which generally specify the use of the 95th percentile for most parameters. Therefore, the selected exposure factors for the RME receptor represent the upper bound of the observed or expected practices that are characteristic of the majority of the population. Because USEPA does not provide values for exposure factors for some receptors/pathways, professional judgment was used to determine some values. When using professional judgment, an effort was made to be reasonably conservative. However, the use of professional judgment adds uncertainty to the RA.

Generally, uncertainty can be assessed for many assumptions made in determining factors for calculating exposures and intakes. Many of these parameters were determined from the statistical analyses of human population characteristics. Often, the database used to summarize a particular exposure parameter (i.e., body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty. For many parameters for which limited information exists (e.g., dermal absorption), greater uncertainty exists. For example, current USEPA guidance (USEPA, 2004b) does not provide dermal absorption factors for exposure to most metals (except arsenic and cadmium) and VOCs in soil. Therefore, risks for dermal contact with soil were not evaluated for metals other than arsenic and cadmium, or for VOCs. Consequently, risks from exposure to soil may be underestimated by omitting metals and VOCs from the dermal RA.

6.7.4 <u>Migration of Soil to Groundwater Pathway</u>

Maximum concentrations in surface soil and subsurface soil were compared to the USEPA SSLs assuming a DAF of 1 for the protection of groundwater. These results are summarized in Tables 6-15 and 6-16, for surface and subsurface soil, respectively.

Migration from Surface Soil to Groundwater

Maximum surface soil concentrations were compared to USEPA SSLs assuming a DAF of 1 (USEPA, 1996). The comparison shown in Table 6-15 indicates that some PAHs (benzo(a)anthracene, BaP, benzo(b)fluoranthene, chrysene, dibenzo(a,h)anthracene, ideno(1,2,3-cd)pyrene, and naphthalene) and metals (arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, and mercury) were

detected in surface soil at concentrations that exceeded USEPA Generic soil-to-groundwater SSLs. These exceedances of SSLs may indicate the potential for chemicals to leach to groundwater and impact water quality. However, most of the chemicals detected in surface soil at concentrations exceeding SSLs for migration from soil to groundwater were not detected in groundwater samples collected at the site. The SSLs used are very conservative because a DAF of 1 assumes that no dilution or attenuation occurs as a chemical migrates from soil to groundwater. It is also possible that the concentrations of PAHs and metals detected in surface soil may be due to naturally occurring background conditions.

Migration from Subsurface Soil to Groundwater

Maximum subsurface soil concentrations were compared to the USEPA SSLs assuming a DAF of 1 (USEPA, 1996). The comparison shown in Table 6-16 indicates that some PAHs (benzo(a)anthracene and BaP) and metals (arsenic, cobalt, iron, lead, manganese, and nickel) were detected in subsurface soil at concentrations that exceeded USEPA Generic soil-to-groundwater SSLs. These exceedances of SSLs may indicate the potential for chemicals to leach to groundwater and impact water quality. However, most of chemicals detected in subsurface soil at concentrations exceeding SSLs for migration from soil to groundwater were not detected in groundwater samples collected at the site. The SSLs used are very conservative because a DAF of 1 assumes that no dilution or attenuation occurs as a chemical migrates from soil to groundwater. It is also possible that the concentrations of PAHs and metals detected in subsurface soil may be due to naturally occurring background conditions.

Based on the above discussion and knowledge of site history, the potential exists for chemicals detected in surface and subsurface soil to adversely impact environmental media downgradient of Site 19, however, it is unlikely that the concentrations of constituents in surface and subsurface soil would adversely impact groundwater quality.

6.7.5 <u>Uncertainty in the Toxicological Evaluation</u>

Uncertainties associated with the toxicity assessment (determination of RfDs and CSFs and use of available criteria) are presented in this section.

6.7.5.1 Derivation of Toxicity Criteria

Uncertainty associated with the toxicity assessment is associated with hazard assessment and dose-response evaluations for the COPCs. The hazard assessment deals with characterizing the nature and strength of the evidence of causation or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated

as a weight-of-evidence determination using USEPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of non-cancer effects, however, positive animal data often suggest the nature of the effects (i.e., the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose related; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the COC is structurally similar to other chemicals for which the toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes determination of a CSF for the carcinogenic assessment and derivation of an RfD or RfC for the non-carcinogenic assessment. Uncertainty is introduced from interspecies (animal-to-human) extrapolation which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are very similar in age and genotype, so intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposures reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95-percent upper bound for the CSF. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on an non-threshold assumption of carcinogenesis. Evidence suggests, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are non-carcinogenic. Therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

For non-cancer effects, additional uncertainty factors may be applied in the derivation of the RfD or RfC to mitigate poor quality of the key study or gaps in the database. Additional uncertainty for non-cancer

effects arises from the use of an effect level in the estimation of an RfD or RfC because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimation of an RfD or RfC for chronic exposure from subchronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the subchronic study. Uncertainty in the derivation of RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty. This is particularly the case when chemical-specific gastrointestinal absorption rates are not available in the literature or when only qualitative statements regarding absorption are available.

6.7.5.2 Uncertainty Associated with Evaluation of the Dermal Exposure Pathway

According to RAGS Part E (USEPA, 2004b), risks from dermal absorption from soil are to be quantitatively evaluated for arsenic, cadmium, chlordane, 2, 4-dichlorophenoxyacetic acid, DDT, TCDD (and other dioxins), PAHs, PCBs, pentachlorophenol, and SVOCs because of the limited guidance available to estimate dermal absorption factors for other constituents. Therefore, the dermal route of exposure was evaluated quantitatively for these chemicals only. Risks for dermal exposure to metals (other than arsenic and cadmium) and VOCs identified as COPCs for soil were not quantified in the RA; consequently, potential risks may be underestimated by excluding these constituents from the dermal RA calculations.

Aqueous risks were calculated using a USEPA model presented in RAGS Part E (USEPA, 2004b), which, according to the guidance, tends to overestimate intakes and risks for dermal contact for some chemicals (e.g., PAHs, PCBs). Because of the large uncertainties associated dermal contact with water, risks from dermal absorption of PAHs from groundwater were not evaluated in this HHRA. This may underestimate the risk estimates for groundwater. Appendices A and B of RAGS Part E discuss the uncertainties in the permeability coefficients for these chemicals and limitations of the dermal absorption model when evaluating chemicals.

6.7.5.3 Uncertainty Associated with Evaluation of Arsenic

In addition, health RAs do not take into account the unique aspects of evaluating exposures to arsenic in soil. For example, risks from ingestion of arsenic in soil are often based on toxicity factors derived from studies of arsenic (soluble arsenate or arsenite) in drinking water. However, the toxicity of arsenic in

drinking water cannot be directly extrapolated to toxicity of arsenic in soil because of differences in chemical form, bioavailability, and excretion kinetics. Because of the differences between soil arsenic and water arsenic, risks from arsenic in soil are lower than what would be calculated using default toxicity values for arsenic in drinking water (Valberg, 1997).

6.7.6 Uncertainty in the Risk Characterization

Uncertainty in risk characterization results primarily from assumptions made regarding additivity of effects from exposure to multiple COPCs from various exposure routes. High uncertainty exists when summing cancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity is made to provide a conservative estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Therefore, the uncertainty regarding antagonistic or synergistic effects is ambiguous because potential human health risks may either be underestimated or overestimated.

6.8 SUMMARY OF HUMAN HEALTH RISK ASSESSMENT

This section and Tables 6-13 and 6-14 present a summary of the RA findings for Site 19. Five potential receptor groups were evaluated: maintenance workers, occupational workers, adolescent trespassers, adult and child residents, and construction workers.

6.8.1 Non-Carcinogenic Risks

Pathway-specific RME and CTE HIs were less than or equal to 1.0 for trespassers, maintenance workers, occupational workers, and future adult residents in the study area. For this reason, adverse non-carcinogenic health effects are not anticipated for these receptors at Site 19.

RME HIs are greater than 1.0 for future child residents and future construction workers in the study area. However, the CTE HIs are less than or equal to 1.0 for these receptors.

For future child residents, ingestion of soil and groundwater is the primary pathway of concern in the RME scenario. Further examination of these results reveals that the organ-specific HIs for skin and CVS and individual HQs for arsenic were the risk drivers.

For future construction workers, inhalation of manganese on particulates/dusts from surface and subsurface soil accounted for most of the non-carcinogenic risk.

The exceedances of 1.0 by organ-specific HIs and individual contaminants indicate that adverse non-carcinogenic health effects are possible under the conditions established in the exposure assessment for future child residents.

6.8.2 Carcinogenic Risks

RME and CTE cancer risk estimates for construction workers, maintenance workers, occupational workers, trespassers, future child residents, and future adults residents and the CTE cancer risk estimate for total future residential risk (child + adult) for Site 19 do not exceed the target USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$). However, RME and CTE cancer risk estimates for maintenance workers, occupational workers, future child residents, and future adults residents and the CTE cancer risk estimate for total future residents (child + adult) exceed the Illinois EPA risk goal ($1x10^{-6}$).

The total (soil + groundwater) site RME cancer risk estimates for total future residents (adult + child), exceed the USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$) and Illinois EPA risk goal ($1x10^{-6}$). The major contributors to cancer risk at Site 19 are arsenic and PAHs (benzo(a)anthracene, BaP, benzo(b)fluoranthene, chrysene, and dibenzo(a,h)anthracene).

6.8.3 Human Health Risk Assessment Contaminants of Concern

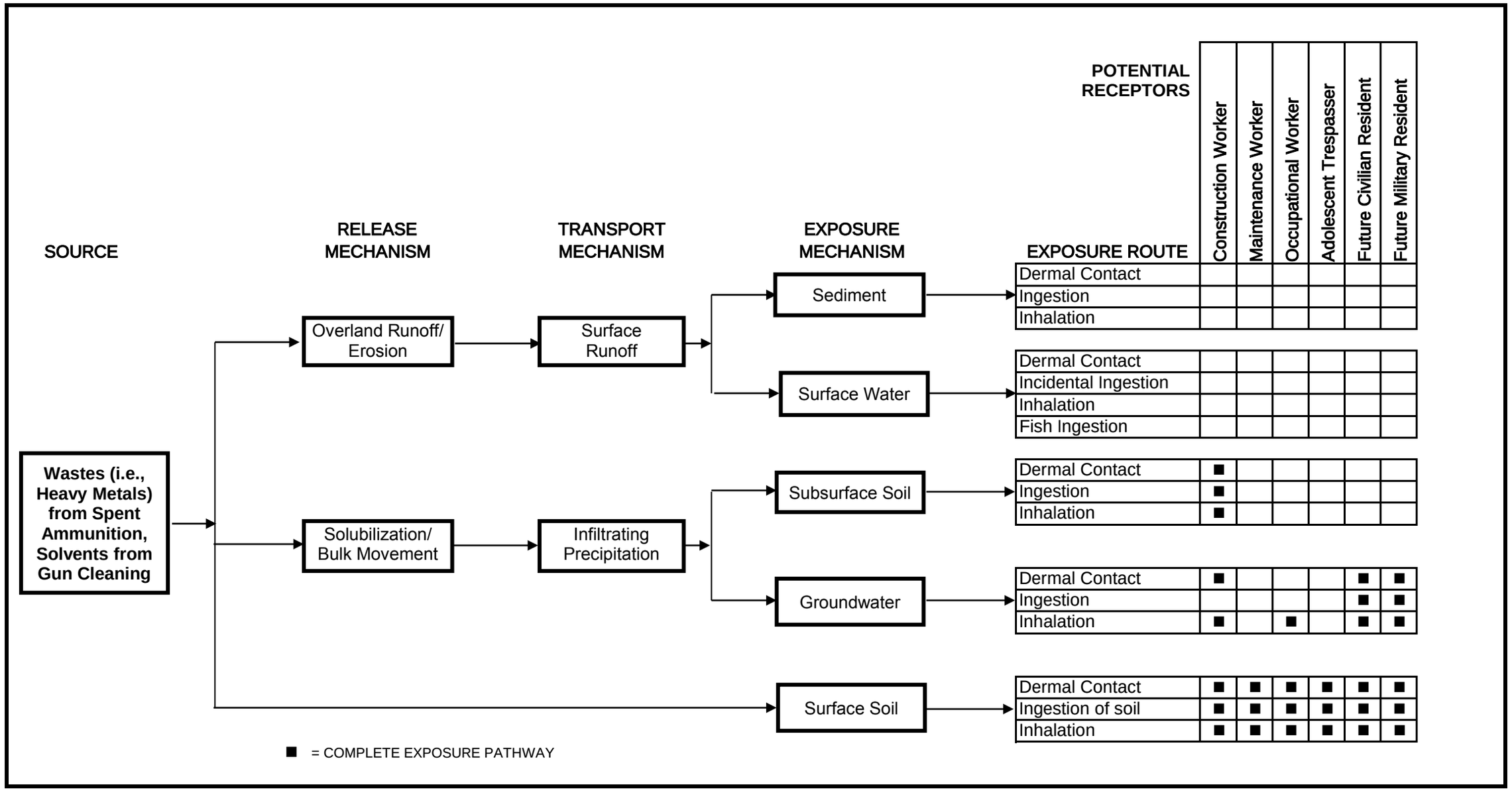
Based on the non-cancer and cancer evaluations, the following contaminants with non-cancer HQs greater than 1.0 or with cancer risks greater than $1x10^{-6}$ in a scenario with total cancer risks greater than $1x10^{-4}$ were identified as COCs: arsenic and PAHs (benzo(a)anthracene, BaP, benzo(b)fluoranthene, chrysene, and dibenzo(a,h)anthracene) in groundwater potentially used as drinking water; arsenic and carcinogenic PAHs for residential exposure to surface soil; and inhalation of manganese in surface and subsurface soil by construction workers.

No chemicals in soil and groundwater were eliminated as COPCs on the basis of comparisons to background concentrations. However, it is important to remember that most PAHs selected as COPCs in exposed surface soil were detected at maximum concentrations that did not exceed surface soil background data. Based on this information and Illinois EPA determination of PAH background urban concentrations, it is possible that these PAHs could be attributed to background conditions and inclusion of

these chemicals as COPCs may result in an overestimation of total risks for this site. In addition, based on the Illinois EPA Summary of Selected Background Conditions for Inorganics in Soil study, it is possible that the arsenic and manganese concentrations could also be attributed to background conditions and the inclusion of these chemicals may result in an overestimation of total risks for this site.

FIGURE 6-1

HUMAN HEALTH CONCEPTUAL SITE MODEL
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS



Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

TABLE 6-1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL - DIRECT CONTACT AND INHALATION
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Result[1]		Maximum Result[1,2]		Units	Location of Maximum Detect	Sample of Maximum Detect	Range of Non Detects	Background Concentration[4]	ORNL Residential Soil Criteria[5]	USEPA SSLs for Migration from Soil to Air - Residential[3a]	USEPA Industrial SSLs for Inhalation[3b]	SSLs for Inhalation Construction Worker Scenario[6]	TACO - Residential Soil Ingestion[8]	TACO - Residential Soil Inhalation[8]	TACO - Industrial - Commercial Inhalation[8]	TACO - Construction Worker Soil Inhalation[8]	NON-TACO - Residential Soil Ingestion[9]	NON-TACO - Residential Soil Inhalation[9]	NON-TACO - Industrial/ Commercial/Soil Inhalation[9]	NON-TACO - Construction Worker Soil Inhalation[9]	COPC Flag[7]	Rationale for Contaminant Deletion or Selection
Volatile Organics (ug/kg)																								
2-BUTANONE	2/12	1.6		2.5		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.2 - 1.8	NA	2800000	NA	NA	1800000000	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
ACETONE	6/12	4.3	J	29		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 2.5	NA	6100000	NA	NA	11000000000	7000000	100000000	100000000	100000000	NA	NA	NA	NA	No	BSL
Polynuclear Aromatic Hydrocarbons (ug/kg)																								
2-METHYLNAPHTHALENE	6/12	2		53		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 2.1	140	31000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
ACENAPHTHENE	7/12	1.6		240		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.4 - 1.5	**130**	340000	NA	NA	NA	470000	NA	NA	NA	NA	NA	NA	NA	No	BSL
ACENAPHTHYLENE[12]	7/12	1.4		74		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.3 - 1.4	**70**	340000	NA	NA	NA	NA	NA	NA	NA	230000	NA	NA	NA	No	BSL
ANTHRACENE	8/12	2.1		590		UG/KG	NTC19SB11	NTC19SB11-SO-0002	0.9 - 0.97	**400**	1700000	NA	NA	NA	2300000	NA	NA	NA	NA	NA	NA	NA	No	BSL
BAP EQUIVALENTS	11/12	1.6641		1758.8		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.2 - 1.2	NA	**15**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
BENZO(A)ANTHRACENE	10/12	2.3		1700		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.6 - 1.7	1800	**150**	NA	NA	2300000	**900**	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
BENZO(A)PYRENE	10/12	4.2		1200		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.1 - 1.2	2100	**15**	NA	NA	230000	**90**	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
BENZO(B)FLUORANTHENE	9/12	6.7		1700		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.7 - 1.9	2100	**150**	NA	NA	2300000	**900**	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
BENZO(G,H,I)PERYLENE[13]	10/12	3.4		940		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.7 - 1.8	1700	170000	NA	NA	NA	230000	NA	NA	NA	230000	NA	NA	NA	No	BSL
BENZO(K)FLUORANTHENE	9/12	2.7		460		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.4 - 1.5	1700	1500	NA	NA	2300000	9000	NA	NA	NA	NA	NA	NA	NA	No	BSL
CHRYSENE	11/12	2.4		1900		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.3 - 1.3	2700	15000	NA	NA	23000000	88000	NA	NA	NA	NA	NA	NA	NA	No	BSL
DIBENZO(A,H)ANTHRACENE	5/12	4.8	J	160		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.7 - 1.9	420	**15**	NA	NA	210000	**90**	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
FLUORANTHENE	10/12	2.2		5100		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 2	**4100**	230000	NA	NA	NA	310000	NA	NA	NA	NA	NA	NA	NA	No	BSL
FLUORENE	7/12	1.8		250		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.4 - 1.5	**180**	230000	NA	NA	NA	310000	NA	NA	NA	NA	NA	NA	NA	No	BSL
INDENO(1,2,3-CD)PYRENE	9/12	4.4		730		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.7 - 1.9	1600	**150**	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
NAPHTHALENE	3/12	4.9		62		UG/KG	NTC19SB11	NTC19SB11-SO-0002	2.6 - 28	200	3600	17000	24000	7300000	160000	17000	27000	1800	NA	NA	NA	NA	No	BSL
PHENANTHRENE[13]	10/12	4.2		3200		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 2	**2500**	170000	NA	NA	NA	230000	NA	NA	NA	230000	NA	NA	NA	No	BSL
PYRENE	11/12	2.4		3500		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 1.9	**3000**	170000	NA	NA	NA	230000	NA	NA	NA	NA	NA	NA	NA	No	BSL
Inorganics (mg/kg)																								
ALUMINUM	16/16	6640		19300		MG/KG	NTC19SB06	NTC19SB06-SO-0001	---	**9500**	**7700**	NA	NA	1800	NA	NA	NA	NA	7800	100000	100000	87000	Yes	ASL
ANTIMONY	1/13	1.2		1.2		MG/KG	NTC19SB17	NTC19SB17-SO-0002	---	4	3.1	NA	NA	NA	3.1	NA	NA	NA	NA	NA	NA	NA	No	BSL
ARSENIC	16/16	5.2		32.2		MG/KG	NTC19SB10	NTC19SB10-SO-0002	---	**13**	**0.39**	770	1400	**5.3**	13	750	1200	25000	NA	NA	NA	NA	Yes	ASL
BARIUM	16/16	31.5		188		MG/KG	NTC19SB06	NTC19SB06-SO-0001	---	**110**	1500	71000	100000	**180**	550	69000	91000	87000	NA	NA	NA	NA	Yes[16]	ASL
BERYLLIUM	16/16	0.49		2		MG/KG	NTC19SB11	NTC19SB11-SO-0002	---	**0.59**	16	1400	2600	7.1	16	1300	2100	44000	NA	NA	NA	NA	No	BSL
CADMIUM	14/16	0.25		0.92	J	MG/KG	NTC19SB06	NTC19SB06-SO-0001	0.22 - 0.24	**0.6**	7	1800	3400	3.6	7.8	1800	2800	59000	NA	NA	NA	NA	No	BSL
CALCIUM	16/16	5210	J	111000	J	MG/KG	NTC19SB07	NTC19SB07-SO-0001	---	**9300**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
CHROMIUM	16/16	13	J	32.6	J	MG/KG	NTC19SB17	NTC19SB17-SO-0002-D	---	**16.2**	**0.29**	280	510	**3**	**23**	270	420	69	NA	NA	NA	NA	Yes	ASL
COBALT	16/16	5		13.3		MG/KG	NTC19SB10	NTC19SB10-SO-0002	---	**8.9**	**2.3**	NA	NA	**2.1**	470	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
COPPER	16/16	17.5		53.6		MG/KG	NTC19SB17	NTC19SB17-SO-0002	---	**19.6**	310	NA	NA	NA	290	NA	NA	NA	NA	NA	NA	NA	No	BSL
IRON	16/16	14600		36800		MG/KG	NTC19SB10	NTC19SB10-SO-0002	---	**15900**	**5500**	NA	NA	NA	NA	NA	NA	NA	5500	NA	NA	NA	Yes	ASL
LEAD	16/16	9.5	J	480	J	MG/KG	NTC19SB03	NTC19SB03-SO-0001	---	**36**	**400**	NA	NA	NA	**400**	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
MAGNESIUM	16/16	5270	J	62100		MG/KG	NTC19SB07	NTC19SB07-SO-0001	---	**4820**	NA	NA	NA	NA	325000	NA	NA	NA	NA	NA	NA	NA	No	BSL
MANGANESE	16/16	336		1820	J	MG/KG	NTC19SB16	NTC19SB16-SO-0103	---	**636**	**180**	NA	NA	**18**	**160**	6900	9100	870	NA	NA	NA	NA	Yes	ASL
MERCURY	15/16	0.018		0.47		MG/KG	NTC19SB06	NTC19SB06-SO-0001	0.015 - 0.015	**0.06**	0.56	1	1.4	10.7	2.3	1	1.6	NA[15]	NA	NA	NA	NA	No	ASL
NICKEL[14]	16/16	14		47.9	J	MG/KG	NTC19SB17	NTC19SB17-SO-0002-D	---	**18**	150	14000	26000	**32**	160	13000	21000	440000	NA	NA	NA	NA	Yes[16]	BSL
POTASSIUM	16/16	1030		2720		MG/KG	NTC19SB11	NTC19SB11-SO-0002	---	**1268**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
SILVER	3/16	0.44		1		MG/KG	NTC19SB06	NTC19SB06-SO-0001	0.22 - 0.25	**0.55**	39	NA	NA	NA	39	NA	NA	NA	NA	NA	NA	NA	No	BSL
SODIUM	4/16	239		565		MG/KG	NTC19SB11	NTC19SB11-SO-0002	220 - 256	**130**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
VANADIUM	16/16	16.4		37.1		MG/KG	NTC19SB06	NTC19SB06-SO-0001	---	**25.2**	39	NA	NA	NA	55	NA	NA	NA	NA	NA	NA	NA	No	BSL
ZINC	16/16	40		250	J	MG/KG	NTC19SB06	NTC19SB06-SO-0001	---	**95**	2300	NA	NA	NA	2300	NA	NA	NA	NA	NA	NA	NA	No	BSL

Associated Samples:
NTC19SB01-SO-0002
NTC19SB03-SO-0001
NTC19SB03-SO-0103
NTC19SB06-SO-0001
NTC19SB11-SO-0002
NTC19SB12-SO-0002
NTC19SB13-SO-0103
NTC19SB15-SO-0103
NTC19SB07-SO-0001
NTC19SB08-SO-0103
NTC19SB09-SO-0002
NTC19SB10-SO-0002
NTC19SB16-SO-0103
NTC19SB16-SO-0103-AVG
NTC19SB16-SO-0103-D
NTC19SB17-SO-0002
NTC19SB17-SO-0002-AVG
NTC19SB17-SO-0002-D
NTC19SB19-SO-0002
NTC19SB20-SO-0002

Footnotes:
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - The maximum detected concentration is used for screening purposes
3a - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites; USEPA, OSWER 9355.4-24, December 2002. Appendix A Exhibit A-1
3b - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites; USEPA, OSWER 9355.4-24, December 2002. Appendix A Exhibit A-2
4 - Background data used - Illinois EPA background concentration (Illinois EPA, Appendix A, Table G of TACO)
5 - USEPA ORNL Screening Level. The noncarcinogenic values (denoted with a "N" flag) are the ORNL value divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag) (USEPA Region IX, October 2004, Updated December 28, 2004).
6 - Soil Screening Levels for Migration from Soil to Air for Construction Worker Scenario were calculated by Tetra Tech, NUS using methodology and equations presented in the Supplemental Guidance For Developing Soil Screening Levels for Superfund Sites, OSWER 93355.4-24, December 2002.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - Section 742 Table A, Tier 1, Soil Remediation Objectives - Residential/Industrial/Commercial (Ingestion or Inhalation)(Online, 2009)
9 - Soil Remediation Objectives for Residential/Industrial/Commercial roperties, Non-TACO Chemicals (2009)
10 - Ten percent of the noncarcinogenic value is less than the carcinogenic value, therefore the noncarcinogenic value is presented.
11 - Values are for hexavalent chromium.
12 - Acenaphthene is used as a surrogate for acenaphthylene
13 - Pyrene is used as a surrogate for benzo(ghi)perylene and phenanthrene
14 - Nickle criteria based on nickle soluble salts
15 - TACO table footnote indicates that elemental Hg " Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern." Site 19 is a former gun range and elemental mercury is not a contaminant of concern at this site.
16 - COPC flag for construction worker inhalation scenario only
BAP equivalent criteria based on BaP
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

TABLE 6-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SUBSURFACE SOIL - DIRECT CONTACT AND INHALATION
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

CAS #	Parameter	Frequency of Detection	Minimum Result[1]	Maximum Result[1,2]	ORNL Residential Soil Criteria [5]		USEPA SSLs for Migration from Soil to Air - Residential[6a]	USEPA Industrial SSLs for Inhalation[6b]	SSLs for Inhalation Construction Worker Scenario[7]	TACO - Residential Soil Ingestion[8]	TACO - Residential Soil Inhalation[8]	TACO - Industrial - Commercial Inhalation [9]	TACO - Construction Worker Soil Inhalation[9]	Non-TACO - Residential Soil Ingestion[10]	Non-TACO - Residential Soil Inhalation[10]	Non-TACO - Industrial/Commercial/Soil Inhalation [11]	Non-TACO - Construction Worker Soil Inhalation[11]	COPC Flag	Rationale for Contaminant Deletion or Selection [12]
	Volatile Organics (µg/kg)																		
108-10-1	4-METHYL-2-PENTANONE (Methy	1/22	0.65	0.65	530000	N	NA	NA	1100000000	NA	NA	NA	NA	NA	310000	310000	34000	No	BSL
67-64-1	ACETONE	12/22	2.3 J	12	6100000	N	NA	NA	11000000000	7000000	100000000	100000000	100000000	NA	NA	NA	NA	No	BSL
75-69-4	TRICHLOROFLUOROMETHANE	1/22	3.9	3.9	79000	N	NA	NA	250000000	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
	Polynuclear Aromatic Hydrocarbons (µg/kg)																		
91-57-6	2-METHYLNAPHTHALENE	4/22	2.2	6.5	31000	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
208-96-8	ACENAPHTHYLENE[13]	1/22	1.7	1.7	340000	N	NA	NA	NA	NA	NA	NA	NA	230000	NA	NA	NA	No	BSL
120-12-7	ANTHRACENE	1/22	4.2	4.2	1700000	N	NA	NA	NA	2300000	NA	NA	NA	NA	NA	NA	NA	No	BSL
CALC055	**BAP EQUIVALENTS**	8/22	1.6637	26.7	**15**	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**Yes**	ASL
56-55-3	BENZO(A)ANTHRACENE	3/22	15	20	150	C	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	No	BSL
50-32-8	**BENZO(A)PYRENE**	6/22	7.1	22	**15**	C	NA	NA	230000	90	NA	NA	NA	NA	NA	NA	NA	**Yes**	ASL
205-99-2	BENZO(B)FLUORANTHENE	3/22	15	18	150	C	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	No	BSL
191-24-2	BENZO(G,H,I)PERYLENE	19/	2.2	11	170000	N	NA	NA	NA	230000	NA	NA	NA	230000	NA	NA	NA	No	
207-08-9	BENZO(K)FLUORANTHENE	3/22	4.5	8.3	1500	C	NA	NA	2300000	9000	NA	NA	NA	NA	NA	NA	NA	No	BSL
218-01-9	CHRYSENE	6/22	2.4	18	15000	C	NA	NA	23000000	880000	NA	NA	NA	NA	NA	NA	NA	No	BSL
206-44-0	FLUORANTHENE	5/22	3	28	230000	N	NA	NA	NA	310000	NA	NA	NA	NA	NA	NA	NA	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	3/22	6.5	7.4	150	C	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	No	BSL
85-01-8	PHENANTHRENE[14]	/	2.4	17	170000	N	NA	NA	NA	230000	NA	NA	NA	230000	NA	NA	NA	No	
129-00-0	PYRENE	12/22	2	27	170000	N	NA	NA	NA	230000	NA	NA	NA	NA	NA	NA	NA	No	BSL
	Inorganics (mg/kg)																		
7429-90-5	**ALUMINUM**	22/22	4500	14700	**7700**	N	NA	NA	**1800**	NA	NA	NA	NA	7800	100000	100000	87000	**Yes**	ASL
7440-38-2	**ARSENIC**	22/22	4	25.1	**0.39**	C	770	1440	**5.3**	**13**	750	1200	25000	NA	NA	NA	NA	**Yes**	ASL
7440-39-3	BARIUM	22/22	10.9	81.9	1500	N	71000	100000	180	550	69000	91000	87000	NA	NA	NA	NA	No	BSL
7440-41-7	BERYLLIUM	22/22	0.36	0.94	16	N	1400	2600	7.1	16	1300	2100	44000	NA	NA	NA	NA	No	BSL
7440-43-9	CADMIUM	13/22	0.23 J	0.43 J	7	N	1800	3400	3.6	7.8	1800	2800	59000	NA	NA	NA	NA	No	BSL
7440-70-2	CALCIUM	22/22	2850 J	119000 J	NA	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
7440-47-3	**CHROMIUM**	22/22	9	25.8	**0.29**	N	280	510	**3**	**23**	270	420	69	NA	NA	NA	NA	**Yes**	ASL
7440-48-4	**COBALT**	22/22	5.2	22.1	**2.3**	N	NA	NA	**2.1**	470	NA	NA	NA	NA	NA	NA	NA	**Yes**	ASL
7440-50-8	COPPER	22/22	15.4	34.2	310	N	NA	NA	NA	290	NA	NA	NA	NA	NA	NA	NA	No	BSL
7439-89-6	**IRON**	22/22	12200	34900	**5500**	N	NA	NA	NA	NA	NA	NA	NA	5500	NA	NA	NA	**Yes**	ASL
7439-92-1	LEAD	22/22	8.1	54.8 J	400	N	NA	NA	NA	400	NA	NA	NA	NA	NA	NA	NA	No	BSL
7439-95-4	MAGNESIUM	22/22	6440 J	56300	NA	N	NA	NA	NA	325000	NA	NA	NA	NA	NA	NA	NA	No	BSL
7439-96-5	**MANGANESE**	22/22	421	1600	**180**	N	NA	NA	**18**	**160**	6900	9100	870	NA	NA	NA	NA	**Yes**	ASL
7439-97-6	MERCURY	13/22	0.013	0.049	0.56	N	1	1.4	10.7	2.3	1	1.6	NA[16]	NA	NA	NA	NA	No	BSL
7440-02-0	**NICKEL[15]**	22/22	14.9	48.8	150	N	14000	26000	**32**	160	13000	21000	440000	NA	NA	NA	NA	**Yes[17]**	BSL
7440-09-7	POTASSIUM	22/22	1210	2950 J	NA	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
7440-23-5	SODIUM	2/22	241	249	NA	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
7440-62-2	VANADIUM	22/22	12.7	29.8	39	N	NA	NA	NA	55	NA	NA	NA	NA	NA	NA	NA	No	BSL
7440-66-6	ZINC	22/22	37.5	140 J	2300	N	NA	NA	NA	2300	NA	NA	NA	NA	NA	NA	NA	No	BSL

Associated Samples:

NTC19SB12-SO-0507	NTC19SB01-SO-0608
NTC19SB14-SO-0204	NTC19SB02-SO-0204
NTC19SB14-SO-0507	NTC19SB03-SO-0810
NTC19SB15-SO-0406	NTC19SB04-SO-0204
NTC19SB18-SO-0204	NTC19SB05-SO-0406
NTC19SB18-SO-0406	NTC19SB05-SO-0608
NTC19SB19-SO-0406	NTC19SB06-SO-0204
NTC19SB20-SO-0406	NTC19SB06-SO-0608
NTC19SB15-SO-0406-D	NTC19SB07-SO-0507
NTC19SB16-SO-0507	NTC19SB08-SO-0406
NTC19SB17-SO-0406	NTC19SB09-SO-0406
	NTC19SB10-SO-0507

Footnotes:

1 - Sample and duplicate are counted as two separate samples when determining minimum and maximum detected concentrations.
2 - The maximum detected concentration is used for screening purposes.
3 - Values presented are sample-specific quantitation limits.
4 - If the maximum concentration of a chemical is less than the Illinois EPA background concentration (illinois EPA, Appendix A, Table G of TACO), that chemical is not selected as a COPC.
5 - USEPA ORNL Screening Level. The non-carcinogenic values (denoted with a "N" flag) are the PRG divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag) (USEPA, 2008).
6a - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites; USEPA, OSWER 9355.4-24, December 2002. Appendix A – Exhibit A-1
6b - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites; USEPA, OSWER 9355.4-24, December 2002. Appendix A – Exhibit A-2
7 - Soil Screening Levels for Migration from Soil to Air for Construction Worker Scenario were calculated by Tetra Tech, NUS using methodology and equations presented in the Supplemental Guida
8 - Section 742 Table A, Tier 1 Soil Remediation Objectives for Residential Properties (Ingestion, Inhalation, or Soil Component of Groundwater Ingestion Route)(online , 2009).
9 - Section 742 Table B, Tier 1 Soil Remediation Objectives for Industrial/Commercial Properties (Ingestion or Inhalation) (online , 2009).
10 - Soil Remediation Objectives for Residential Properties, Non-TACO Chemicals (2007).
11 - Soil Remediation Objectives for Indusrial/Commercial Properties, Non-TACO Chemicals (2007).
12 -The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and background levels for metals.
13 - Acenaphthene is used as a surrogate for acenaphthylene.
14 - Pyrene is used as a surrogate for benzo(ghi)perylene and phenanthrene.
15 - Nickle criteria are based on nickle soluble salts
16 - TACO table footnote indicates that elemental Hg " Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern." Site 19 is a former gun range and elemental mercury is not a contaminant of concern at this site.
17 - COPC flag for construction worker inhalation scenario only
BAP equivalent criteria based on BaP
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level

For Elimination as a COPC:
BSL = Below COPC screening level
NUT = Essential nutrient

TABLE 6-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

CAS #	Parameter	Frequency of Detection	Minimum Result(1)	Maximum Result(1,2)	Units	Location of Maximum Concentration	Sample with Maximum Concentration	Range of Non-detects (3)	USEPA ORNL Residential Tap Water Criteria (4)		USEPA MCL (5)	TACO - Class I Groundwater Criteria (6)	Non-TACO - Class I Groundwater Criteria (7)	Concentration Used for Vapor Intrusion Screening (8)	COPC Flag	Rationale for Contaminant Deletion or Selection (9)
	Volatile Organics (µg/L)															
67-64-1	ACETONE	1/2	8.5	8.5	UG/L	NTC19MW02	NTC19MW021208	1.8 - 1.8	2200	N	NA	6300	NA	220000	No	BSL
108-88-3	TOLUENE	1/2	0.22	0.22	UG/L	NTC19MW02	NTC19MW021208	0.14 - 0.14	230	N	1000	1000	NA	1500	No	BSL
	Polynuclear Aromatic Hydrocarbons (µg/L)															
91-57-6	2-METHYLNAPHTHALENE	2/2	0.0093	0.017	UG/L	NTC19MW02	NTC19MW021208	---	15	N	NA	NA	28	NA	No	BSL
83-32-9	ACENAPHTHENE	1/2	0.02	0.02	UG/L	NTC19MW02	NTC19MW021208	0.0057 - 0.0058	220	N	NA	420	NA	NA	No	BSL
208-96-8	ACENAPHTHYLENE (10)	1/2	0.016	0.016	UG/L	NTC19MW02	NTC19MW021208	0.0047 - 0.0048	220	N	NA	NA	210	NA	No	BSL
120-12-7	ANTHRACENE	1/2	0.026	0.026	UG/L	NTC19MW02	NTC19MW021208	0.0094 - 0.0096	1100	N	NA	2100	NA	NA	No	BSL
CALC055	BAP EQUIVALENTS	1/2	0.037795	0.037795	UG/L	NTC19MW02	NTC19MW021208	0.0057 - 0.0058	0.0029	C	0.2	0.2	NA	NA	Yes	**ASL**
56-55-3	BENZO(A)ANTHRACENE	1/2	0.036 J	0.036 J	UG/L	NTC19MW02	NTC19MW021208	0.012 - 0.012	0.029	C	NA	0.13	NA	NA	Yes	**ASL**
50-32-8	BENZO(A)PYRENE	1/2	0.018	0.018	UG/L	NTC19MW02	NTC19MW021208	0.0057 - 0.0058	0.0029	C	0.2	0.2	NA	NA	Yes	**ASL**
205-99-2	BENZO(B)FLUORANTHENE	1/2	0.019	0.019	UG/L	NTC19MW02	NTC19MW021208	0.011 - 0.012	0.029	C	NA	0.18	NA	NA	No	BSL
191-24-2	BENZO(G,H,I)PERYLENE	1/2	0.013	0.013	UG/L	NTC19MW02	NTC19MW021208	0.0066 - 0.0067	110	N	NA	NA	210	NA	No	BSL
207-08-9	BENZO(K)FLUORANTHENE (11)	1/2	0.016	0.016	UG/L	NTC19MW02	NTC19MW021208	0.0085 - 0.0086	0.29	C	NA	0.17	NA	NA	No	BSL
218-01-9	CHRYSENE	1/2	0.035	0.035	UG/L	NTC19MW02	NTC19MW021208	0.01 - 0.01	2.9	C	NA	1.5	NA	NA	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	1/2	0.013	0.013	UG/L	NTC19MW02	NTC19MW021208	0.0047 - 0.0048	0.0029	C	NA	0.3	NA	NA	Yes	**ASL**
206-44-0	FLUORANTHENE	1/2	0.03	0.03	UG/L	NTC19MW02	NTC19MW021208	0.012 - 0.012	150	N	NA	280	NA	NA	No	BSL
86-73-7	FLUORENE	1/2	0.028	0.028	UG/L	NTC19MW02	NTC19MW021208	0.0066 - 0.0067	150	N	NA	280	NA	NA	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	1/2	0.011	0.011	UG/L	NTC19MW02	NTC19MW021208	0.0038 - 0.0038	0.029	C	NA	0.43	NA	NA	No	BSL
85-01-8	PHENANTHRENE (11)	2/2	0.0091	0.038	UG/L	NTC19MW02	NTC19MW021208	---	110	N	NA	NA	210	NA	No	BSL
129-00-0	PYRENE	1/2	0.03	0.03	UG/L	NTC19MW02	NTC19MW021208	0.012 - 0.012	110	N	NA	210	NA	NA	No	BSL
	Inorganics (µg/L)															
7429-90-5	ALUMINUM	2/2	134	272	UG/L	NTC19MW02	NTC19MW021208	---	3700	N	NA	NA	3500	NA	No	BSL
7440-38-2	ARSENIC	1/2	3.3	3.3	UG/L	NTC19MW01	NTC19MW011208-D	3 - 3	0.045	C	10	50	NA	NA	Yes	**ASL**
7440-39-3	BARIUM	2/2	51.8	167	UG/L	NTC19MW02	NTC19MW021208	---	730	N	2000	2000	NA	NA	No	BSL
7440-70-2	CALCIUM	2/2	88100 J	116000 J	UG/L	NTC19MW01	NTC19MW011208-D	---	NA		NA	NA	NA	NA	No	BSL
7439-89-6	IRON	2/2	182	489	UG/L	NTC19MW02	NTC19MW021208	---	2600	N	NA	NA	5000	NA	No	BSL
7439-95-4	MAGNESIUM	2/2	46200	48900	UG/L	NTC19MW01	NTC19MW011208-D	---	NA		NA	NA	NA	NA	No	BSL
7439-96-5	MANGANESE	2/2	35.8	39.6	UG/L	NTC19MW02	NTC19MW021208	---	88	N	NA	150	NA	NA	No	BSL
7440-09-7	POTASSIUM	2/2	7860	9120	UG/L	NTC19MW01	NTC19MW011208-D	---	NA		NA	NA	NA	NA	No	BSL
7440-23-5	SODIUM	2/2	36900	70300	UG/L	NTC19MW01	NTC19MW011208-D	---	NA		NA	NA	NA	NA	No	BSL
7440-66-6	ZINC	1/2	9.4	9.4	UG/L	NTC19MW02	NTC19MW021208	5 - 5	1100	N	NA	5000	NA	NA	No	BSL

Footnotes:
1 - Sample and duplicate are counted as two separate samples when determining minimum and maximum detected concentrations.
2 - The maximum detected concentration is used for screening purposes.
3 - Values presented are sample-specific quantitation limits.
4 - USEPA ORNL Tap Water Screening Level. The non-carcinogenic values (denoted with a "N" flag) are the PRG divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag) (USEPA, 2008).
5 - Federal Maximum Contaminant Level (USEPA, 2006).
6 - Illinois EPA Remediation Objectives for Class 1 Groundwater (online 2009).
7 - Groundwater Remediation Objectives for Chemicals Not Listed in TACO (Illinois EPA, May 1, 2007).
8 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (USEPA, 2002).
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or hazard index =1 and an attenuation factor of 0.001.
9 -The chemical is selected as a COPC if the maximum detected concentration exceeds the drinking water or vapor intrusion screening level.
10 - Acenaphthene is used as a surrogate for acenaphthylene.
11 - Pyrene is used as a surrogate for benzo(ghi)perylene and phenanthrene.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not available.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level

For Elimination as a COPC:
BSL = Below COPC screening level
NUT = Essential nutrient

Associated Samples:
NTC19MW011208
NTC19MW011208-D
NTC19MW021208

TABLE 6-4

CHEMICALS RETAINED AS COPCs
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical	Surface Soil		Subsurface Soil		Groundwater
	Direct Contact	Soil to Air*	Direct Contact	Soil to Air*	Direct Contact
PAHs/Semivolatile Organic Compounds					
BENZO(A)ANTHRACENE	X				X
BENZO(A)PYRENE	X		X		X
BENZO(B)FLUORANTHENE	X				
DIBENZO(A,H)ANTHRACENE	X				X
INDENO(1,2,3-CD)PYRENE	X				
Inorganics					
ALUMINUM	X		X	X	
ARSENIC	X	X	X	X	X
BARIUM		X			
CHROMIUM	X	X	X	X	
COBALT	X	X	X	X	
IRON	X		X		
LEAD	X				
MANGANESE	X	X	X	X	
NICKEL		X		X	

Notes:

X - Indicates chemical was retained as a COPC.

*Construction worker scenario (discussed in detail in Sections 6.3.2 and 6.3.3)

TABLE 6-5

HUMAN HEALTH RISK ASSESSMENT
EXPOSURE ROUTES FOR QUANTITATIVE EVALUATION
SITE 19 – SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Exposure Routes
Maintenance Workers (current and future land use)	• Surface Soil - Dermal Contact • Surface Soil - Incidental Ingestion • Inhalation of Vapor/Dust (from soil)
Adolescent Trespassers (current and future land use)	• Surface Soil - Dermal Contact • Surface Soil - Incidental Ingestion • Inhalation of Vapor/Dust (from soil)
Construction Workers (future land use)	• Surface and Subsurface Soil - Dermal Contact • Surface and Subsurface Soil - Incidental Ingestion • Inhalation of Vapor/Dust (from soil) • Groundwater - Dermal Contact (during excavation) • Groundwater Inhalation of Volatile O rganics in a Trench (during excavation)
Occupational Workers (future land use)	• Surface Soil - Dermal Contact • Surface Soil - Incidental Ingestion • Inhalation of Vapor/Dust (from soil) • Inhalation of Indoor Vapor (from groundwater)
On-Base Military Residents (Adult/Children) (future land use)	• Surface Soil - Dermal Contact • Surface Soil - Incidental Ingestion • Inhalation of Vapor/Dust (from soil) • Groundwater - Dermal Contact • Groundwater - Ingestion • Inhalation of Indoor Vapor (from groundwater)
On Site Civilian Residents (Adult/Children) (future land use)	• Surface Soil - Dermal Contact • Surface Soil - Incidental Ingestion • Inhalation of Vapor/Dust (from soil) • Groundwater - Dermal Contact • Groundwater - Ingestion • Inhalation of Indoor Vapor (from groundwater)

TABLE 6-6

SUMMARY OF EXPOSURE INPUT PARAMETERS
REASONABLE MAXIMUM EXPOSURES
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Exposure Parameter	Maintenance Worker	Adolescent Trespasser	Construction Worker	Occupational Worker	On-Site Adult Resident	On-Site Child Resident
All Exposures						
C_{soil} (mg/kg)	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]
C_{gw} (µg/L)	NA	NA	Maximum	Maximum	Maximum	Maximum
EF (days/year)	250[3]	26[4]	30[2]	250[4]	350[5]	350[5]
ED (years)	25[3]	10[6]	1[4]	25[3]	24[5]	6[5]
BW (kg)	70[5]	42[7]	70[5]	70[5]	70[5]	15[5]
AT_n (days)	9,125[9]	3,650[9]	42[8]	9,125[9]	8,760[9]	2,190[9]
AT_c (days)	25,550[9]	25,550[9]	25,550[9]	25,550[9]	25,550[9]	25,550[9]
Incidental Ingestion/Dermal Contact with Soil						
IR (mg/day)	100[5]	100[5]	330[10]	100[5]	100[5]	200[5]
FI (unitless)	1[5]	1[5]	1[5]	1[5]	1[5]	1[5]
SA (cm^2/day)	3,300[11]	3,280[7]	3,300[11]	3,300[11]	5,700[11]	2,800[11]
AF (mg/cm^2)	0.2[11]	0.2[11]	0.3[11]	0.2[11]	0.07[11]	0.2[11]
ABS (unitless)	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]	chemical-specific[11]
CF (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06
Inhalation Fugitive Dust/Volatile Emissions from Soil						
C_{air} (mg/m^3)	calculated[10]	calculated[10]	calculated[10]	calculated[10]	calculated[10]	calculated[10]
InhR (m^3/hour)	2.5[10]	1.9[7]	2.5[7]	2.5[10]	20 m^3/day[10]	10 m^3/day[7]
ET (hours/day)	8[10]	2[4]	8[12]	8[10]	24[10]	24[7]
PEF (m^3/kg)	1.36E+9[10]	1.36E+9[10]	1.27 x 10^6[10]	1.36E+9[10]	1.36E+9[10]	1.36E+9[10]
VF (m^3/kg)	chemical-specific[10]	chemical-specific[10]	chemical-specific[10]	chemical-specific[10]	chemical-specific[10]	chemical-specific[10]
Ingestion/Dermal Contact with Groundwater						
IR_{gw} (L/day)	NA	NA	NA	NA	2[5]	1.5[7]
ET (hours/day) and t_{event} (hours/event)	NA	NA	4[4]	NA	0.33[4]	0.33[4]
EV (events/day)	NA	NA	1[4]	NA	1[4]	1[4]
A (cm^2/day)	NA	NA	3,300[11]	NA	18,000[11]	6,600[11]
K_p (cm/hour)	NA	NA	chemical-specific[11]	NA	chemical-specific[11]	chemical-specific[11]

TABLE 6-6

SUMMARY OF EXPOSURE INPUT PARAMETERS
REASONABLE MAXIMUM EXPOSURES
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Exposure Parameter	Maintenance Worker	Adolescent Trespasser	Construction Worker	Occupational Worker	On-Site Adult Resident	On-Site Child Resident
t* (hours), τ (hour), and B (unitless)	NA	NA	chemical-specific[11]	NA	chemical-specific[11]	chemical-specific[11]
Inhalation of Volatile Emissions while Showering						
C_{air} (mg/m^3)	NA	NA	NA	NA	Calculated[13]	Calculated[13]
InhR (m^3/hour)	NA	NA	NA	NA	0.6[9]	0.6[9]
ET (hours/day)	NA	NA	NA	NA	0.33[4]	0.33[4]
Inhalation of Volatile Emissions from Groundwater by Vapor Intrusion and in a Trench (Construction Workers)						
C_{air} (mg/m^3)	NA	NA	calculated[14]	calculated[15]	calculated[15]	calculated[15]
InhR (m^3/hour)	NA	NA	2.5[7]	2.5[10]	0.833[10]	0.42[7]
ET (hours/day)	NA	NA	4[4]	8[10]	24[10]	24[7]

A	Skin surface area available for contact	EF	Exposure frequency
ABS	Absorption factor	ET	Exposure time
AF	Soil-to-skin adherence factor	EV	Event frequency
AT_c	Averaging time for carcinogenic effects	FI	Fraction ingested from contaminated source
AT_n	Averaging time for non-carcinogenic effects	InhR	Inhalation rate
B	Bunge Model partitioning coefficient	IR	Ingestion rate (soil or groundwater)
BW	Body weight	K_p	Permeability coefficient from water through skin
CF	Conversion factor	SA	Skin surface area available for contact
IR	Ingestion rate	PEF	Particulate emission factor
C_{soil}	Exposure concentration for soil	τ	Lag time
C_{gw}	Exposure concentration for groundwater	t*	Time it takes to reach steady-state conditions
C_{air}	Exposure concentration for air	t_{event}	Duration of event
ED	Exposure duration		

1 - USEPA, 2002.
2 - Illinois EPA, 2004.
3 - USEPA, 1991
4- Professional judgment.
5 - USEPA, 1993
6 - Adolescents ages 7 to 16 years old.
7 - USEPA, 1997
8 - Illinois EPA, 2003.
9 - USEPA, 1989
10 - USEPA, 2002
11 - USEPA, 2004
12 - Assume an 8-hour work shift.
13 - Foster, S.A. and P.C. Chrostowski, 1987
14 - VDEQ, 2004
15 - USEPA, 2004

Note: The exposure factors for future civilian and military residents are the same, except for exposure duration (ED) for adult military residents. Exposure duration for adult military residents was assumed to be the typical enlistment times of 6 years for the RME and CTE.

TABLE 6-7

SUMMARY OF EXPOSURE INPUT PARAMETERS
CENTRAL TENDENCY EXPOSURES
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Exposure Parameter	Maintenance Worker	Adolescent Trespasser	Construction Worker	Occupational Worker	On-Site Adult Resident	On-Site Child Resident
All Exposures						
C_{soil} (mg/kg)	Maximum or 95% UCL(1)	Maximum or 95% UCL(1)	Maximum or 95% UCL(1)	Maximum or 95% UCL(1)	Maximum or 95% UCL(1)	Maximum or 95% UCL(1)
C_{gw} (µg/L)	NA	NA	Maximum	Maximum	Maximum	Maximum
EF (days/year)	219(3)	13(4)	30(2)	219(4)	234(3)	234(3)
ED (years)	9(3)	10(5)	1(4)	9(3)	7(3)	2(3)
BW (kg)	70(3)	42(6)	70(3)	70(3)	70(3)	15(3)
AT_n (days)	3,285(8)	3,650(8)	42(7)	3,285(8)	2,555(8)	730(8)
AT_c (days)	25,550(8)	25,550(8)	25,550(8)	25,550(8)	25,550(8)	25,550(8)
Incidental Ingestion/Dermal Contact with Soil						
IR (mg/day)	50(9)	50(9)	165(9)	50(9)	50(9)	100(9)
FI (unitless)	1(3)	1(3)	1(3)	1(3)	1(3)	1(3)
SA (cm^2/day)	3,300(10)	3,100(6)	3,300(10)	3,300(10)	5,700(10)	2,800(10)
AF (mg/cm^2)	0.02(10)	0.04(10)	0.1(10)	0.02(10)	0.01(10)	0.04(10)
ABS (unitless)	chemical-specific(10)	chemical-specific(10)	chemical-specific(10)	chemical-specific(10)	chemical-specific(10)	chemical-specific(10)
CF (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06
Inhalation Fugitive Dust/Volatile Emissions from Soil						
C_{air} (mg/m^3)	calculated(11)	calculated(11)	calculated(11)	calculated(11)	calculated(11)	calculated(11)
InhR (m^3/hour)	1.5(6)	1.2(6)	1.5(6)	1.5(6)	20 m^3/day(11)	10 m^3/day(6)
ET (hours/day)	4(9)	1(9)	4(9)	4(9)	24(11)	24(6)
PEF (m^3/kg)	1.36E+9(11)	1.36E+9(11)	1.27 x 10^6(11)	1.36E+9(11)	1.36E+9(11)	1.36E+9(11)
VF (m^3/kg)	chemical-specific(11)	chemical-specific(11)	chemical-specific(11)	chemical-specific(11)	chemical-specific(11)	chemical-specific(11)
Ingestion/Dermal Contact with Groundwater						
IR_{gw} (L/day)	NA	NA	NA	NA	1.4(3)	0.66(6)
ET (hours/day) and t_{event} (hours/event)	NA	NA	2(8)	NA	0.25(4)	0.25(4)
EV (events/day)	NA	NA	1(4)	NA	1(4)	1(4)
A (cm^2/day)	NA	NA	3,300(10)	NA	18,000(10)	6,600(10)
K_p (cm/hour)	NA	NA	chemical-specific(10)	NA	chemical-specific(10)	chemical-specific(10)

TABLE 6-7

SUMMARY OF EXPOSURE INPUT PARAMETERS
CENTRAL TENDENCY EXPOSURES
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Exposure Parameter	Maintenance Worker	Adolescent Trespasser	Construction Worker	Occupational Worker	On-Site Adult Resident	On-Site Child Resident
t* (hours), τ (hour), and B (unitless)	NA	NA	chemical-specific[10]	NA	chemical-specific[10]	chemical-specific[10]
Inhalation of Volatile Emissions while Showering						
C_{air} (mg/m^3)	NA	NA	NA	NA	Calculated[12]	Calculated[12]
InhR (m^3/hour)	NA	NA	NA	NA	0.6[8]	0.6[8]
ET (hours/day)	NA	NA	NA	NA	0.25[4]	0.25[4]
Inhalation of Volatile Emissions from Groundwater by Vapor Intrusion and in a Trench (Construction Workers)						
C_{air} (mg/m^3)	NA	NA	calculated[13]	calculated[14]	calculated[14]	calculated[14]
InhR (m^3/hour)	NA	NA	1.5[6]	1.5[5]	0.833[11]	0.42[6]
ET (hours/day)	NA	NA	2[9]	8[11]	24[11]	24[11]

Notes:

A	Skin surface area available for contact	EF	Exposure frequency
ABS	Absorption factor	ET	Exposure time
AF	Soil-to-skin adherence factor	EV	Event frequency
AT_c	Averaging time for carcinogenic effects	FI	Fraction ingested from contaminated source
AT_n	Averaging time for non-carcinogenic effects	InhR	Inhalation rate
B	Bunge Model partitioning coefficient	IR	Ingestion rate (soil or groundwater)
BW	Body weight	K_p	Permeability coefficient from water through skin
CF	Conversion factor	SA	Skin surface area available for contact
IR	Ingestion rate	PEF	Particulate emission factor
C_{soil}	Exposure concentration for soil	τ	Lag time
C_{gw}	Exposure concentration for groundwater	t*	Time it takes to reach steady-state conditions
C_{air}	Exposure concentration for air	t_{event}	Duration of event
ED	Exposure duration		

1 - USEPA, 2002
2 - Illinois EPA, 2004.
3 - USEPA, 1993
4 - Professional judgment.
5 - Adolescents ages 7 to 16 years old.
6 - USEPA, 1997
7 - Illinois EPA, 2003.
8 - USEPA, 1989
9 - CTE is assumed to be 1/2 the RME value.
10 - USEPA, 2004
11 - USEPA, 2002
12 - Foster, S.A. and P.C. Chrostowski, 1987
13 - VDEQ 2004
14 - USEPA, 2004

Note: The exposure factors for future civilian and military residents are the same, except for exposure duration (ED) for adult military residents. Exposure duration for adult military residents was assumed to be the typical enlistment times of 6 years for the RME and CTE.

TABLE 6-8

EXPOSURE POINT CONCENTRATIONS FOR COPCs
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Surface Soil[1] (mg/kg)	Subsurface Soil[1] (mg/kg)	Groundwater (µg/L)[2] Maximum (RME and CTE scenarios)
Semivolatile Organic Compounds			
BENZO(A)PYRENE EQUIVALENTS	1	0.02	0.038
Inorganics			
ALUMINUM	13800	9460	
ARSENIC	14.4	12	3.3
BARIUM	98.1		
CHROMIUM	22.2	17.5	
COBALT	10.8	11.1	
IRON	29600	23800	
LEAD	92.9[3]		
MANGANESE	1050	845	
NICKEL	29	27.7	

Blank spaces indicate that the chemical was not selected as a COPC for the specified medium.

1 - UCLs calculated using USEPA's ProUCL software, unless otherwise noted. See RAGS Part D Table 3s in Appendix F-1 for details concerning the UCLs. The 95-percent UCL on the mean (95-percent UCL) used as EPC.
2 - Maximum concentrations are used for the RME and CTE scenarios.
3 - As per IEUBK and ALM guidance, the arithmetic average concentration is used as the EPC for lead.

TABLE 6-9

NON-CANCER TOXICITY DATA - ORAL/DERMAL
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source	Date
Semivolatile Organic Compounds										
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics										
ALUMINUM	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	CNS	100	NCEA	10/23/2006
ARSENIC	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	4/2009
BARIUM	Chronic	2.0E-01	mg/kg/day	0.07	1.4E-02	mg/kg/day	Kidney	3/1	IRIS	4/2009
CHROMIUM	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	Fetotoxicity, GS, Bone	300/3	IRIS	2/2/2009
COBALT	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Blood	NA	ORNL	9/12/2008
IRON	Chronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	GS	1.5	NCEA	9/11/2006
LEAD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	1/3	IRIS	4/2009
MERCURY(3)	Chronic	3.0E-04	mg/kg/day	0.07	2.1E-05	mg/kg/day	Autoimmune	1000/1	IRIS	2/2/2009

Notes:

1 - USEPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

3 - Values are for mercuric chloride.

Definitions:

CNS = Central nervous system

CVS = Cardiovascular system

GS = Gastrointestinal System

HEAST= Health Effects Assessment Summary Tables

IRIS = Integrated Risk Information System

NA = Not applicable

NCEA = USEPA National Center for Environmental Assessment

ORNL = Oak Ridge National Laboratory Regional Screening Level Tables, September 2008

TABLE 6-10

NON-CANCER TOXICITY DATA - INHALATION
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s)
Semivolatile Organic Compounds									
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics									
ALUMINUM	Chronic	5.0E-03	mg/m3	1.4E-03	(mg/kg/day)	CNS	300	NCEA	10/23/2006
ARSENIC	NA	3.00E-05	mg/m^3	8.6E-06	(mg/kg/day)	CNS, GI, heart	NA	CA EPA	2000
BARIUM	Chronic	5.0E-04	mg/m^3	1.4E-04	(mg/kg/day)	Fetus	1000/1	HEAST	7/1997
CHROMIUM	Chronic	1.0E-04	mg/m^3	NA	(mg/kg/day)	Respiratory	300/1	IRIS	4/2009
COBALT	Chronic	6.0E-06	mg/m^3	NA	(mg/kg/day)	Respiratory	NA	ORNL	9/12/2008
IRON	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	Chronic	3.00E-04	mg/m^3	8.6E-05	(mg/kg/day)	CNS	1000/1	IRIS	4/2009
MERCURY	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 - Extrapolated RfD = RfC *$20m^3$/day / 70 kg

Definitions:
IRIS = Integrated Risk Information System
CNS = Central Nervous System
HEAST= Health Effects Assessment Summary Tables
NA = Not Applicable
NCEA = USEPA National Center for Environmental Assessment
ORNL = Oak Ridge National Laboratory Screening Level Tables, September 2008

TABLE 6-11

CANCER TOXICITY DATA - ORAL/DERMAL
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source	Date
Semivolatile Organic Compounds								
BENZO(A)ANTHRACENE	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
BENZO(A)PYRENE	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	4/2009
BENZO(B)FLUORANTHENE	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
DIBENZO(A,H)ANTHRACENE	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
INDENO(1,2,3-CD)PYRENE	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
Inorganics								
ALUMINUM	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	4/2009
BARIUM	NA	NA	NA	NA	NA	D	IRIS	4/2009
CHROMIUM	NA	NA	NA	NA	NA	D/Not classifiable as to human carcinogenicity	IRIS	2/2/2009
COBALT	NA	NA	NA	NA	NA	NA	NA	NA
IRON								
LEAD	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	NA	NA	NA	NA	NA	D	IRIS	4/2009
MERCURY	NA	NA	NA	NA	NA	C/Possible Human Carcinogen	IRIS	4/2009

Notes:

1 - USEPA, 2004

2 - Adjusted dermal cancer slope factor = oral cancer slope factor/oral absorption efficiency for dermal

EPA Group:

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of non-carcinogenicity.

Definitions:

IRIS = Integrated Risk Information System.

NA = Not available.

NCEA = National Center for Environmental Assessment, value from ORNL Regional Screening Level tables.

USEPA(1) = USEPA, 1993d

TABLE 6-12

CANCER TOXICITY DATA - INHALATION
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source	Date
Semivolatile Organic Compounds (2)							
BENZO(A)ANTHRACENE	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
BENZO(A)PYRENE	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
BENZO(B)FLUORANTHENE	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
DIBENZO(A,H)ANTHRACENE	1.2E-03	$(ug/m^3)^{-1}$	4.1E+00	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
INDENO(1,2,3-CD)PYRENE	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
Inorganics							
ALUMINUM	NA	NA	NA	NA	NA	NA	NA
ARSENIC	4.3E+00	$(mg/m^3)^{-1}$	NA	NA	A	IRIS	4/2009
BARIUM	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	1.2E-02	$(ug/m^3)^{-1}$	NA	NA	A/Known human carcinogen	IRIS	4/2009
COBALT	9.0E-03	$(ug/m^3)^{-1}$	NA	NA	NA	ORNL	9/12/2008
IRON	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	D	IRIS	4/2009
MANGANESE	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	C/Possible Human Carcinogen	IRIS	4/2009

1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

Definitions:

IRIS = Integrated Risk Information System.

HEAST= Health Effects Assessment Summary Tables

ORNL = Oak Ridge National Laboratory Regional Screening Level tables, September 2008

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of non-carcinogenicity.

TABLE 6-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATON GRAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Construction/Excavation Worker	Surface Soil	Ingestion	2.E-07	- -	- -	- -	0.5	- -
		Dermal Contact	3.E-08	- -	- -	- -	0.01	- -
		Inhalation	6.E-07	- -	- -	- -	5	Manganese
		Total	8.E-07	- -	- -	- -	5	Manganese
	Subsurface Soil	Ingestion	1.E-07	- -	- -	- -	0.4	- -
		Dermal Contact	9.E-09	- -	- -	- -	0.01	- -
		Inhalation	5.E-07	- -	- -	- -	4	Manganese
		Total	6.E-07	- -	- -	- -	5	Manganese
	Groundwater	Ingestion	NA	- -	- -	- -	NA	- -
		Dermal Contact	1.E-09	- -	- -	- -	0.001	- -
		Total	1.E-09	- -	- -	- -	0.001	- -
		Total Surface Soil	8.E-07	- -	- -	- -	5	- -
		Total Subsurface Soil	6.E-07	- -	- -	- -	5	- -
		Total Groundwater	1.E-09	- -	- -	- -	0.001	- -
		Total Across the Entire Site	**1.E-06**	- -	- -	- -	**10**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Maintenance Worker	Surface Soil	Ingestion	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Dermal Contact	4.E-06	- -	- -	cPAHs	0.009	- -
		Total	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Total Surface Soil	1.E-05	- -	- -	- -	0.2	- -
		Total Across the Entire Site	**1.E-05**	- -	- -	- -	**0.2**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Occupational Worker	Surface Soil	Ingestion	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Dermal Contact	4.E-06	- -	- -	cPAHs	0.009	- -
		Total	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Total Surface Soil	1.E-05	- -	- -	- -	0.2	- -
		Total Across the Entire Site	**1.E-05**	- -	- -	- -	**0.2**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Adolescent Trespasser	Surface Soil	Ingestion	1.E-06	- -	- -	- -	0.03	- -
		Dermal Contact	6.E-07	- -	- -	- -	0.002	- -
		Total	2.E-06	- -	- -	- -	0.03	- -
		Total Surface Soil	2.E-06	- -	- -	- -	0.03	- -
		Total Across the Entire Site	**2.E-06**	- -	- -	- -	**0.03**	- -

TABLE 6-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATON GRAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Child Resident	Surface Soil	Ingestion	7.E-05	- -	cPAHs, Arsenic	- -	2	- -
		Dermal Contact	2.E-05	- -	cPAHs	Arsenic	0.05	- -
		Total	8.E-05	- -	cPAHs, Arsenic	- -	2	- -
	Groundwater	Ingestion	5.E-05	- -	Arsenic	cPAHs	1.1	- -
		Dermal Contact	6.E-08	- -	- -	- -	0.002	- -
		Total	5.E-05	- -	Arsenic	cPAHs	1.1	- -
		Total Surface Soil	8.E-05	- -	- -	- -	2	- -
		Total Groundwater	5.E-05	- -	- -	- -	1.1	- -
		Total Across the Entire Site	**1.E-04**	- -	- -	- -	**3**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Adult Resident	Surface Soil	Ingestion	2.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Dermal Contact	4.E-06	- -	- -	cPAHs	0.008	- -
		Total	2.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
	Groundwater	Ingestion	5.E-05	- -	Arsenic	cPAHs	0.3	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.0009	- -
		Total	5.E-05	- -	Arsenic	cPAHs	0.3	- -
		Total Surface Soil	2.E-05	- -	- -	- -	0.2	- -
		Total Groundwater	5.E-05	- -	- -	- -	0.3	- -
		Total Across the Entire Site	**7.E-05**	- -	- -	- -	**0.5**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Total Residential Risks	Surface Soil	Ingestion	8.E-05	- -	cPAHs, Arsenic	- -	NA	- -
		Dermal Contact	2.E-05	- -	cPAHs	Arsenic	NA	- -
		Total	1.E-04	- -	cPAHs, Arsenic	- -	NA	- -
	Groundwater	Ingestion	1.E-04	- -	cPAHs, Arsenic	- -	NA	- -
		Dermal Contact	2.E-07	- -	- -	- -	NA	- -
		Total	1.E-04	- -	cPAHs, Arsenic	- -	NA	- -
		Total Surface Soil	1.E-04	- -	- -	- -	NA	- -
		Total Groundwater	1.E-04	- -	- -	- -	NA	- -
		Total Across the Entire Site	**2.E-04**	- -	- -	- -	NA	- -

cPAHs = Carcinogenic PAHs
NA = Not applicable

TABLE 6-14

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURE (CTE)
SITE 19 - SMALL ARMS RANGE BUILDING 910
NAVAL STAIOTN GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Construction/Excavation Worker	Surface Soil	Ingestion	8.E-08	- -	- -	- -	0.3	- -
		Dermal Contact	9.E-09	- -	- -	- -	0.005	- -
		Inhalation	3.E-07	- -	- -	- -	2	Manganese
		Total	4.E-07	- -	- -	- -	3	Manganese
	Subsurface Soil	Ingestion	5.E-08	- -	- -	- -	0.2	- -
		Dermal Contact	3.E-09	- -	- -	- -	0.004	- -
		Inhalation	3.E-07	- -	- -	- -	2	Manganese
		Total	3.E-07	- -	- -	- -	2	Manganese
	Groundwater	Ingestion	NA	- -	- -	- -	NA	- -
		Dermal Contact	5.E-10	- -	- -	- -	0.0007	- -
		Total	5.E-10	- -	- -	- -	0.0007	- -
		Total Surface Soil	4.E-07	- -	- -	- -	3	- -
		Total Subsurface Soil	3.E-07	- -	- -	- -	2	- -
		Total Groundwater	5.E-10	- -	- -	- -	0.0007	- -
		Total Across the Entire Site	**7.E-07**	- -	- -	- -	**5**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Maintenance Worker	Surface Soil	Ingestion	2.E-06	- -	- -	- -	0.07	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.0008	- -
		Total	2.E-06	- -	- -	- -	0.07	- -
		Total Surface Soil	2.E-06	- -	- -	- -	0.07	- -
		Total Across the Entire Site	**2.E-06**	- -	- -	- -	**0.07**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Occupational Worker	Surface Soil	Ingestion	2.E-06	- -	- -	- -	0.07	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.0008	- -
		Total	2.E-06	- -	- -	- -	0.07	- -
		Total Surface Soil	2.E-06	- -	- -	- -	0.07	- -
		Total Across the Entire Site	**2.E-06**	- -	- -	- -	**0.07**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Adolescent Trespasser	Surface Soil	Ingestion	2.E-07	- -	- -	- -	0.007	- -
		Dermal Contact	2.E-08	- -	- -	- -	0.0002	- -
		Total	2.E-07	- -	- -	- -	0.007	- -
		Total Surface Soil	2.E-07	- -	- -	- -	0.007	- -
		Total Across the Entire Site	**2.E-07**	- -	- -	- -	**0.007**	- -

TABLE 6-14

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURE (CTE)
SITE 19 - SMALL ARMS RANGE BUILDING 910
NAVAL STAIOTN GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Child Resident	Surface Soil	Ingestion	4.E-06	- -	- -	Arsenic	0.7	- -
		Dermal Contact	2.E-07	- -	- -	- -	0.007	- -
		Total	4.E-06	- -	- -	Arsenic	0.7	- -
	Groundwater	Ingestion	4.E-06	- -	- -	Arsenic	0.09	- -
		Dermal Contact	1.E-08	- -	- -	- -	0.0002	- -
		Total	4.E-06	- -	- -	Arsenic	0.09	- -
		Total Surface Soil	4.E-06	- -	- -	- -	0.7	- -
		Total Groundwater	4.E-06	- -	- -	- -	0.09	- -
		Total Across the Entire Site	**8.E-06**	- -	- -	- -	**0.8**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Adult Resident	Surface Soil	Ingestion	1.E-06	- -	- -	- -	0.07	- -
		Dermal Contact	8.E-08	- -	- -	- -	0.0008	- -
		Total	1.E-06	- -	- -	- -	0.07	- -
	Groundwater	Ingestion	7.E-06	- -	- -	Arsenic	0.14	- -
		Dermal Contact	2.E-08	- -	- -	- -	0.0005	- -
		Total	7.E-06	- -	- -	Arsenic	0.14	- -
		Total Surface Soil	1.E-06	- -	- -	- -	0.07	- -
		Total Groundwater	7.E-06	- -	- -	- -	0.14	- -
		Total Across the Entire Site	**8.E-06**	- -	- -	- -	**0.2**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Total Residential Risks	Surface Soil	Ingestion	5.E-06	- -	- -	cPAHs, Arsenic	NA	- -
		Dermal Contact	3.E-07	- -	- -	- -	NA	- -
		Total	5.E-06	- -	- -	cPAHs, Arsenic	NA	- -
	Groundwater	Ingestion	1.E-05	- -	- -	Arsenic	NA	- -
		Dermal Contact	3.E-08	- -	- -	- -	NA	- -
		Total	1.E-05	- -	- -	Arsenic	NA	- -
		Total Surface Soil	5.E-06	- -	- -	- -	NA	- -
		Total Groundwater	1.E-05	- -	- -	- -	NA	- -
		Total Across the Entire Site	**2.E-05**	- -	- -	- -	NA	- -

cPAHs = Carcinogenic PAHs

TABLE 6-15

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL - MIGRATION TO GROUNDWATER
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

CAS #	Parameter	Frequency of Detection	Minimum Result[1]	Maximum Result[1,2]	Units	Sample of Maximum Detect	Range of Non-detects[3]	Background Concentration[4]	ORNL Risk-Based Migration to GW SSL[5]		ORNL MCL Based Migration to GW SSL[5]	TACO - Residential Migration to Groundwater - Class 1[6]	NON-TACO - Residential Migration to Groundwater - Class 1[7]	Above SSL
	Volatile Organics (ug/kg)													
78-93-3	2-BUTANONE	2/12	1.6	2.5	UG/KG	NTC19SB11-SO-0002	1.2 - 1.8	NA	1500	N	NA	NA	17000	No
67-64-1	ACETONE	6/12	4.3 J	29	UG/KG	NTC19SB11-SO-0002	1.9 - 2.5	NA	4400	N	NA	25000	NA	No
	Polynuclear Aromatic Hydrocarbons (ug/kg)													
91-57-6	2-METHYLNAPHTHALENE	6/12	2	53	UG/KG	NTC19SB11-SO-0002	1.9 - 2.1	140	900	N	NA	NA	NA	No
83-32-9	ACENAPHTHENE	7/12	1.6	240	UG/KG	NTC19SB11-SO-0002	1.4 - 1.5	130	27000	N	NA	570000	NA	No
208-96-8	ACENAPHTHYLENE	7/12	1.4	74	UG/KG	NTC19SB11-SO-0002	1.3 - 1.4	70	27000	N	NA	NA	85000	No
120-12-7	ANTHRACENE	8/12	2.1	590	UG/KG	NTC19SB11-SO-0002	0.9 - 0.97	400	450000	N	NA	12000000	NA	No
CALC055	**BAP EQUIVALENTS**	11/12	1.6641	1758.8	UG/KG	NTC19SB20-SO-0002	1.2 - 1.2	NA	4.6	C	310	8000	NA	Yes
56-55-3	**BENZO(A)ANTHRACENE**	10/12	2.3	1700	UG/KG	NTC19SB11-SO-0002	1.6 - 1.7	1800	14	C	NA	2000	NA	Yes
50-32-8	**BENZO(A)PYRENE**	10/12	4.2	1200	UG/KG	NTC19SB11-SO-0002	1.1 - 1.2	2100	4.6	C	310	8000	NA	Yes
205-99-2	**BENZO(B)FLUORANTHENE**	9/12	6.7	1700	UG/KG	NTC19SB20-SO-0002	1.7 - 1.9	2100	47	C	NA	5000	NA	Yes
191-24-2	BENZO(G,H,I)PERYLENE	10/12	3.4	940	UG/KG	NTC19SB20-SO-0002	1.7 - 1.8	1700	150000	N	NA	NA	27000000	No
207-08-9	BENZO(K)FLUORANTHENE	9/12	2.7	460	UG/KG	NTC19SB20-SO-0002	1.4 - 1.5	1700	460	C	NA	49000	NA	No
218-01-9	**CHRYSENE**	11/12	2.4	1900	UG/KG	NTC19SB11-SO-0002	1.3 - 1.3	2700	1400	C	NA	160000	NA	Yes
53-70-3	**DIBENZO(A,H)ANTHRACENE**	5/12	4.8 J	160	UG/KG	NTC19SB20-SO-0002	1.7 - 1.9	420	15	C	NA	2000	NA	Yes
206-44-0	FLUORANTHENE	10/12	2.2	5100	UG/KG	NTC19SB11-SO-0002	1.9 - 2	4100	210000	N	NA	4300000	NA	No
86-73-7	FLUORENE	7/12	1.8	250	UG/KG	NTC19SB11-SO-0002	1.4 - 1.5	180	33000	N	NA	560000	NA	No
193-39-5	**INDENO(1,2,3-CD)PYRENE**	9/12	4.4	730	UG/KG	NTC19SB20-SO-0002	1.7 - 1.9	1600	160	C	NA	69000	NA	Yes
91-20-3	**NAPHTHALENE**	3/12	4.9	62	UG/KG	NTC19SB11-SO-0002	2.6 - 28	200	0.55	C	NA	12000	NA	Yes
85-01-8	PHENANTHRENE	10/12	4.2	3200	UG/KG	NTC19SB11-SO-0002	1.9 - 2	2500	150000	N	NA	NA	200000	No
129-00-0	PYRENE	11/12	2.4	3500	UG/KG	NTC19SB11-SO-0002	1.9 - 1.9	3000	150000	N	NA	4200000	NA	No
	Inorganics (mg/kg)													
7429-90-5	ALUMINUM	16/16	6640	19300	MG/KG	NTC19SB06-SO-0001	---	9500	55000	N	NA	NA	NA	No
7440-36-0	**ANTIMONY**	1/13	1.2	1.2	MG/KG	NTC19SB17-SO-0002	---	4	0.66	N	0.27	NA	NA	Yes
7440-38-2	**ARSENIC**	16/16	5.2	32.2	MG/KG	NTC19SB10-SO-0002	---	13	0.0013	C	0.29	30	NA	Yes
7440-39-3	**BARIUM**	16/16	31.5	188	MG/KG	NTC19SB06-SO-0001	---	110	300	N	82	1800	NA	Yes
7440-41-7	BERYLLIUM	16/16	0.49	2	MG/KG	NTC19SB11-SO-0002	---	0.59	58	N	3.2	1000	NA	No
7440-43-9	**CADMIUM**	14/16	0.25	0.92 J	MG/KG	NTC19SB06-SO-0001	0.22 - 0.24	0.6	1.4	N	0.38	59	NA	Yes
7440-70-2	CALCIUM	16/16	5210 J	111000 J	MG/KG	NTC19SB07-SO-0001	---	9300	NA		NA	NA	NA	No
7440-47-3	**CHROMIUM**	16/16	13 J	32.6 J	MG/KG	NTC19SB17-SO-0002-D	---	16.2	NA	C	NA	32	NA	Yes
7440-48-4	**COBALT**	16/16	5	13.3	MG/KG	NTC19SB10-SO-0002	---	8.9	0.49	N	NA	NA	NA	Yes
7440-50-8	**COPPER**	16/16	17.5	53.6	MG/KG	NTC19SB17-SO-0002	---	19.6	51	N	46	330000	NA	Yes
7439-89-6	**IRON**	16/16	14600	36800	MG/KG	NTC19SB10-SO-0002	---	15900	640	N	NA	NA	NA	Yes
7439-92-1	**LEAD**	16/16	9.5 J	480 J	MG/KG	NTC19SB03-SO-0001	---	36	NA		14	107	NA	Yes
7439-95-4	MAGNESIUM	16/16	5270 J	62100	MG/KG	NTC19SB07-SO-0001	---	4820	NA		NA	NA	NA	No
7439-96-5	**MANGANESE**	16/16	336	1820 J	MG/KG	NTC19SB16-SO-0103	---	636	57	N	NA	NA	NA	Yes
7439-97-6	**MERCURY**	15/16	0.018	0.47	MG/KG	NTC19SB06-SO-0001	0.015	0.06	0.033	N	0.1	6.4	NA	Yes
7440-02-0	NICKEL	16/16	14	47.9 J	MG/KG	NTC19SB17-SO-0002-D	---	18	48	N	NA	700	NA	No
7440-09-7	POTASSIUM	16/16	1030	2720	MG/KG	NTC19SB11-SO-0002	---	1268	NA		NA	NA	NA	No
7440-22-4	SILVER	3/16	0.44	1	MG/KG	NTC19SB06-SO-0001	0.22 - 0.25	0.55	1.6	N	NA	39	NA	No
7440-23-5	SODIUM	4/16	239	565	MG/KG	NTC19SB11-SO-0002	220 - 256	130	NA		NA	NA	NA	No
7440-62-2	VANADIUM	16/16	16.4	37.1	MG/KG	NTC19SB06-SO-0001	---	25.2	180	N	180	980	NA	No
7440-66-6	ZINC	16/16	40	250 J	MG/KG	NTC19SB06-SO-0001	---	95	680	N	NA	16000	NA	No

Associated Samples:
NTC19SB01-SO-0002
NTC19SB03-SO-0001
NTC19SB03-SO-0103
NTC19SB06-SO-0001
NTC19SB11-SO-0002
NTC19SB12-SO-0002
NTC19SB13-SO-0103
NTC19SB15-SO-0103
NTC19SB07-SO-0001
NTC19SB08-SO-0103
NTC19SB09-SO-0002
NTC19SB10-SO-0002
NTC19SB16-SO-0103
NTC19SB16-SO-0103-D
NTC19SB17-SO-0002
NTC19SB17-SO-0002-D
NTC19SB19-SO-0002
NTC19SB20-SO-0002

Footnotes:
1 - Sample and duplicate are counted as two separate samples when determining minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - If the maximum concentration of a chemical is less than the Illinois EPA background concentration (illinois EPA, Appendix A, Table G of TACO), that chemical was not selected as a COPC.
5 - USEPA ORNL Soil Screening Level for the Potection of Groundwater (USEPA, 2008)
6 - Section 742 Table A, Tier 1 Soil Remediation Objectives for Residential Properties (online, 2009).
7 - Soil Remediation Objectives for Residential Properties, Non-TACO Chemicals (2007)
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria.

Definitions:
C = Carcinogen
COPC = Chemical of potentia
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not avail

TABLE 6-16

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SUBSURFACE SOIL - MIGRATION TO GROUNDWATER
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

CAS #	Parameter	Frequency of Detection	Minimum Result[1]	Maximum Result[1,2]	Units	Sample of Maximum Detect	Range of Non-detects[3]	Background Concentration[4]	ORNL Risk-Based Migration to GW SSL[5]		ORNL MCL Based Migration to GW SSL[5]	TACO - Residential Migration to Groundwater - Class 1[6]	NON-TACO - Residential Migration to Groundwater - Class 1[7]	Above SSL
	Volatile Organics (ug/kg)													
108-10-1	4-METHYL-2-PENTANONE	1/22	0.65	0.65	UG/KG	NTC19SB17-SO-0406	0.48 - 0.81	NA	440	N	NA	NA	NA	No
67-64-1	ACETONE	12/22	2.3 J	12	UG/KG	NTC19SB15-SO-0406-D	1.7 - 2.8	NA	4400	N	NA	25000	NA	No
75-69-4	TRICHLOROFLUOROMETHANE	1/22	3.9	3.9	UG/KG	NTC19SB07-SO-0507	0.78 - 1.3	NA	840	N	NA	NA	34000	No
	Polynuclear Aromatic Hydrocarbons (ug/kg)													
91-57-6	2-METHYLNAPHTHALENE	4/22	2.2	6.5	UG/KG	NTC19SB15-SO-0406-D	1.8 - 2.1	NA	900	N	NA	NA	NA	No
208-96-8	ACENAPHTHYLENE	1/22	1.7	1.7	UG/KG	NTC19SB04-SO-0204	1.2 - 1.4	NA	27000	N	NA	NA	85000	No
120-12-7	ANTHRACENE	1/22	4.2	4.2	UG/KG	NTC19SB18-SO-0204	0.88 - 0.99	NA	450000	N	NA	12000000	NA	No
CALC055	**BAP EQUIVALENT-HALFND**	8/22	1.6637	26.697	UG/KG	NTC19SB18-SO-0204	1.1 - 1.2	NA	**4.6**	C	310	8000	NA	Yes
56-55-3	**BENZO(A)ANTHRACENE**	3/22	15	20	UG/KG	NTC19SB06-SO-0204	1.5 - 1.7	NA	**14**	C	NA	2000	NA	Yes
50-32-8	**BENZO(A)PYRENE**	6/22	7.1	22	UG/KG	NTC19SB18-SO-0204	1.1 - 1.2	NA	**4.6**	C	310	8000	NA	Yes
205-99-2	BENZO(B)FLUORANTHENE	3/22	15	18	UG/KG	NTC19SB06-SO-0204	1.7 - 1.9	NA	47	C	NA	5000	NA	No
191-24-2	BENZO(G,H,I)PERYLENE	19/	2.2	11	UG/KG	NTC19SB06-SO-0204	1.7 - 1.8	NA	150000	N	NA	NA	27000000	No
207-08-9	BENZO(K)FLUORANTHENE	3/22	4.5	8.3	UG/KG	NTC19SB06-SO-0204	1.4 - 1.6	NA	460	C	NA	49000	NA	No
218-01-9	CHRYSENE	6/22	2.4	18	UG/KG	NTC19SB06-SO-0204	1.2 - 1.3	NA	1400	C	NA	160000	NA	No
206-44-0	FLUORANTHENE	5/22	3	28	UG/KG	NTC19SB04-SO-0204	1.8 - 2.1	NA	210000	N	NA	4300000	NA	No
193-39-5	INDENO(1,2,3-CD)PYRENE	3/22	6.5	7.4	UG/KG	NTC19SB18-SO-0204	1.7 - 1.9	NA	160	C	NA	69000	NA	No
85-01-8	PHENANTHRENE	/	2.4	17	UG/KG	NTC19SB18-SO-0204	1.8 - 2.1	NA	150000	N	NA	NA	200000	No
129-00-0	PYRENE	12/22	2	27	UG/KG	NTC19SB04-SO-0204	1.7 - 1.9	NA	150000	N	NA	4200000	NA	No
	Inorganics (mg/kg)													
7429-90-5	ALUMINUM	22/22	4500	14700	MG/KG	NTC19SB02-SO-0204	---	**9500**	55000	N	NA	NA	NA	No
7440-38-2	**ARSENIC**	22/22	4	25.1	MG/KG	NTC19SB05-SO-0406	---	**13**	**0.0013**	C	**0.29**	30	NA	Yes
7440-39-3	BARIUM	22/22	10.9	81.9	MG/KG	NTC19SB02-SO-0204	---	110	300	N	82	1800	NA	No
7440-41-7	BERYLLIUM	22/22	0.36	0.94	MG/KG	NTC19SB01-SO-0608	---	**0.59**	58	N	3.2	1000	NA	No
7440-43-9	CADMIUM	13/22	0.23 J	0.43 J	MG/KG	NTC19SB06-SO-0204	0.22 - 0.24	0.6	1.4	N	**0.38**	59	NA	Yes
7440-70-2	CALCIUM	22/22	2850 J	119000 J	MG/KG	NTC19SB12-SO-0507	---	**9300**	NA	N	NA	NA	NA	No
7440-47-3	CHROMIUM	22/22	9	25.8	MG/KG	NTC19SB02-SO-0204	---	**16.2**	NA	N	NA	32	NA	No
7440-48-4	**COBALT**	22/22	5.2	22.1	MG/KG	NTC19SB02-SO-0204	---	**8.9**	**0.49**	N	NA	NA	NA	Yes
7440-50-8	COPPER	22/22	15.4	34.2	MG/KG	NTC19SB02-SO-0204	---	**19.6**	51	N	46	330000	NA	No
7439-89-6	**IRON**	22/22	12200	34900	MG/KG	NTC19SB04-SO-0204	---	**15900**	**640**	N	NA	NA	NA	Yes
7439-92-1	**LEAD**	22/22	8.1	54.8 J	MG/KG	NTC19SB06-SO-0204	---	**36**	NA	N	**14**	107	NA	Yes
7439-95-4	MAGNESIUM	22/22	6440 J	56300	MG/KG	NTC19SB14-SO-0204	---	**4820**	NA	N	NA	NA	NA	No
7439-96-5	**MANGANESE**	22/22	421	1600	MG/KG	NTC19SB02-SO-0204	---	**636**	**57**	N	NA	NA	NA	Yes
7439-97-6	MERCURY	13/22	0.013	0.049	MG/KG	NTC19SB04-SO-0204	0.013 - 0.016	0.06	**0.033**	N	0.1	6.4	NA	Yes
7440-02-0	**NICKEL**	22/22	14.9	48.8	MG/KG	NTC19SB02-SO-0204	---	**18**	**48**	N	NA	700	NA	Yes
7440-09-7	POTASSIUM	22/22	1210	2950 J	MG/KG	NTC19SB02-SO-0204	---	**1268**	NA	N	NA	NA	NA	No
7440-23-5	SODIUM	2/22	241	249	MG/KG	NTC19SB17-SO-0406	216 - 249	**130**	NA	N	NA	NA	NA	No
7440-62-2	VANADIUM	22/22	12.7	29.8	MG/KG	NTC19SB06-SO-0204	---	**25.2**	180	N	180	980	NA	No
7440-66-6	ZINC	22/22	37.5	140 J	MG/KG	NTC19SB06-SO-0204	---	**95**	680	N	NA	16000	NA	No

Footnotes:
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - If the maximum concentration of a chemical is less than the Illinois EPA background concentration (Illinois EPA, Appendix A, Table G of TACO), that chemical was not selected as a COPC.
5 - USEPA ORNL Soil Screening Level for the Potection of Groundwater (USEPA, 2008)
6 - Section 742 Table A, Tier 1 Soil Remediation Objectives for Residential Properties (online, 2009).
7 - Soil Remediation Objectives for Residential Properties, Non-TACO Chemicals (2007)
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria.

Definitions:
C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not available.

Associated Samples:

NTC19SB12-SO-0507	NTC19SB19-SO-0406	NTC19SB01-SO-0608	NTC19SB06-SO-0204
NTC19SB14-SO-0204	NTC19SB20-SO-0406	NTC19SB02-SO-0204	NTC19SB06-SO-0608
NTC19SB14-SO-0507	NTC19SB15-SO-0406-AVG	NTC19SB03-SO-0810	NTC19SB07-SO-0507
NTC19SB15-SO-0406	NTC19SB15-SO-0406-D	NTC19SB04-SO-0204	NTC19SB08-SO-0406
NTC19SB18-SO-0204	NTC19SB16-SO-0507	NTC19SB05-SO-0406	NTC19SB09-SO-0406
NTC19SB18-SO-0406	NTC19SB17-SO-0406	NTC19SB05-SO-0608	NTC19SB10-SO-0507

7.0 CONCLUSIONS AND RECOMMENDATIONS

This section provides a summary of the conclusions drawn from the RI/RA and recommendations for future activities at the site.

7.1 CONCLUSIONS

This section briefly summarizes the conclusions based on RI activities including the results of groundwater, subsurface soil, and surface soil sampling and the HHRA.

Site 19 was a former indoor shooting range that was in operation for 55 years until the demolition of Building 910 in 2000. Approximately 340,000 rounds of small arms ammunition per year were delivered to the rifle range. Spent ammunition was collected from the floor of the range and deposited into a 22-gallon can. It is estimated that 19 million pounds of ammunition were generated by this facility, providing the potential for lead to have impacted the site soil and groundwater. Chemicals used at the rifle range include CLP brand cleaner (20 cases per year, each case containing 150 pint bottles) and standard issue bore cleaner #6850-00-224-6663 (3751-gallon cans per year). The use of these chemicals provides the potential for VOCs and PAHs to have impacted the site soil and groundwater. In addition, a dry cleaning facility was located just southwest of the former rifle range. Dry cleaning operations were active for over 50 years. Soil contamination associated with the dry cleaning operation has been documented, and these contaminants (i.e., chlorinated VOCs and their by products) may be present in soil and groundwater at Site 19. Although the quantity of solvent used at the dry cleaning facility is unknown, it is known that no more then 1,200 gallons of spent PCE were stored at the dry cleaning facility at any given time.

The conclusions of the Site 19 RI/RA are as follows:

- Very few VOCs were detected at Site 19. Low concentrations of VOCs were detected in Site 19 groundwater, subsurface soil, and surface soil, and VOCs were detected at concentrations that were less than the minimum screening criteria.

- PAHs were present in groundwater, subsurface soil, and surface soil samples collected at Site 19. Benzo(a)anthracene and BAP exceeded the minimum screening criteria most frequently of the detected PAHs and were found in the three media sampled. PAH exceedances at Site 19 do not appear to be confined to any particular area of the site.

- Several metals were detected in surface soil and subsurface soil (but not groundwater) samples collected at Site 19 at concentrations greater than minimum screening levels. Lead concentrations exceeded the minimum screening level at most surface soil sampling locations except for NTC19SB15. Exceedances of lead in subsurface soil at Site 19 do not appear to be confined to any particular area of the site. In subsurface soil samples, lead was not detected as frequently in excess of the minimum screening level. Lead was detected at 7 of the 18 subsurface sample locations.

- Based on the HHRA, the following contaminants were identified as COCs based on non-cancer Hazard Quotients greater than 1.0 or cancer risks greater than $1x\ 10^{-6}$: arsenic and PAHs (benzo(a)anthracene, BAP, benzo(b)fluoranthene, chrysene, and dibenzo(a,h)anthracene) in groundwater potentially used as drinking water and in soil. These are the primary COC risk drivers for total future residents. Groundwater at the site is not used and is not expected to be used in the future as drinking water. Naval Station Great Lakes is an active Navy facility and is expected to remain active for the foreseeable future. In accordance with Naval Station Great Lakes Instruction 11130.1 dated September 29, 2003, use of groundwater and surface water runoff within all geographical areas of the base, for any purpose, is strictly prohibited without prior written approval. Groundwater underlying Naval Station Great Lakes is not used for drinking water and is not expected to be used in the future. Drinking water for the base and residents of the surrounding communities is supplied from municipal systems drawing water from Lake Michigan.

- No chemicals in soil were eliminated as COPCs/COCs on the basis of comparisons to background concentrations. Most PAHs selected as COPCs/COCs in exposed surface soil were detected at maximum concentrations that did not exceed surface soil background data as shown in the table below. Based on this information and Illinois EPA determination of PAH background urban concentrations, is possible that these PAHs could be attributed to background conditions and inclusion of these chemicals as COPCs/COCs may result in an overestimation of total risks for this site. In addition, based on the Illinois EPA Summary of Selected Background Conditions for Inorganics in Soil study, it is possible that the arsenic and manganese concentrations could also be attributed to background as shown in the table below. The Illinois EPA TACO regulations that include the concentrations of PAH in background soil (Title 35, Part 742, Appendix A, Table H) and the concentrations of inorganics in background soil (Title 35, Part 742, Appendix A, Table G) are not Applicable nor Relevant and Appropriate Regulations at this site but merely a To Be Considered (TBC) regulation.

COPCs/COCs	Surface Soil Average*/Maximum	Illinois EPA Background Soil	Subsurface Soil Average*/Maximum	Illinois EPA Background Soil
Inorganics (mg/kg)				
Arsenic	11.5/32.2	13	9.77/25.1	13
Manganese	889/1820	636	736/1600	636
Polynuclear Aromatic Hydrocarbons (µg/kg)				
Benzo(a)anthracene	444/1700	1800	17/20	NA
Benzo(a)pyrene	314/1200	2100	14.5/22	NA
Benzo(b)fluoranthene	429/1700	2100	16/18	NA
Chrysene	372/1900	2700	10.6/18	NA
Dibenzo(a,h)anthracene	68.3/160	420	N/A	NA

* Average is the average of the samples collected with positive results (not including non-detects).

- The lead risk assessment results, based on the IEUBK Model, estimate a 0.136 percent chance that any child will have a blood lead value greater than 10 µg/dL, which is less than the USEPA acceptable target of 5 percent. The Adult Lead Model results indicate that the central estimate blood lead levels for construction workers and maintenance/occupational workers and their fetuses were less than the established level of concern (10 µg/dL). The model also shows the probabilities that receptor blood-lead levels would be less than USEPA's goal of limiting exposure to lead so that no more than 5 percent of the exposed receptors have an estimated blood-lead level greater than the established level of concern.

7.2 RECOMMENDATIONS

Based on the results of this RI/RA, no further investigation is warranted and preparation of a Focused Feasibility Study is recommended for this site. Potential remedial alternatives would include, but not be limited to, No Action, Limited Action (Land Use Controls), and a Removal Action. A Proposed Plan and Record of Decision should be prepared for the alternative recommended by the Focused Feasibility Study.

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APPENDIX A

FIELD FORMS

APPENDIX A.1

TASK MODIFICATION FORMS

TETRA TECH NUS
FIELD TASK MODIFICATION REQUEST FORM

Site 19	112G009316.0000.0310	1
Project/Installation Name	CTO & Project Number	Task Mod. Number
Work Plan	Site 19 all locations	12/1/08
Modification To (e.g. Work Plan)	Site/Sample Location	Date

Activity Description: DPT locations will be Modified due to Site conditions. Large Piles onsite obstructing locations identified in WP. Field personel will try and get as close as possible

Reason for Change: Site Disturbance

Recommended Disposition: Get as close to origional locations as possible

Field Operations Leader (Signature) — Date: 12/1/08

Approved Disposition:

Project/Task Order Manager (Signature) — Date: 12/16/08

Distribution:

Program/Project File –
Project/Task Order Manager –
Field Operations Leader –

Other:

TETRA TECH NUS
FIELD TASK MODIFICATION REQUEST FORM

Site 19	112G00936.0000.0810	2
Project/Installation Name	**CTO & Project Number**	**Task Mod. Number**
Work Plan	Site 19 all locations	12/3/08
Modification To (e.g. Work Plan)	**Site/Sample Location**	**Date**

Activity Description: Additional Samples (soil) collected. In surface soil-fill + split 20 surface soil-native in HP to 10 surface soil-fill and 10 surface soil-native. An additional 4 surface soil native had already been collected.

Reason for Change: Lead readings were higher at the non-Native surface soil than the native surface soils. So it was decided to collect 10 non-Native surface soil samples as well as 10 Native surface soil samples in the case of a risk assessment potentially being conducted.

Recommended Disposition: Select 10 additional samples were lead readings were highest via the XRF.

Field Operations Leader (Signature) — Date: 12/3/08

Approved Disposition:
DISCUSSED FIELD SCREEN LEAD RESULTS WITH ILLINOIS EPA AND NAVY AND THE DECISION OF THE TEAM WAS TO COLLECT A MINIMUM OF 10 SURFACE SOIL-FILL AND 10 SURFACE-SOIL-NATIVE

Project/Task Order Manager (Signature) — Date: 12/16/08

Distribution:

Program/Project File –
Project/Task Order Manager –
Field Operations Leader –

Other: _____

TETRA TECH NUS
FIELD TASK MODIFICATION REQUEST FORM

Site 19	112G00936.0000.0310	3
Project/Installation Name	**CTO & Project Number**	**Task Mod. Number**
Work Plan	Site 19 Well locations	12/5/08
Modification To (e.g. Work Plan)	**Site/Sample Location**	**Date**

Activity Description: Installing monitoring wells in very tight clay

Reason for Change: Clay will not produce any water after 2+ days of hole being open. Even after drilling down to 30-40 ft bgs.

Recommended Disposition: Only 2 monitoring wells were installed in locations that had a sandier material that allowed water to collect in the wells. 6 were intended to be installed. Wells were also installed as stick-ups due to constant site disturbance.

Field Operations Leader (Signature) — **Date** 12/5/08

Approved Disposition:
LACK OF WATER IN 38 TO 40 FOOT SOIL BORING AFTER BEING OPEN (+NAVY) OVER THE WEEKEND WAS DISCUSSED WITH ILLINOIS EPA AND THE DECISION OF THE TEAM WAS TO INSTALL 2 WELLS AND GROUT THE 4 DRY HOLES

Project/Task Order Manager (Signature) — **Date** 12/16/08

Distribution:

Program/Project File –
Project/Task Order Manager –
Field Operations Leader –

Other: _____

APPENDIX A.2

BORING LOGS

REMEDIAL INVESTIGATION AND RISK ASSESSMENT REPORT

FOR

SITE 19 – SMALL ARMS RANGE 910

NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command
Midwest
201 Decatur Avenue, Building 1A
Great Lakes, Illinois 60088

Submitted by:
Tetra Tech NUS, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 468

JUNE 2009

BORING LOGS APPROVED FOR SUBMITTAL BY:

6/29/09

KEITH HENN, P.G.
ILLINOIS LICENSED GEOLOGIST 196-001091

LICENSED PROFESSIONAL GEOLOGIST
KEITH W. HENN
196-001091
ILLINOIS

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB01
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe/HSA
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB01									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	CL-ML	brown	dark brown	DMP	CLAY with silt	and little coarse sand	0
1									0
2									0
3									0
4	2	100							0
			SP	brown	-NA-	DMP	SAND - well graded		
5									0
			CL-ML	brown	light brown	MST	CLAY	with some sand and little gravel	
6									0
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=182 1.5'=32 2.5'=32 3.5'=45 4.5'=27 5.5'-6.5'=ND 7.5'=14 8.5'=13 9.5'=15 10.5'=16 11.5'=13

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB02
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB02									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	-NA-	DRY	Organic CLAY		0
			SP	brown	-NA-	DMP	SAND - well graded		
1			CL	brown	light brown	MST	CLAY with sand	Little coarse sand	0
2									0
3									0
4	2	87							0
5									0
6									0
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=107 1.5'=12 2.5'=21 3.5'=102 4.5'-6.5'=ND 7.5'=22 8.5-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB03
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/05/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: DPT
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB03

Depth (ft bgs)*	Run No.	Run % Recov	Lithology USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	75	OL	dark brown	-NA-	DMP	Organic CLAY		0
			SP	brown	-NA-	DMP	SAND - well graded		
			CL	brown	light brown	WET	CLAY	with little coarse sand and trace gravel	
1									0
2									0
3									0
4	2	87							0
5									0
6									0
7									0
8	3	100							0
9									0
10									0
11									0
12	4	100							0
13									0
14									0
15									0
16	5	100							0
17									0
18									0
19	6	100							0
20									0
21									0
22	7	100							0
23									0
24	8	100							0
25									0
26	9	100							0
27									0
28	10	100							0
29									0

End of Boring: 30 feet bgs
Notes: Temporary well point installed but after a couple of days it did not produce any water so it was abandoned. XRF Lead Readings (ppm): 0.5’=92 1.5’=175 2.5’=ND 3.5’=68
4.5’=113 5.5’-7.5'=ND 8.5’-22 9.5’=ND 10.5’=17 11.5’=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB04
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB04									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	-NA-	DMP	Organic CLAY		0
1			GP	light tan	-NA-	DRY	SANDY GRAVEL with minor clay		0
			CL-ML	dark orange	brown	DMP	SILTY CLAY	with little sand	
2									0
3									0
			SM	brown	light brown	DMP	SAND with silt		
4	2	87							0
5									0
			CL	dark brown	light brown	MST	CLAY	little coarse grained sands	
6									0
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=88 1.5'=19 2.5'=33 3.5'-4.5'=ND 5.5'=14 6.5'-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB05
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB05									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	-NA-	DMP	Organic CLAY		0
1			SW	brown	-Select-	DRY	SAND - poorly graded		0
2			CL	brown	dark orange	DMP	CLAY with sand	little sand and trace gravel. some brick frags	0
3			GW	light tan	-NA-	DRY	GRAVEL - poorly graded	with somee sand	0
			SP-SC	brown	light brown	MST	SAND with clay	increasing clay with depth	
4	2	87							0
5									0
6									0
7									0
8	3	100							0
9									0
			CL	grey	-NA-	WET	CLAY	little coarse grained sands	
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=123 1.5'=119 2.5'=26 3.5-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB06
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): Yes (NTC19-MW01)

RI Field Investigation - Boring ID: NTC19SB06									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	brown	DRY	Organic CLAY	little sand	0
1			CL	brown	dark orange	DMP	CLAY	little sand	0
2									0
3			SP	dark orange	brown	MST	SAND - well graded	trace gravel	0
4	2	87							0
5									0
6									0
7			SW	grey	-NA-	WET	SAND - poorly graded	trace gravel	0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=102 1.5'=815 2.5'=25 3.5'=34 4.5'-5.5'=ND 6.5'=24 7.5'-8.5'=ND 9.5'=16 10.5'-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB07
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB07									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	SM	dark brown	brown	DRY	SILT with sand and clay	trace gravel	0
1									0
2									0
			SM	brown	dark orange	DMP	SAND with silt and clay	little gravel	
3									0
4	2	87							0
5									0
			SM	brown	dark orange	WET	SAND with silt	little gravel	
6									0
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings(ppm): 0.5'=59 1.5'=120 2.5'=157 3.5'=102 4.5'=48 5.5-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB08
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB08									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	CL-ML	dark brown	brown	DMP	SILTY CLAY	little fine gravels	0
1			SP-SM	brown	dark orange	DMP	SAND with silt	trace gravel	0
2									0
3									0
4	2	87							0
5									0
6									0
7									0
			CL-ML	grey	-NA-	WET	CLAY with silt	trace sand	
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=95 1.5'=172 2.5'=82 3.5-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB09
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): Yes (NTC19-MW02)

RI Field Investigation - Boring ID: NTC19SB09									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	CL-ML	dark brown	brown	DMP	SILTY CLAY	little coarse sand	0
1			SC-SM	dark brown	brown	DMP	SILTY CLAY	little coarse sand	0
2			SM	brown	-NA-	MST	SILTY SAND	little gravel	0
3									0
4	2	87							0
5									0
6									0
7			SM	grey	-NA-	WET	SILTY SAND		0
8	3	100							0
9			CL-ML	grey	-NA-	WET	SILTY CLAY		0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=79 1.5'=23 2.5-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB10
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB10									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	brown	DRY	Organic CLAY	little fine gravel	0
			SM	brown	-NA-	DMP	SILTY SAND	with little gravel and clay increading in depth	
1									0
2									0
3									0
			CL-ML	brown	grey	MST	SILTY CLAY	with little coarse sand and gravel	
4	2	87							0
5									0
6									0
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=29 1.5'=42 2.5'=16 3.5'=40 4.5'=20 5.5-6.5'=ND 7.5'=16 8.5'-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB11
Start Date: 12/02/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/02/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB11									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	black	dark brown	DRY	Organic CLAY		0
1			SM	dark brown	black	DMP	SILTY SAND	little gravelly black asphalt like material	0
			CL-ML	dark brown	light brown	DMP	SILTY CLAY	silty clay with increasing clay with depth.	
2									0
3									0
4	2	87							0
5									0
6									0
7									0
8	3	100							0
9									0
			CL-ML	grey	-NA-	WET	SILTY CLAY	little gravel throughout	
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=29 1.5'=40 2.5-9.5'=ND 10.5'=16 11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB12
Start Date: 12/03/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/06/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB12

Depth (ft bgs)*	Run No.	Run % Recov	Lithology USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	75	OL	dark brown	brown	DMP	Organic CLAY	some silt little gravel	0
1			GW	light tan	-Select-	DRY	GRAVEL with minor fine sand and silt		0
			CL-ML	brown	-Select-	DMP	CLAY with sand and silt	little coarse sand and fine gravel	
2									0
3									0
4	2	87	CL-ML	brown	grey	MST	CLAY with silt		0
5									0
6									0
7									0
8	3	100							0
9									0
			CL-ML	grey	-NA-	WET	CLAY with silt		
10									0
11									0
12	4	100							0
13									0
14									0
15	5	100							0
16									0
17									0
18	6	100							0
19									0
20	7	100							0
21									0
22									0
23	8	100							0
24									0
25									0
26	9	100							0
27									0
28	10	100							0
29									0

30											0

End of Boring: 31 feet bgs
Notes: Installed temporary well point but after setting for about 2 days it did not produce water so it was abandoned in place. XRF readings (ppm): 0.5'=78ppm 1.5'=29ppm 2.5'-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB13
Start Date: 12/03/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/03/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB13									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	brown	DMP	Organic CLAY	some silt and little sand and gravel	0
			GW	light tan	-NA-	DRY	GRAVEL		
			CL-ML	brown	grey	DMP	SILTY CLAY	with little sand and fine gravel	
1									0
2									0
3									0
4	2	87	CL	brown	grey	MST	CLAY with silt	little coarse grain sands and fine gravels	0
5									0
6									0
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=99ppm 1.5'-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB14
Start Date: 12/03/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/03/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB14									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	brown	DMP	Organic CLAY	with some silt and little sand and gravel	0
1			GW	light tan	-NA-	DRY	GRAVEL	little sand	0
			SP	brown	-NA-	DMP	SAND - well graded	little gravel	
2			CL-ML	brown	grey	MST	SILTY CLAY	little coarse sand and trace gravel	0
3									0
4	2	87							0
5									0
6									0
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=111 1.5'-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB15
Start Date: 12/03/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/03/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB15									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	brown	WET	Organic CLAY	some silt and little sand	0
			SP	light brown	-NA-	DMP	SAND - well graded	little fine gravel	
			CL-ML	brown	grey	MST	CLAY with silt	little sand and gravel	
1									0
2									0
3									0
4	2	87							0
5									0
6									0
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings(ppm): 0.5'=80 1.5-6.5'=ND 7.5'=18 8.5'-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB16
Start Date: 12/03/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/03/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB16									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	brown	DMP	Organic CLAY	1-1.3 brick/gravel layer	0
1									0
2			SP	brown	dark orange	DMP	SAND - well graded	with some little gravel	0
3									0
4	2	87							0
5									0
6									0
			SC-SM	grey	light red	WET	CLAY with sand and silt	little gravel	
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Lead Readings (ppm): 0.5'=44 1.5'=38 2.5'=196 3.5'=14 4.5'=ND 5.5'=54 6.5'=27 7.5'-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB17
Start Date: 12/03/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/05/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB17

Depth (ft bgs)*	Run No.	Run % Recvy	Lithology USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	75	OL	dark brown	-NA-	DMP	Organic CLAY	with some silt and little fine gravels and coarse sands	0
			SC-SM	brown	-NA-	DMP	SAND with silt and clay	little gravel	
1									0
2									0
3									0
4	2	87							0
5									0
6									0
			CL-ML	grey	-NA-	WET	SILTY CLAY	little gravel and coarse sand aprox 36.5-37.5' bgs a few thin layers of sandy clay with silt	
7									0
8	3	100							0
9									0
10									0
11									0
12	4	100							0
13									0
14									0
15									0
16	5	100							0
17									0
18									0
19	6	100							0
20									0
21									0
22	7	100							0
23									0
24	8	100							0
25									0
26	9	100							0
27									0
28	10	100							0
29									0

30	11	100							0
31									0
32	12	100							0
33									0
34	13	100							0
35									0
36	14	100							0
37									0
38	15	100							0
39									0

End of Boring: 40 feet bgs
Notes: Temporary well point installed but after a couple of days it did not produce any water so it was abandoned. XRF Lead Readings (ppm): 0.5'=31 1.5'=613 2.5'=22 3.5'-7.5'
8.5'=19 9.5-11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB18
Start Date: 12/03/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/06/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB18									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	-NA-	DMP	Organic CLAY	with some silt and little sand and gravel	0
			GW	light tan	-NA-	DRY	GRAVEL	with some sand	
1									0
			OL	dark brown	-NA-	MST	Organic CLAY	with little sand and gravel	
2			CL-ML	brown	grey	MST	SILTY CLAY	with little coarse sand and fine gravel	0
3									0
4	2	87							0
5									0
6									0
7									0
8	3	100							0
9									0
10									0
11									0
12	4	100							0
13									0
14									0
15									0
16	5	100							0
17									0
18									0
19	6	100							0
20									0
21									0
22									0
23	7	100							0
24									0
25									0
26									0
27	8	100							0
28									0
29									0

End of Boring: 30 feet bgs
Notes: Temporary well point installed but after a couple of days it did not produce any water so it was abandoned. XRF Lead Readings (ppm): 0.5'=22 1.5'=67 2.5-5.5'=ND 6.5'= 8.5'=ND 9.5'=19 10.5'=16 11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB19
Start Date: 12/03/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/03/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB19									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	-NA-	DMP	Organic CLAY	little gravel and sand (1in of gravel at 1.5')	0
1									0
			SP	brown	-NA-	DMP	SAND - well graded	some fine gravel	
2									0
3			CL-ML	brown	grey	MST	SILTY CLAY	little coarse sand and gravel	0
4	2	87							0
5									0
6									0
7									0
8	3	100							0
9									0
10									0
11									0

End of Boring: 12 feet bgs
Notes: XRF Readings (ppm): 0.5'=31 1.5-9.5'=ND 10.5'=13 11.5'=ND

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - RI Field Investigation - Round 1 - Site 19
Boring ID: NTC19SB20
Start Date: 12/03/2008
Project Number: 112G00936
Geologist: Shannon Hill
End of Boring Date: 12/03/2008
Drilling Company: Environmental Field Services, Inc.
Lead Driller: Jeremy Boeche
Background PID Screening: 0.0 ppm
Drilling Rig: Geoprobe
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

RI Field Investigation - Boring ID: NTC19SB20									Analytical Results - Screening
	Run		Lithology						
Depth (ft bgs)*	No.	% Recov	USCS	Primary Color	Secondary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	75	OL	dark brown	-NA-	DMP	Organic CLAY	little gravel and coarse sand	0
1			CL-ML	brown	grey	DMP	SILTY CLAY	little fine gravel and coarse sand	0
2									0
3									0
4	2	100							0
5									0
6			SM	brown	-NA-	MST	SAND with silt	little coarse sand	0
7									0
8	3	100							0
9									0
10			CL-ML	grey	-NA-	MST	SILTY CLAY	little gravel and coarse sand	0
11									0

End of Boring: 12 feet bgs
Notes: Temporary well point installed but after a couple of days it did not produce any water so it was abandoned. XRF Lead Readings (ppm): 0.5'=22 1.5-11.5'=ND

APPENDIX A.3

SOIL SAMPLE LOG SHEETS

Start Report

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB01-SO-0608	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB01	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	08:20	DPT	6.5=ND 7.5'=14	2	brown	Native Surface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	08:20	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	08:20	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	08:20	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB01-SO-0002	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB01	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	08:10	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-4
✗			SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		
✗			SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB02-SO-0204	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB02	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	08:54	DPT	Lead: 2.5'=21ppm, 3.5'=102ppm	2	brown	Native surface soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	08:52	SW-846 6010B	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	08:52	SW-846 8270C	PAHs	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	08:52	SW-846 8260B	TCL VOCs	None	3	EnCore	5 gram EnCore		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB03-SO-0103	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB03	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	09:00	DPT	Lead: 1.5'=12, 2.5'=21	2	brown	Native Surface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	09:00	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	09:00	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	09:00	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB03-SO-0810	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB03	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	09:10	DPT	Lead: 8.5'=22, 9.5'=ND	2	brown	

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	09:10	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	09:10	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	09:10	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB03-SO-0001	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB03	**Created Date**	12/4/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	08:50	SW-846 6010B	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	Surface soil (not native)	ED00000091-4

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB04-SO-0204	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB04	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	14:48	DPT	Lead: 2.5'=33, 3.5'=ND	2	dark orange	Native Surface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	09:45	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	09:45	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	09:45	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB05-SO-0406	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB05	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	10:20	DPT	Lead: 2.5'=26, 3.5'=11.5	2	brown	Native Surface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	10:20	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	10:20	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	10:20	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB05-SO-0608	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB05	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	10:30	DPT	ND	2	brown	Subsurface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	10:30	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	10:30	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	10:30	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	10:30	ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		ED00000091-1

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB06-SO-0204	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB06	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	11:30	DPT	XRF: 1.5'= 815, 2.5'= 25, 3.5'=34	2	brown	Native Surface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	11:30	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	11:30	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	11:30	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB06-SO-0608	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB06	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	11:40	DPT	XRF: 6.5'=24, 7.5'= ND	2	dark orange	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	11:40	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	11:40	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	11:40	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB06-SO-0001	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB06	**Created Date**	12/4/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	11:10	DPT	XRF: 0.5'=102, 1.5'=815	1	dark brown	Surface Soil (non native)

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/2/08	11:10	SW-846 6010B	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap		ED00000091-4

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB07-SO-0507	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB07	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	13:11	DPT	XRF: ND	2	brown	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/2/08	13:11	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	13:11	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	13:11	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB07-SO-0001	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB07	**Created Date**	12/4/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	13:00	DPT	XRF: 0.5'= 59. 1.5'= 120	1	dark brown	Surface Soil (non native)

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/2/08	13:00	SW-846 6010B	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap		ED00000091-4

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB08-SO-0103	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB08	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	13:40	DPT	XRF: 1.5'= 172, 2.5'= 82	2	brown	

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	13:40	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	13:40	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	13:40	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB08-SO-0406	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB08	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	13:45	DPT	XRF: ND	2	brown	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	13:45	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	13:45	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	13:45	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB09-SO-0002	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB09	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	14:10	DPT	XRF: 0.5'= 79, 1.5'= 23	2	dark brown	Surface Soil (non native)

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	14:10	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	14:10	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	14:10	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB09-SO-0406	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB09	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	14:20	DPT	XRF: ND	2	brown	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/2/08	14:20	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	14:20	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	14:20	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB10-SO-0002	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB10	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	15:02	DPT	XRF: 0.5'= 29, 1.5'= 42	2	brown	Surface Sample (non native)

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	15:02	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	15:02	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	15:02	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB10-SO-0507	**Created By**	John Wright
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB10	**Created Date**	11/25/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	15:08	DPT	XRF: ND	2	brown	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/2/08	15:08	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	15:08	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	15:08	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB11-SO-0002	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB11	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/2/08	15:47	DPT	XRF: 0.5'= 29, 1.5'= 40	2	brown	Surface Soil Sample (non native)

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/2/08	15:47	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-1
✓	12/2/08	15:47	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✓	12/2/08	15:47	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-1
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB12-SO-0002	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB12	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	08:32	DPT	XRF: 0.5'= 78, 1.5'= 29	2	brown	Surface Soil (non native)

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	08:32	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	08:32	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	08:32	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB12-SO-0507	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB12	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	08:40	DPT	XRF: ND	2	brown	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/3/08	08:40	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	08:40	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	08:40	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	08:40	ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		ED00000091-2

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB13-SO-0103	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB13	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	09:08	DPT	XRF: ND	2	brown	Native Surface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	09:08	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	09:08	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	09:08	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB14-SO-0204	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB14	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	10:00	DPT	XRF: ND	2	brown	Native Surface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/3/08	10:00	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	10:00	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	10:00	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB14-SO-0507	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB14	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	10:05	DPT	XRF: ND	2	brown	

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	10:05	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	10:05	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	10:05	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB15-SO-0103	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB15	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	10:23	DPT	XRF: ND	2	brown	Native Surface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/3/08	10:23	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	10:23	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	10:23	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB15-SO-0406	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB15	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	10:47	DPT	XRF: ND	2	grey	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	10:27	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	10:27	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	10:27	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB16-SO-0103	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB16	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	11:01	DPT	XRF: 1.5'= 38, 2.5'= 196	2	brown	Native Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	11:01	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	11:01	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	11:01	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB16-SO-0507	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB16	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	11:06	DPT	XRF: 5.5'= 54, 6.5'= 27	2	brown	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	11:06	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	11:06	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	11:06	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB17-SO-0002	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB17	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	11:39	DPT	XRF: 0.5'= 31, 1.5'= 613	2	brown	Surface Soil (non native)

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	11:39	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	11:39	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	11:39	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB17-SO-0406	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB17	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	11:44	DPT	XRF: ND	2	grey-brown	

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	11:44	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	11:44	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	11:44	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB18-SO-0204	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB18	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	13:16	DPT	XRF: ND	2	brown	Native Surface Soil

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	13:16	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	13:16	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	13:16	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB18-SO-0406	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB18	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	13:20	DPT	XRF: ND	2	grey-brown	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/3/08	13:20	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	13:20	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	13:20	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	13:20	ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		ED00000091-2

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB19-SO-0002	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB19	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	13:50	DPT	XRF: 0.5'= 31, 1.5'= ND	2	dark brown	Surface Soil (non native)

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	13:50	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	13:50	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	13:50	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB19-SO-0406	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB19	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	13:53	DPT	XRF: ND	2	brown	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain #
✓	12/3/08	13:53	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	13:53	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	13:53	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB20-SO-0002	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB20	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	14:30	DPT	XRF: 0.5'= 22ppm	2	dark brown	Surface Soil (non native)

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	14:30	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	14:30	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	14:30	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

Tetra Tech NUS, Inc.

SOIL SEDIMENT SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**Sample ID #**	NTC19SB20-SO-0406	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Sample Location ID**	NTC19SB20	**Created Date**	11/26/08
Task/Contract #	0468	**Sampled By**	Shannon Hill	**Modified By**	Shannon Hill
WBS Code #		**Concentration**	Not known	**Modified Date**	12/15/08
QA Sample Type				**Printed By**	John Wright
Status	Complete			**Printed Date**	1/9/09

Sample Collection Records

Date	Time	Method	Monitor (ppm)	Depth (ft)	Color	Description
12/3/08	14:40	DPT	XRF: ND	2	brown	Subsurface Soil Sample

Analysis Records

Collected	Date	Time	Analysis / Method	Description of Analysis	Preservative	Count	Type	Requirements	Comments	Chain#
✓	12/3/08	14:40	SW-846 8260B	TCL VOCs	4°C	3	EnCore	5 gram EnCore		ED00000091-2
✓	12/3/08	14:40	SW-846 6010B	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✓	12/3/08	14:40	SW-846 8270C	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		ED00000091-2
✗			ASTM D422	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		

General Observations and Notes

No Notes

- End of Report -

APPENDIX A.4

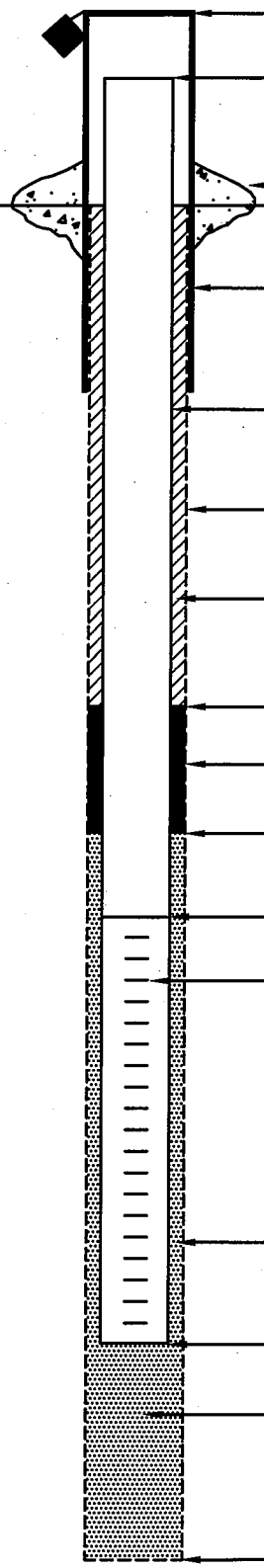
MONITORING WELL CONSTRUCTION SHEETS AND SURVEY

WELL NO.: NTC19-MW01

Tetra Tech NUS, Inc.

OVERBURDEN MONITORING WELL SHEET STICK-UP

PROJECT NAVST Great Lakes	LOCATION Site 19	DRILLER Jeremy Boeche
PROJECT NO. 00936 CTO 4168	BORING SB06	DRILLING METHOD HSA
DATE BEGUN 12/4/08	DATE COMPLETED 12/4/08	
FIELD GEOLOGIST C. Warino		DEVELOPMENT METHOD Whaler Pump
GROUND ELEVATION	DATUM	



ELEVATION/HEIGHT OF TOP OF SURFACE CASING: NA / NA

ELEVATION/HEIGHT OF TOP OF RISER PIPE: 665.06 / 2.48

TYPE OF SURFACE SEAL: Concrete

I.D. OF SURFACE CASING:

TYPE OF SURFACE CASING:

RISER PIPE I.D.: 2"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 4.25"

TYPE OF BACKFILL: Sand

ELEVATION/DEPTH TOP OF SEAL: 660.06 / 2.5

TYPE OF SEAL: Bentonite

DEPTH TOP OF SAND PACK: 4.5

ELEVATION/DEPTH TOP OF SCREEN: 657.06 / 5.5

TYPE OF SCREEN: PVC

SLOT SIZE x LENGTH: 0.010" x 10'

I.D. OF SCREEN: 2"

TYPE OF SAND PACK: #1

ELEVATION/DEPTH BOTTOM OF SCREEN: 647.06 / 15.5'

ELEVATION/DEPTH BOTTOM OF SAND PACK: 646.56 / 16'

BACKFILL MATERIAL BELOW SAND:

ELEVATION/DEPTH OF HOLE: 646.56 / 16'

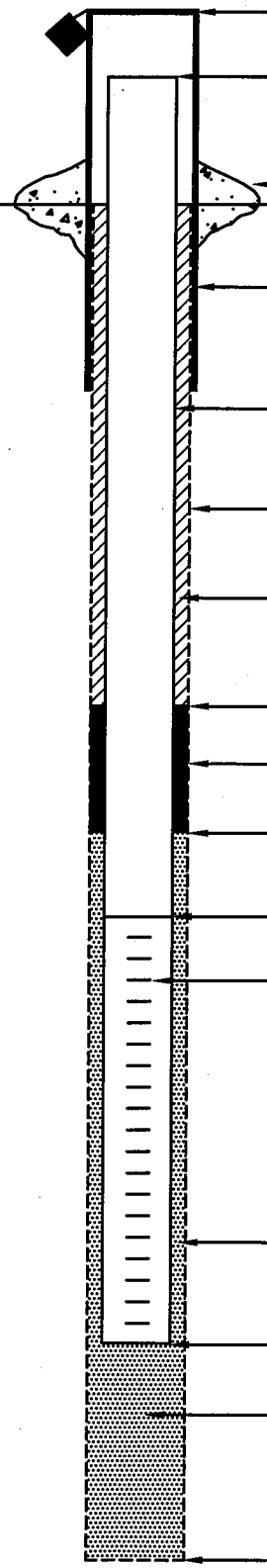
ACAD:FORM_MWSU.dwg 07/20/99 INL

WELL NO.: NTC19 - MW02

Tetra Tech NUS, Inc.

OVERBURDEN MONITORING WELL SHEET STICK-UP

PROJECT NAVST Great Lakes	LOCATION Site 19	DRILLER Jeremy Breche
PROJECT NO. 009936 CTO 468	BORING SB09	DRILLING METHOD HSA
DATE BEGUN 12/4/08	DATE COMPLETED 12/4/08	
FIELD GEOLOGIST C. Warino		DEVELOPMENT METHOD Peristaltic Pump
GROUND ELEVATION	DATUM	



ELEVATION/HEIGHT OF TOP OF SURFACE CASING: NA / NA

ELEVATION/HEIGHT OF TOP OF RISER PIPE: 664.89 / 3.13

TYPE OF SURFACE SEAL: concrete

I.D. OF SURFACE CASING:

TYPE OF SURFACE CASING:

RISER PIPE I.D.: 2"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 4.25"

TYPE OF BACKFILL: Sand

ELEVATION/DEPTH TOP OF SEAL: 656.82 / 5.13'

TYPE OF SEAL: Bentonite

DEPTH TOP OF SAND PACK: 7.13'

ELEVATION/DEPTH TOP OF SCREEN: 653.82 / 8.13'

TYPE OF SCREEN: PVC

SLOT SIZE x LENGTH: 0.010" x 10'

I.D. OF SCREEN: 2"

TYPE OF SAND PACK: #1

ELEVATION/DEPTH BOTTOM OF SCREEN: 653.82 / 8.13'

ELEVATION/DEPTH BOTTOM OF SAND PACK: 653.32 / 18.63'

BACKFILL MATERIAL BELOW SAND:

ELEVATION/DEPTH OF HOLE: 653.32 / 18.63'

ACAD:FORM_MWSU.dwg 07/20/99 INL

APPENDIX A.5

MONITORING WELL DEVELOPMENT SHEETS

Tetra Tech NUS, Inc.

EXISTING

MONITORING WELL DEVELOPMENT RECORD

Well: NTC 19 MW-01
Site: Site 19
Date Installed: 12/4/08
Date Developed: 12/4/08
Dev. Method: Surged & Pumped
Pump Type: Waterra

Depth to Bottom (ft.): 15.5
Static Water Level Before (ft.): 9.91
Static Water Level After (ft.):
Screen Length (ft.): 10'
One Well Volume (gal/L): ~1 gal
Casing ID (in.): 2 inch PVC

Responsible Personnel: G. Warring
Drilling Company: E.F.S.
Project Name: NAVAL STATION GREAT LAKES Site 19
Project Number: 00936 CTO 468
PID Readings: Bore Hole 0.0 ppm
PID Readings: Breathing Zone 0.0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)
0835	0	0	9.91	–	–	–	–	SWABBING SCREEN
0840	0.5	600	10.61	11.81	6.51	0.14	MAX	BROWN, SILTY
0845		600	10.66	11.81	7.12	0.27	MAX	TAN, SILTY
0850		600	10.95	13.84	7.22	0.14	MAX	TAN, SILTY
0855		600	10.95	13.72	7.46	0.14	MAX	TAN, SILTY
0900		600	10.85	13.96	7.46	0.14	MAX	TAN, SILTY
0910	5.0	600	10.80	13.98	7.49	0.13	MAX	TAN, SILTY
0920		600	10.71	13.30	7.42	0.13	310	CLEAR/CLOUDY
0930		600	10.71	14.37	7.47	0.13	100	CLEAR
0935	END	DEVELOPMENT						WATER IS VISIBLY CLEAR
								TURBIDITY IS <100 ON THE
								HORRIBA.

Tetra Tech NUS, Inc.

EXISTING

MONITORING WELL DEVELOPMENT RECORD

Well: NTC19-MW02
Site: SITE 1 - WILLOW GLEN GOLF COURS
Date Installed: 12/4/08
Date Developed: 12/7/08
Dev. Method: Surged & Pumped
Pump Type: Peristaltic Pump

Depth to Bottom (ft.): 18.13
Static Water Level Before (ft.): 15.2'
Static Water Level After (ft.):
Screen Length (ft.): 10'
One Well Volume (gal/L):
Casing ID (in.): 2 inch PVC

Responsible Personnel: C. Warino
Drilling Company: EFS
Project Name: NAVAL STATION GREAT LAKES Site 19
Project Number: 00936 CTO 468
PID Readings: Bore Hole 0.0 ppm
PID Readings: Breathing Zone 0.0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)
10:17	—	400	15.41	12.77	7.89	0.10	220	Clear
10:22	~1 gal	"	16.50	13.62	7.82	0.11	140	Clear
10:27	~1.5 gal	"	17.82	13.81	7.92	0.10	120	Clear
*	PUMPED	WELL	DRY. *					ALLOWING RECHARGE.

APPENDIX A.6

GROUNDWATER SAMPLE LOG SHEETS

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

Event:	RI Field Investigation
Site Name:	Site 19 - GREAT LAKES NTC
Project No:	112G00936.0000.0230 (ED00000091)

Sample ID:	**NTC19-MW01-1208**	Sampler:	Shannon Hill/Charlie Warino
Well ID:	NTC19-MW01	Well Type:	Monitoring Well
QC Duplicate ID:	NTC19FD120808-01	MS/MSD:	Yes-MS/MSD

Well Information

Well Diameter (in)	2	Static Water Level (ft-BTOR)	9.96
Top of Screen (ft-BTOR)	5.5	H&S PID Monitor Reading (ppm)	0
Bottom of Screen (ft-BTOR)	15.5	Purge Method	Low flow - peristaltic
Total Depth of Well (ft-BTOR)	15.5	Sample Method	Low flow - peristaltic

Equipment

QED: MP20-1513	Water Quality Meter	Hach: 0604C016375	Turbidity Meter	H05002712	Pump Control Box

Purge Information

Date	Time	Level (ft-BTOR)	Rate (mL/min)	Color	Odor	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTUs)	Temp (C)	ORP (mV)	Salinity (%)	Other
12/8/08	16:52	9.96	200	Slightly Turbid	None	NA	NA	NA	NA	NA	NA	NA	NA
12/8/08	16:59	10.21	200	Slightly Turbid	None	7.43	1.158	5.97	NA	12.29	149	NA	NA
12/8/08	17:05	10.21	200	Slightly Turbid	None	7.38	1.123	6.25	NA	11.43	150	NA	NA
12/8/08	17:10	10.20	200	Clear	None	7.34	1.124	6.08	NA	11.14	151	NA	NA
12/8/08	17:15	10.21	200	Clear	None	7.31	1.130	5.92	47.4	12.02	153	NA	NA
12/8/08	17:20	10.21	200	Clear	None	7.35	1.115	5.81	24.8	11.83	152	NA	NA
12/8/08	17:25	10.21	200	Clear	None	7.36	1.118	5.73	21.8	11.71	154	NA	NA
12/8/08	17:30	10.21	200	Clear	None	7.45	1.117	5.54	17.2	11.18	149	NA	NA
12/8/08	17:36	10.21	200	Clear	None	7.37	1.120	5.38	16.4	11.15	153	NA	NA
12/8/08	17:40	10.21	200	Clear	None	7.45	1.107	5.33	14.0	10.66	150	NA	NA
12/8/08	17:45	10.21	200	Clear	None	7.44	1.118	5.20	13.4	10.85	150	NA	NA
12/8/08	17:50	10.21	190	Clear	None	7.39	1.117	5.11	16.3	10.56	151	NA	NA
12/8/08	17:55	10.21	190	Clear	None	7.40	1.118	4.85	15.7	10.37	152	NA	NA

Final Purge / Sample Data

Start Purge	End Purge	Duration (min)	Total Vol (L)	Color	Odor	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTUs)	Temp (C)	ORP (mV)	Salinity	Other
16:52	17:55	63	12.5	Clear	None	7.40	1.118	4.85	15.7	10.37	152	NA	NA

Laboratory Analysis:

Collected	Date	Time	Description	Analysis	Preserv.	#	Type	Vol	COC Notes	Chain#
✓	12/8/08	17:59	VOCs	SW-846 8260B	4°C/HCL	3	Glass - Clear	40ml vials	MS/MSD	ED00000091-5
✓	12/8/08	17:59	PAHs	SW-846 8270C	4°C	2	Glass - Amber	1L	MS/MSD	ED00000091-5
✓	12/8/08	17:59	Metals (Total)	SW-846 6010B	4°C/HNO3	1	Plastic - PE	500ml	MS/MSD	ED00000091-5
✓	12/8/08	17:59	Metals (Dissolved)	SW-846 6010B - Filtered	4°C/HNO3	1	Plastic - PE	500ml	MS/MSD	ED00000091-5

General Notes:

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

Event:	RI Field Investigation
Site Name:	Site 19 - GREAT LAKES NTC
Project No:	112G00936.0000.0230 (ED00000091)

Sample ID:	**NTC19-MW02-1208**	Sampler:	Shannon Hill
Well ID:	NTC19-MW02	Well Type:	Monitoring Well
QC Duplicate ID:	N/A	MS/MSD:	N/A

Well Information

Well Diameter (in)	2	Static Water Level (ft-BTOR)	15.72
Top of Screen (ft-BTOR)	8.13	H&S PID Monitor Reading (ppm)	0
Bottom of Screen (ft-BTOR)	18.13	Purge Method	Low flow - peristaltic
Total Depth of Well (ft-BTOR)	18.13	Sample Method	Low flow - peristaltic

Equipment

QED: MP20-1513	Water Quality Meter	Hach: 0604C016375	Turbidity Meter	H05002712	Pump Control Box

Purge Information

Date	Time	Level (ft-BTOR)	Rate (mL/min)	Color	Odor	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTUs)	Temp (C)	ORP (mV)	Salinity (%)	Other
12/8/08	15:27	15.72	100	Clear	None	NA	NA	NA	NA	NA	NA	NA	NA
12/8/08	15:38	15.85	100	Clear	None	7.13	0.868	6.77	7.71	9.30	240	NA	NA

Final Purge / Sample Data

Start Purge	End Purge	Duration (min)	Total Vol (L)	Color	Odor	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTUs)	Temp (C)	ORP (mV)	Salinity	Other
15:27	15:38	11	1.1	Clear	None	7.13	0.868	6.77	7.71	9.30	240	NA	NA

Laboratory Analysis:

Collected	Date	Time	Description	Analysis	Preserv.	#	Type	Vol	COC Notes	Chain#
✓	12/8/08	15:45	VOCs	SW-846 8260B	4°C/HCL	3	Glass - Clear	40ml vials		ED00000091-5
✓	12/8/08	15:45	PAHs	SW-846 8270C	4°C	2	Glass - Amber	1L		ED00000091-5
✓	12/8/08	15:45	Metals (Total)	SW-846 6010B	4°C/HNO3	1	Plastic - PE	500ml		ED00000091-5
✓	12/8/08	15:45	Metals (Dissolved)	SW-846 6010B - Filtered	4°C/HNO3	1	Plastic - PE	500ml		ED00000091-5

General Notes:

Because well ran dry very quickly previous day when developed only one reading was taken
then sample was quickly collected before well went dry again.

APPENDIX A.7

SAMPLE LOG SHEETS FOR QUALITY ASSURANCE/ QUALITY CONTROL

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-IDW-01	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**		**Created Date**	12/2/08
Task/Contract #	0468	**QA Sample Type**	Other	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/3/08	14:50	SW-846 8260B	VOCs	2	Glass - Clear	Other	AQ	4°C	4 oz jar	ED00000091-3
✓	12/3/08	14:50	SW-846 6010B	Metals (Total)	2	Glass - Clear	Other	AQ	4°C	4 oz jars	ED00000091-3

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-TB120208	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**		**Created Date**	12/2/08
Task/Contract #	0468	**QA Sample Type**	Trip Blank	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/2/08	08:00	NONE		1	Glass - Clear	40ml vials	AQ	4°C/HCL	Trip blank for VOCs	ED00000091-1

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-FD120308-01	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**	NTC19SB15-SO-0406	**Created Date**	12/3/08
Task/Contract #	0468	**QA Sample Type**	Field Duplicate	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/3/08	00:00	SW-846 8260B	VOCs	3	Other	Other	AQ	4°C	En Core samplers	ED00000091-2
✓	12/3/08	00:00	SW-846 8270C	PAHs	1	Glass - Clear	Other	AQ	4°C	4oz jars	ED00000091-2
✓	12/3/08	00:00	SW-846 6010B	Metals (Total)	1	Glass - Clear	Other	AQ	4°C	4oz jar	ED00000091-2

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-FD120308-03	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**	NTC19SB17-SO-0002	**Created Date**	12/3/08
Task/Contract #	0468	**QA Sample Type**	Field Duplicate	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/3/08	00:00	SW-846 8260B	VOCs	3	Other	Other	AQ	4°C	En Core samplers 5 gramz	ED00000091-2
✓	12/3/08	00:00	SW-846 8270C	PAHs	1	Glass - Clear	Other	AQ	4°C	4 oz jar	ED00000091-2
✓	12/3/08	00:00	SW-846 6010B	Metals (Total)	1	Glass - Clear	Other	AQ	4°C	4 oz jar	ED00000091-2

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-FD120308-02	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**	NTC19SB16-SO-0103	**Created Date**	12/3/08
Task/Contract #	0468	**QA Sample Type**	Field Duplicate	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/3/08	00:00	SW-846 8260B	VOCs	3	Other	Other	AQ	4°C	En Core samples 5 gram	ED00000091-2
✓	12/3/08	00:00	SW-846 8270C	PAHs	1	Glass - Clear	Other	AQ	4°C	4 oz jar	ED00000091-2
✓	12/3/08	00:00	SW-846 6010B	Metals (Total)	1	Glass - Clear	Other	AQ	4°C	4 oz jar	ED00000091-2

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-TB120308	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**		**Created Date**	12/3/08
Task/Contract #	0468	**QA Sample Type**	Trip Blank	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/16/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/3/08	08:00	NONE		2	Glass - Clear	40ml vials	AQ	4°C/HCL	VOC Trip Blank	ED00000091-2

Tetra Tech NUS, Inc.

RI Field Investigation - GREAT LAKES NTC

QUALITY CONTROL SAMPLING LOG

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-RB120308-01	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**		**Created Date**	12/3/08
Task/Contract #	0468	**QA Sample Type**	Rinsate Blank	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/3/08	17:00	SW-846 8260B	VOCs	3	Glass - Clear	40ml vials	AQ	4°C/HCL		ED00000091-2
✓	12/3/08	17:00	SW-846 8270C	PAHs	1	Glass - Clear	1L	AQ	4°C		ED00000091-2
✓	12/3/08	17:00	SW-846 6010B	Metals (Total)	1	Plastic - PE	250ml	AQ	4°C/HNO3		ED00000091-2

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-SB120308-01	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**		**Created Date**	12/3/08
Task/Contract #	0468	**QA Sample Type**	Source Water Blank	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/3/08	17:10	SW-846 8260B	VOCs	3	Glass - Clear	40ml vials	AQ	4°C/HCL		ED00000091-2
✓	12/3/08	17:10	SW-846 8270C	PAHs	1	Glass - Amber	1L	AQ	4°C		ED00000091-2
✓	12/3/08	17:10	SW-846 6010B	Metals (Total)	1	Plastic - PE	250ml	AQ	4°C/HNO3		ED00000091-2

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19FD120808-01	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**	NTC19-MW01-1208	**Created Date**	12/8/08
Task/Contract #	0468	**QA Sample Type**	Field Duplicate	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✗			SW-846 6010B	Metals (Total)	1	Plastic - PE	250ml	AQ	4°C/HNO3		
✓	12/8/08	00:00	SW-846 6010B	Metals (Total)	1	Plastic - PE	500ml	AQ	4°C/HNO3		ED00000091-5
✓	12/8/08	00:00	SW-846 8260B	VOCs	3	Glass - Clear	40ml vials	AQ	4°C/HCL		ED00000091-5
✓	12/8/08	00:00	SW-846 6010B - Filtered	Metals (Dissolved)	1	Plastic - PE	500ml	AQ	4°C/HNO3		ED00000091-5
✗		00:00	SW-846 6010B - Filtered	Metals (Dissolved)	1	Plastic - PE	250ml	AQ	4°C/HNO3		
✓	12/8/08	00:00	SW-846 8270C	PAHs	2	Glass - Amber	1L	AQ	4°C		ED00000091-5
✗		00:00	SW-846 8260B	VOCs	3	Glass - Clear	40ml vials	AQ	4°C/HCL		

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-TB120809	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**		**Created Date**	12/8/08
Task/Contract #	0468	**QA Sample Type**	Trip Blank	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/8/08	08:00	SW-846 8260B	VOCs	2	Glass - Clear	40ml vials	AQ	4°C/HCL		ED00000091-5

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC19-IDW02	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**		**Created Date**	12/8/08
Task/Contract #	0468	**QA Sample Type**	Other	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✓	12/8/08	19:45	SW-846 6010B	Metals (Total)	4	Glass - Amber	1L	AQ	4°C	Misc. IDW Analysis: Flash Point	ED00000091-5

Tetra Tech NUS, Inc.

QUALITY CONTROL SAMPLING LOG

RI Field Investigation - GREAT LAKES NTC

Project Information

Facility Name	GREAT LAKES NTC	**QC Sample ID #**	NTC17PCFD10	**Created By**	Shannon Hill
TtNUS Project #	112G00936	**Corresponding Sample ID**	NTC17PCSD42	**Created Date**	12/9/08
Task/Contract #	0468	**QA Sample Type**	Field Duplicate	**Modified By**	Shannon Hill
WBS Code #		**Sample Location**	QC	**Modified Date**	12/15/08
Status	Complete	**Sampled By**	Shannon Hill	**Printed By**	John Wright
		Concentration	Not known	**Printed Date**	1/9/09

Log Entries

Collected	Date	Time	Analysis / Method	Description of Analysis	Count	Type	Requirements	Matrix	Preservative	Comments	Chain of Custody #
✗		00:00	SW-846 8270C	PAHs	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	AQ	4°C		
✗		00:00	NONE	Pesticides/PCBs	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	AQ	4°C		
✓	12/9/08	00:00	NONE	Metals (Copper, Lead, Zinc, Mercury)	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	AQ	4°C		ED00000091-6
✓	12/9/08	00:00	NONE	PAHs/Pesticides /PCBs	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	AQ	4°C		ED00000091-6

APPENDIX A.8

ILLINOIS DEPARTMENT OF PUBLIC HEALTH WELL PERMITS

Illinois Department of Public Health
WATER WELL CONSTRUCTION REPORT

Date 12/22/08

TYPE OR PRESS FIRMLY WITH BLACK INK PEN. COMPLETE WITHIN 30 DAYS OF WELL COMPLETION AND SEND TO THE APPROPRIATE HEALTH DEPARTMENT.

1. Type of Well a. Driven Well Casing diam. ____in. Depth ____ft.
   b. Bored Well Buried Slab [ ] Yes [ ] No
   Hole Diameter ____in. to ____ft.; ____in. to ____ft.; ____in. to ____ft.
   c. Drilled Well PVC casing Formation packer set at depth of ____ft.
   Hole Diameter 8.5 in. to 15.0 ft. ____in. to ____ft. ____in. to ____ft.

Type of Grout	# of Bags	Grout Weight	From (ft.)	To (ft.)	Tremie Depth (ft.)
Bentonite	1	50 lbs.	3.0	1.0	

d. Drilled Well Steel Casing- - - Mechanically Driven [ ] Yes [ ] No
Hole Diameter ____in. to ____ft. ____in. to ____ft. ____in. to ____ft.

Type of Grout	# of Bags	Grout Weight	From (ft.)	To (ft.)	Tremie Depth (ft.)

e. Well finished within X] Unconsolidated Materials [ ] Bedrock

f. Kind of Gravel Sand Pack	Grain Size/Supplier #	From (ft.)	To (ft.)
Washed Quartz Sand	Global #5	15.0	3.0

2. Well Use [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock
   X] Monitoring [ ] Other
3. Date Well Completed 12/4/08 Well Disinfected [ ] Yes X] No
   Driller's estimated well yield N/A gpm
4. Date Permanent Pump Installed N/A
5. Pump Capacity ____gpm Set at (depth) ____ft.
6. Pitless Adapter Model and Manufacturer ____
7. Well Cap Type and Manufacturer Test Well Plug - Morrison Bros.
8. Pressure Tank Working Cycle ____gals. Captive Air [ ] Yes [ ] No
9. Pump System Disinfected [ ] Yes [ ] No
10. Name of Pump Company ____
11. Pump Installer ____ License # ____
12. ____ License # ____
    Licensed Pump Contractor Signature

Illinois Department of Public Health
Division of Environmental Health
525 W. Jefferson St.
Springfield, IL 62761

DO NOT write on these lines

IMPORTANT NOTICE: This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. DISCLOSURE OF THIS INFORMATION IS MANDATORY. This form has been approved by the Forms Management Center.

GEOLOGICAL AND WATER SURVEY WELL RECORD

13. Property Owner United States Navy Well # NTC19-MW01
14. Driller Jeremy Boeche License # N/A
15. Name of Drilling Co. Environmental Field Services, Inc.
16. Permit No. N/A Date Issued ____
17. Date Drilling Started 12/4/08
18. Well SITE address Site 19 - Naval Station Great Lakes, Great Lakes, IL
19. Township Name Shields Land ID # ____
20. Subdivision Name ____ Lot # ____
21. Location a. County Lake
    b. Township ____ Range ____ Section ____
    c. ____ Quarter ____ Quarter ____ Quarter
    d. Coordinates ____ Site Elevation ____ ft. (msl)

For Survey Use

22. Casings, Liners* and Screen Information

Diam. (in.)	Material	Joint	Slot Size	From (ft.)	To (ft.)
2"	PVC	Flush		5.0	6"
2"	PVC	Flush	.010	15.0	5.0

(*) ____
(List reason for liner, type of upper and lower seals installed)

23. Water from N/A at a depth of ____ft. to ____ft.
    a. Static water level ____ ft. below casing which is ____in. above ground
    b. Pumping level is ____ ft. pumping ____gpm after pumping for ____hours

24. Earth Materials Passed Through

	From (ft.)	To (ft.)
N/A		

(If dry hole, fill out log and indicate how hole was sealed.)

25. Licensed Water Well Contractor Signature N/A License Number

SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

Illinois Department of Public Health
WATER WELL CONSTRUCTION REPORT

Date 12/22/08

TYPE OR PRESS FIRMLY WITH BLACK INK PEN. COMPLETE WITHIN 30 DAYS OF WELL COMPLETION AND SEND TO THE APPROPRIATE HEALTH DEPARTMENT.

1. Type of Well a. Driven Well Casing diam. ____in. Depth ____ft.
   b. Bored Well Buried Slab [ ] Yes [ ] No
   Hole Diameter ____in. to ____ft.; ____in. to ____ft.; ____in. to ____ft.
   c. Drilled Well PVC casing Formation packer set at depth of ____ft.
   Hole Diameter 8.5 in. to 16.0 ft. ____in. to ____ft. ____in. to ____ft.

Type of Grout	# of Bags	Grout Weight	From (ft.)	To (ft.)	Tremie Depth (ft.)
Bentonite	1.5	50 lbs.	4.0	1.0	

d. Drilled Well Steel Casing- - - Mechanically Driven [ ] Yes [ ] No
Hole Diameter ____in. to ____ft. ____in. to ____ft. ____in. to ____ft.

Type of Grout	# of Bags	Grout Weight	From (ft.)	To (ft.)	Tremie Depth (ft.)

e. Well finished within [X] Unconsolidated Materials [ ] Bedrock

f. Kind of Gravel Sand Pack	Grain Size/Supplier #	From (ft.)	To (ft.)
Washed Quartz Sand	Global #5	16.0	4.0

2. Well Use [ ] Domestic [ ] Irrigation [ ] Commercial [ ] Livestock
   X Monitoring [ ] Other
3. Date Well Completed 12/7/08 Well Disinfected [ ] Yes [X] No
   Driller's estimated well yield N/A gpm
4. Date Permanent Pump Installed N/A
5. Pump Capacity ____gpm Set at (depth) ____ft.
6. Pitless Adapter Model and Manufacturer ____
7. Well Cap Type and Manufacturer Test Well Plug - Morrison Bros.
8. Pressure Tank Working Cycle ____gals. Captive Air [ ] Yes [ ] No
9. Pump System Disinfected [ ] Yes [ ] No
10. Name of Pump Company ____
11. Pump Installer ____ License # ____
12. ____ License # ____
    Licensed Pump Contractor Signature

Illinois Department of Public Health
Division of Environmental Health
525 W. Jefferson St.
Springfield, IL 62761

DO NOT write on these lines

IMPORTANT NOTICE: This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. **DISCLOSURE OF THIS INFORMATION IS MANDATORY.** This form has been approved by the Forms Management Center.

GEOLOGICAL AND WATER SURVEY WELL RECORD

13. Property Owner United States Navy Well # NTC19-MW02
14. Driller Jeremy Boeche License # N/A
15. Name of Drilling Co. Environmental Field Services, Inc.
16. Permit No. N/A Date Issued ____
17. Date Drilling Started 12/7/08
18. Well SITE address Site 19 - Naval Station Great Lakes, Great Lakes, IL
19. Township Name Shields Land ID # ____
20. Subdivision Name ____ Lot # ____
21. Location a. County Lake
    b. Township ____ Range ____ Section ____
    c. ____ Quarter ____ Quarter ____ Quarter
    d. Coordinates ____ Site Elevation ____ ft. (msl)

For Survey Use

22. Casings, Liners* and Screen Information

Diam. (in.)	Material	Joint	Slot Size	From (ft.)	To (ft.)
2"	PVC	Flush		6.0	6"
2"	PVC	Flush	.010	16.0	6.0

(*) ____
(List reason for liner, type of upper and lower seals installed)

23. Water from N/A at a depth of ____ft. to ____ft.
    a. Static water level ____ ft. below casing which is ____in. above ground
    b. Pumping level is ____ ft. pumping ____gpm after pumping for ____hours

24. Earth Materials Passed Through

	From (ft.)	To (ft.)
N/A		

(If dry hole, fill out log and indicate how hole was sealed.)

25. Licensed Water Well Contractor Signature N/A License Number

SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

APPENDIX A.9

CHAIN OF CUSTODY FORMS

TETRA TECH NUS, INC

CHAIN OF CUSTODY
NUMBER: ED00000091-1

Project No:	Facility:	Project Manager:	Carrier:	Laboratory Name:
112G00936	**GREAT LAKES NTC**	**Bob Davis**	**Federal Express**	**Empirical Laboratories** **227 French Landing Drive** **Nashville, TN 37228**
Task No:	Turn Around Time:	Field Ops Leader:	Carrier/Waybill No.	Point of Contact:
0468	**Standard**	**Shannon Hill**	**863138881009**	**Marcia McGinnity** **615-345-1115**

Date	Sample ID #	Time	Analysis	Loc ID	Matrix	Description	Preservative	Container Count	Container Type	Container Reqs	Comments 0812036	
12/02/2008	NTC19SB01-SO-0608	08:20	SW-846 8260B	NTC19SB01	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-01
12/02/2008	NTC19SB01-SO-0608	08:20	SW-846 6010B	NTC19SB01	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB01-SO-0608	08:20	SW-846 8270C	NTC19SB01	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB02- SO - 0204	08:52	SW-846 6010B	NTC19SB02	SO	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap		-02
12/02/2008	NTC19SB02- SO - 0204	08:52	SW-846 8270C	NTC19SB02	SO	PAHs	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB02- SO - 0204	08:52	SW-846 8260B	NTC19SB02	SO	TCL VOCs	None	3	EnCore	5 gram EnCore		
12/02/2008	NTC19SB03-SO-0103	09:00	SW-846 8260B	NTC19SB03	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-03
12/02/2008	NTC19SB03-SO-0103	09:00	SW-846 6010B	NTC19SB03	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB03-SO-0103	09:00	SW-846 8270C	NTC19SB03	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB03-SO-0810	09:10	SW-846 8260B	NTC19SB03	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-04
12/02/2008	NTC19SB03-SO-0810	09:10	SW-846 6010B	NTC19SB03	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB03-SO-0810	09:10	SW-846 8270C	NTC19SB03	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB04-SO-0204	09:45	SW-846 8260B	NTC19SB04	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-05
12/02/2008	NTC19SB04-SO-0204	09:45	SW-846 6010B	NTC19SB04	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB04-SO-0204	09:45	SW-846 8270C	NTC19SB04	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB05-SO-0406	10:20	SW-846 8260B	NTC19SB05	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-06
12/02/2008	NTC19SB05-SO-0406	10:20	SW-846 6010B	NTC19SB05	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB05-SO-0406	10:20	SW-846 8270C	NTC19SB05	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB05-SO-0608	10:30	SW-846 8260B	NTC19SB05	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-07
12/02/2008	NTC19SB05-SO-0608	10:30	SW-846 6010B	NTC19SB05	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB05-SO-0608	10:30	SW-846 8270C	NTC19SB05	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB05-SO-0608	10:30	ASTM D422	NTC19SB05	SO	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB06-SO-0204	11:30	SW-846 8260B	NTC19SB06	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-08
12/02/2008	NTC19SB06-SO-0204	11:30	SW-846 6010B	NTC19SB06	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB06-SO-0204	11:30	SW-846 8270C	NTC19SB06	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB06-SO-0608	11:40	SW-846 8260B	NTC19SB06	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-09
12/02/2008	NTC19SB06-SO-0608	11:40	SW-846 6010B	NTC19SB06	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		

12/02/2008	NTC19SB06-SO-0608	11:40	SW-846 8270C	NTC19SB06	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB07-SO-0507	13:11	SW-846 8260B	NTC19SB07	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-10
12/02/2008	NTC19SB07-SO-0507	13:11	SW-846 6010B	NTC19SB07	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB07-SO-0507	13:11	SW-846 8270C	NTC19SB07	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB08-SO-0103	13:40	SW-846 8260B	NTC19SB08	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-11
12/02/2008	NTC19SB08-SO-0103	13:40	SW-846 6010B	NTC19SB08	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB08-SO-0103	13:40	SW-846 8270C	NTC19SB08	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB08-SO-0406	13:45	SW-846 8260B	NTC19SB08	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-12
12/02/2008	NTC19SB08-SO-0406	13:45	SW-846 6010B	NTC19SB08	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB08-SO-0406	13:45	SW-846 8270C	NTC19SB08	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB09-SO-0002	14:10	SW-846 8260B	NTC19SB09	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-13
12/02/2008	NTC19SB09-SO-0002	14:10	SW-846 6010B	NTC19SB09	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB09-SO-0002	14:10	SW-846 8270C	NTC19SB09	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB09-SO-0406	14:20	SW-846 8260B	NTC19SB09	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-14
12/02/2008	NTC19SB09-SO-0406	14:20	SW-846 6010B	NTC19SB09	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB09-SO-0406	14:20	SW-846 8270C	NTC19SB09	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB10-SO-0002	15:02	SW-846 8260B	NTC19SB10	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-15
12/02/2008	NTC19SB10-SO-0002	15:02	SW-846 6010B	NTC19SB10	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB10-SO-0002	15:02	SW-846 8270C	NTC19SB10	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB10-SO-0507	15:08	SW-846 8260B	NTC19SB10	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-16
12/02/2008	NTC19SB10-SO-0507	15:08	SW-846 6010B	NTC19SB10	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB10-SO-0507	15:08	SW-846 8270C	NTC19SB10	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB11-SO-0002	15:47	SW-846 8260B	NTC19SB11	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-17
12/02/2008	NTC19SB11-SO-0002	15:47	SW-846 6010B	NTC19SB11	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19SB11-SO-0002	15:47	SW-846 8270C	NTC19SB11	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/02/2008	NTC19TB120208	08:00	NONE	QC	AQ		4°C/HCL	1	Glass - Clear	40ml vials	Trip blank for VOCs	-18

1. Relinquished By: **Shannon Hill**	Date: 12/02/2008	Time: 19:00	Received By: **Federal Express**	Date: 12/02/2008	Time: 19:30
2. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
3. Relinquished By:	Date:	Time:	Received By:	Date: 12-3-08	Time: 0900

Comments:

TETRA TECH NUS, INC

CHAIN OF CUSTODY
NUMBER: ED00000091-2

Project No:	Facility:	Project Manager:	Carrier:	Laboratory Name:
112G00936	**GREAT LAKES NTC**	**Bob Davis**	**Federal Express**	**Empirical Laboratories** **227 French Landing Drive** **Nashville, TN 37228**
Task No:	Turn Around Time:	Field Ops Leader:	Carrier/Waybill No.	Point of Contact:
0468	**Standard**	**Shannon Hill**	**863138880870**	**Marcia McGinnity** **615-345-1115**

0812060

Date	Sample ID #	Time	Analysis	Loc ID	Matrix	Description	Preservative	Container Count	Container Type	Container Reqs	Comments	
12/03/2008	NTC19-FD120308-01	00:00	**SW-846 8260B**	QC	AQ	VOCs	4°C	3	Other	Other	En Core samplers,5 grams	-01
12/03/2008	NTC19-FD120308-01	00:00	**SW-846 8270C**	QC	AQ	PAHs	4°C	1	Glass - Clear	Other	4oz jars	
12/03/2008	NTC19-FD120308-01	00:00	**SW-846 6010B**	QC	AQ	Metals (Total)	4°C	1	Glass - Clear	Other	4oz jar	
12/03/2008	NTC19-FD120308-02	00:00	**SW-846 8260B**	QC	AQ	VOCs	4°C	3	Other	Other	En Core samples 5 gram	-02
12/03/2008	NTC19-FD120308-02	00:00	**SW-846 8270C**	QC	AQ	PAHs	4°C	1	Glass - Clear	Other	4 oz jar	
12/03/2008	NTC19-FD120308-02	00:00	**SW-846 6010B**	QC	AQ	Metals (Total)	4°C	1	Glass - Clear	Other	4 oz jar	
12/03/2008	NTC19-FD120308-03	00:00	**SW-846 8260B**	QC	AQ	VOCs	4°C	3	Other	Other	En Core samplers 5 gramz	-03
12/03/2008	NTC19-FD120308-03	00:00	**SW-846 8270C**	QC	AQ	PAHs	4°C	1	Glass - Clear	Other	4 oz jar	
12/03/2008	NTC19-FD120308-03	00:00	**SW-846 6010B**	QC	AQ	Metals (Total)	4°C	1	Glass - Clear	Other	4 oz jar	
12/03/2008	NTC19-RB120308-01	17:00	**SW-846 8260B**	QC	AQ	VOCs	4°C/HCL	3	Glass - Clear	40ml vials		-04
12/03/2008	NTC19-RB120308-01	17:00	**SW-846 8270C**	QC	AQ	PAHs	4°C	1	Glass - Clear	1L		
12/03/2008	NTC19-RB120308-01	17:00	**SW-846 6010B**	QC	AQ	Metals (Total)	4°C/HNO3	1	Plastic - PE	250ml		
12/03/2008	NTC19-SB120308-01	17:10	**SW-846 8260B**	QC	AQ	VOCs	4°C/HCL	3	Glass - Clear	40ml vials		-05
12/03/2008	NTC19-SB120308-01	17:10	**SW-846 8270C**	QC	AQ	PAHs	4°C	1	Glass - Amber	1L		
12/03/2008	NTC19-SB120308-01	17:10	**SW-846 6010B**	QC	AQ	Metals (Total)	4°C/HNO3	1	Plastic - PE	250ml		
12/03/2008	NTC19-TB120308	08:00	**NONE**	QC	AQ		4°C/HCL	2	Glass - Clear	40ml vials	VOC Trip Blank	-06
12/03/2008	NTC19SB12-SO-0002	08:32	**SW-846 8260B**	NTC19SB12	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-07
12/03/2008	NTC19SB12-SO-0002	08:32	**SW-846 6010B**	NTC19SB12	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/03/2008	NTC19SB12-SO-0002	08:32	**SW-846 8270C**	NTC19SB12	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/03/2008	NTC19SB12-SO-0507	08:40	**SW-846 8260B**	NTC19SB12	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-08
12/03/2008	NTC19SB12-SO-0507	08:40	**SW-846 6010B**	NTC19SB12	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/03/2008	NTC19SB12-SO-0507	08:40	**SW-846 8270C**	NTC19SB12	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/03/2008	NTC19SB12-SO-0507	08:40	**ASTM D422**	NTC19SB12	SO	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap		
12/03/2008	NTC19SB13-SO-0103	09:08	**SW-846 8260B**	NTC19SB13	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-09
12/03/2008	NTC19SB13-SO-0103	09:08	**SW-846 6010B**	NTC19SB13	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/03/2008	NTC19SB13-SO-0103	09:08	**SW-846 8270C**	NTC19SB13	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		
12/03/2008	NTC19SB14-SO-0204	10:00	**SW-846 8260B**	NTC19SB14	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore		-10
12/03/2008	NTC19SB14-SO-0204	10:00	**SW-846 6010B**	NTC19SB14	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap		

2/03/2008	NTC19SB14-SO-0204	10:00	SW-846 8270C	NTC19SB14	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	0012060-11
2/03/2008	NTC19SB14-SO-0507	10:05	SW-846 8260B	NTC19SB14	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-11
2/03/2008	NTC19SB14-SO-0507	10:05	SW-846 6010B	NTC19SB14	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB14-SO-0507	10:05	SW-846 8270C	NTC19SB14	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB15-SO-0103	10:23	SW-846 8260B	NTC19SB15	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-12
2/03/2008	NTC19SB15-SO-0103	10:23	SW-846 6010B	NTC19SB15	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB15-SO-0103	10:23	SW-846 8270C	NTC19SB15	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB15-SO-0406	10:27	SW-846 8260B	NTC19SB15	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-13
2/03/2008	NTC19SB15-SO-0406	10:27	SW-846 6010B	NTC19SB15	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB15-SO-0406	10:27	SW-846 8270C	NTC19SB15	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB16-SO-0103	11:01	SW-846 8260B	NTC19SB16	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-14
2/03/2008	NTC19SB16-SO-0103	11:01	SW-846 6010B	NTC19SB16	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB16-SO-0103	11:01	SW-846 8270C	NTC19SB16	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB16-SO-0507	11:06	SW-846 8260B	NTC19SB16	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-15
2/03/2008	NTC19SB16-SO-0507	11:06	SW-846 6010B	NTC19SB16	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB16-SO-0507	11:06	SW-846 8270C	NTC19SB16	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB17-SO-0002	11:39	SW-846 8260B	NTC19SB17	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-16
2/03/2008	NTC19SB17-SO-0002	11:39	SW-846 6010B	NTC19SB17	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB17-SO-0002	11:39	SW-846 8270C	NTC19SB17	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB17-SO-0406	11:44	SW-846 8260B	NTC19SB17	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-17
2/03/2008	NTC19SB17-SO-0406	11:44	SW-846 6010B	NTC19SB17	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB17-SO-0406	11:44	SW-846 8270C	NTC19SB17	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB18-SO-0204	13:16	SW-846 8260B	NTC19SB18	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	MS/MSD -18
2/03/2008	NTC19SB18-SO-0204	13:16	SW-846 6010B	NTC19SB18	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	MS/MSD
2/03/2008	NTC19SB18-SO-0204	13:16	SW-846 8270C	NTC19SB18	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	MS/MSD
2/03/2008	NTC19SB18-SO-0406	13:20	SW-846 8260B	NTC19SB18	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-19
2/03/2008	NTC19SB18-SO-0406	13:20	SW-846 6010B	NTC19SB18	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB18-SO-0406	13:20	SW-846 8270C	NTC19SB18	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB18-SO-0406	13:20	ASTM D422	NTC19SB18	SO	Grain Size	None	1	Glass - Amber	8 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB19-SO-0002	13:50	SW-846 8260B	NTC19SB19	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-20
2/03/2008	NTC19SB19-SO-0002	13:50	SW-846 6010B	NTC19SB19	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB19-SO-0002	13:50	SW-846 8270C	NTC19SB19	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB19-SO-0406	13:53	SW-846 8260B	NTC19SB19	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	MS/MSD -21
2/03/2008	NTC19SB19-SO-0406	13:53	SW-846 6010B	NTC19SB19	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	MS/MSD
2/03/2008	NTC19SB19-SO-0406	13:53	SW-846 8270C	NTC19SB19	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	MS/MSD
2/03/2008	NTC19SB20-SO-0002	14:30	SW-846 8260B	NTC19SB20	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-22
2/03/2008	NTC19SB20-SO-0002	14:30	SW-846 6010B	NTC19SB20	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB20-SO-0002	14:30	SW-846 8270C	NTC19SB20	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB20-SO-0406	14:40	SW-846 8260B	NTC19SB20	SO	TCL VOCs	4°C	3	EnCore	5 gram EnCore	-23
2/03/2008	NTC19SB20-SO-0406	14:40	SW-846 6010B	NTC19SB20	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
2/03/2008	NTC19SB20-SO-0406	14:40	SW-846 8270C	NTC19SB20	SO	PAHs	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	

1. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Shannon Hill	12/03/2008	19:00	**Federal Express**	12/03/2008	20:00
			[illegible]	12/4/08	09:00

3.6°C 5.5°C

2. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
			[illegible]	12/4/08	09:00
3. Relinquished By:	Date:	Time:	Received By:	Date:	Time:

3.6°C, 5.5°C

Comments:

TETRA TECH NUS, INC

CHAIN OF CUSTODY
NUMBER: ED00000091-4

Project No:	Facility:	Project Manager:	Carrier:	Laboratory Name:
112G00936	**GREAT LAKES NTC**	**Bob Davis**	**Airborne Express**	**Environmental Field Services, Inc.** **40 West State Road 32** **Westfield, IN 46074**
Task No:	Turn Around Time:	Field Ops Leader:	Carrier/Waybill No.	Point of Contact:
0468	**Standard**	**Shannon Hill**	**86313880973**	**Steve Burck** **317-896-1116**

Date	Sample ID #	Time	Analysis	Loc ID	Matrix	Description	Preservative	Container Count	Container Type	Container Reqs	Comments
12/02/2008	NTC19SB01-SO-0002	08:10	**SW-846 6010B**	NTC19SB01	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
12/02/2008	NTC19SB03-SO-0001	08:50	**SW-846 6010B**	NTC19SB03	SO	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	
12/02/2008	NTC19SB06-SO-0001	11:10	**SW-846 6010B**	NTC19SB06	SO	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	
12/02/2008	NTC19SB07-SO-0001	13:00	**SW-846 6010B**	NTC19SB07	SO	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	

0812073
-01
-02
-03
-04

1. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Shannon Hill	12/04/2008	17:00	**Airborne Express**	12/04/2008	18:00
2. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
3. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
			[signature]	12-5-08	0900

Comments:

TETRA TECH NUS, INC

CHAIN OF CUSTODY
NUMBER: ED00000091-5

Project No: .12G00936	Facility: **GREAT LAKES NTC**	Project Manager: **Bob Davis**	Carrier: **Federal Express**	Laboratory Name: **Empirical Laboratories 227 French Landing Drive Nashville, TN 37228**
Task No: 468	Turn Around Time: **Standard**	Field Ops Leader: **Shannon Hill**	Carrier/Waybill No. **863138880881**	Point of Contact: **Marcia McGinnity 615...**

Date	Sample ID #	Time	Analysis	Loc ID	Matrix	Description	Preservative	Container Count	Container Type	Container Reqs	Comments
2/08/2008	NTC19-IDW02	19:45	**SW-846 6010B**	QC	AQ	~~Metals (Total)~~ IDW	4°C	4	Glass - Amber	1L	Misc. IDW Analysis: Flash Point,pH,Reactive Sulfide Reactive Cyanide,Phenolics,PCBs → [redacted] Rush 0812145-0
2/08/2008	NTC19-MW01-1208	17:59	**SW-846 8260B**	NTC19-MW01	GW	VOCs	4°C/HCL	3	Glass - Clear	40ml vials	MS/MSD 0812147-01
2/08/2008	NTC19-MW01-1208	17:59	**SW-846 8270C**	NTC19-MW01	GW	PAHs	4°C	2	Glass - Amber	1L	MS/MSD
2/08/2008	NTC19-MW01-1208	17:59	**SW-846 6010B**	NTC19-MW01	GW	Metals (Total)	4° C/HNO3	1	Plastic - PE	500ml	MS/MSD
2/08/2008	NTC19-MW01-1208	17:59	**SW-846 6010B - Filtered**	NTC19-MW01	GW	Metals (Dissolved)	4° C/HNO3	1	Plastic - PE	500ml	MS/MSD
2/08/2008	NTC19-MW02-1208	15:45	**SW-846 8260B**	NTC19-MW02	GW	VOCs	4°C/HCL	3	Glass - Clear	40ml vials	-02
2/08/2008	NTC19-MW02-1208	15:45	**SW-846 8270C**	NTC19-MW02	GW	PAHs	4°C	2	Glass - Amber	1L	
2/08/2008	NTC19-MW02-1208	15:45	**SW-846 6010B**	NTC19-MW02	GW	Metals (Total)	4° C/HNO3	1	Plastic - PE	500ml	
2/08/2008	NTC19-MW02-1208	15:45	**SW-846 6010B - Filtered**	NTC19-MW02	GW	Metals (Dissolved)	4° C/HNO3	1	Plastic - PE	500ml	
2/08/2008	NTC19-TB120809	08:00	**SW-846 8260B**	QC	AQ	VOCs	4°C/HCL	2	Glass - Clear	40ml vials	-03
2/08/2008	NTC19FD120808-01	00:00	**SW-846 6010B**	QC	AQ	Metals (Total)	4° C/HNO3	1	Plastic - PE	500ml	-04
2/08/2008	NTC19FD120808-01	00:00	**SW-846 8260B**	QC	AQ	VOCs	4°C/HCL	3	Glass - Clear	40ml vials	
2/08/2008	NTC19FD120808-01	00:00	**SW-846 6010B - Filtered**	QC	AQ	Metals (Dissolved)	4° C/HNO3	1	Plastic - PE	500ml	
2/08/2008	NTC19FD120808-01	00:00	**SW-846 8270C**	QC	AQ	PAHs	4°C	2	Glass - Amber	1L	

1. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Shannon Hill	12/09/2008	08:00	**Federal Express**	12/09/2008	08:00
			[signature]	12/10/08	09:00

5.6°C, 1.9°C

TETRA TECH NUS, INC

CHAIN OF CUSTODY
NUMBER: ED00000091-5

Project No:	Facility:	Project Manager:	Carrier:	Laboratory Name:
112G00936	**GREAT LAKES NTC**	**Bob Davis**	**Federal Express**	**Empirical Laboratories** **227 French Landing Drive** **Nashville, TN 37228**
Task No:	Turn Around Time:	Field Ops Leader:	Carrier/Waybill No.	Point of Contact:
0468	**Standard**	**Shannon Hill**	**863138880881**	**Marcia McGinnity** **615...**

Date	Sample ID #	Time	Analysis	Loc ID	Matrix	Description	Preservative	Container Count	Container Type	Container Reqs	Comments
12/08/2008	NTC19-IDW02	19:45	**SW-846 6010B**	QC	AQ	~~Metals (Total)~~ IDW	4°C	4	Glass - Amber	1L	Misc. IDW Analysis: Flash Point,pH,Reactive Sulfide Reactive Cyanide,Phenolics,PCBs → ~~[illegible]~~ Flash 0812145-01
12/08/2008	NTC19-MW01-1208	17:59	**SW-846 8260B**	NTC19-MW01	GW	VOCs	4°C/HCL	3	Glass - Clear	40ml vials	MS/MSD 0812147-01
12/08/2008	NTC19-MW01-1208	17:59	**SW-846 8270C**	NTC19-MW01	GW	PAHs	4°C	2	Glass - Amber	1L	MS/MSD
12/08/2008	NTC19-MW01-1208	17:59	**SW-846 6010B**	NTC19-MW01	GW	Metals (Total)	4° C/HNO3	1	Plastic - PE	500ml	MS/MSD
12/08/2008	NTC19-MW01-1208	17:59	**SW-846 6010B - Filtered**	NTC19-MW01	GW	Metals (Dissolved)	4° C/HNO3	1	Plastic - PE	500ml	MS/MSD
12/08/2008	NTC19-MW02-1208	15:45	**SW-846 8260B**	NTC19-MW02	GW	VOCs	4°C/HCL	3	Glass - Clear	40ml vials	-02
12/08/2008	NTC19-MW02-1208	15:45	**SW-846 8270C**	NTC19-MW02	GW	PAHs	4°C	2	Glass - Amber	1L	
12/08/2008	NTC19-MW02-1208	15:45	**SW-846 6010B**	NTC19-MW02	GW	Metals (Total)	4° C/HNO3	1	Plastic - PE	500ml	
12/08/2008	NTC19-MW02-1208	15:45	**SW-846 6010B - Filtered**	NTC19-MW02	GW	Metals (Dissolved)	4° C/HNO3	1	Plastic - PE	500ml	
12/08/2008	NTC19-TB120809	08:00	**SW-846 8260B**	QC	AQ	VOCs	4°C/HCL	2	Glass - Clear	40ml vials	-03
12/08/2008	NTC19FD120808-01	00:00	**SW-846 6010B**	QC	AQ	Metals (Total)	4° C/HNO3	1	Plastic - PE	500ml	-04
12/08/2008	NTC19FD120808-01	00:00	**SW-846 8260B**	QC	AQ	VOCs	4°C/HCL	3	Glass - Clear	40ml vials	
12/08/2008	NTC19FD120808-01	00:00	**SW-846 6010B - Filtered**	QC	AQ	Metals (Dissolved)	4° C/HNO3	1	Plastic - PE	500ml	
12/08/2008	NTC19FD120808-01	00:00	**SW-846 8270C**	QC	AQ	PAHs	4°C	2	Glass - Amber	1L	

1. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Shannon Hill	12/09/2008	08:00	**Federal Express**	12/09/2008	08:00
			[illegible]	12/10/08	09:00

5.6°C, 1.9°C

TETRA TECH NUS, INC

CHAIN OF CUSTODY
NUMBER: ED00000091-4

Project No:	Facility:	Project Manager:	Carrier:	Laboratory Name:
112G00936	**GREAT LAKES NTC**	**Bob Davis**	**Airborne Express**	**Environmental Field Services, Inc.** **40 West State Road 32** **Westfield, IN 46074**
Task No:	Turn Around Time:	Field Ops Leader:	Carrier/Waybill No.	Point of Contact:
0468	**Standard**	**Shannon Hill**	**86313880973**	**Steve Burck** **317-896-1116**

Date	Sample ID #	Time	Analysis	Loc ID	Matrix	Description	Preservative	Container Count	Container Type	Container Reqs	Comments
12/02/2008	NTC19SB01-SO-0002	08:10	**SW-846 6010B**	NTC19SB01	SO	TAL Metals	4°C	1	Glass - Amber	4 oz. wide-mouth w/Teflon cap	
12/02/2008	NTC19SB03-SO-0001	08:50	**SW-846 6010B**	NTC19SB03	SO	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	
12/02/2008	NTC19SB06-SO-0001	11:10	**SW-846 6010B**	NTC19SB06	SO	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	
12/02/2008	NTC19SB07-SO-0001	13:00	**SW-846 6010B**	NTC19SB07	SO	TAL Metals	4°C	1	Glass - Clear	4 oz. wide-mouth w/Teflon cap	

0812073
-01
-02
-03
-04

1. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Shannon Hill	12/04/2008	17:00	**Airborne Express**	12/04/2008	18:00
2. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
3. Relinquished By:	Date:	Time:	Received By:	Date:	Time:
			[signature]	12-5-08	0900

Comments:

APPENDIX B

DATA VALIDATION PACKAGES AND ASSESSMENT

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**B. DAVIS**	**DATE:**	**FEBRUARY 3, 2009**
FROM:	**JOSEPH KALINYAK**	**COPIES:**	**DV FILE**

SUBJECT: **ORGANIC DATA VALIDATION- VOC/SVOC**
CTO 468, NTC GREAT LAKES
SDG GL001

SAMPLES: 17/Soil/VOC/SVOC

NTC19SB01-SO-0608	NTC19SB02-SO-0204	NTC19SB03-SO-0103
NTC19SB03-SO-0810	NTC19SB04-SO-0204	NTC19SB05-SO-0406
NTC19SB05-SO-0608	NTC19SB06-SO-0204	NTC19SB06-SO-0608
NTC19SB07-SO-0507	NTC19SB08-SO-0103	NTC19SB08-SO-0406
NTC19SB09-SO-0002	NTC19SB09-SO-0406	NTC19SB10-SO-0002
NTC19SB10-SO-0507	NTC19SB11-SO-0002	

1/Aqueous/VOC

NTC19TB120208

OVERVIEW

The sample set for CTO 468 NTC Great Lakes, SDG GL001 consists of one aqueous (1) trip blank and seventeen (17) soil environmental samples. The samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOC). The one trip blank was analyzed for TCL VOCs only. There were no field duplicate pairs included in this sample delivery group (SDG).

A full validation was performed on only 10 of the 18 VOC samples and 9 of the 17 SVOC samples as listed below. The remaining samples were given a cursory validation review.

Full Validation: 9/Soil/VOC

NTC19SB01-SO-0608	NTC19SB02-SO-0204	NTC19SB03-SO-0103
NTC19SB03-SO-0810	NTC19SB04-SO-0204	NTC19SB05-SO-0406
NTC19SB05-SO-0608	NTC19SB06-SO-0204	NTC19SB06-SO-0608

Full Validation: 1/Aqueous/VOC
NTC19TB120208

Full Validation: 9/Soil/SVOC

NTC19SB01-SO-0608	NTC19SB02-SO-0204	NTC19SB03-SO-0103
NTC19SB03-SO-0810	NTC19SB04-SO-0204	NTC19SB05-SO-0406
NTC19SB05-SO-0608	NTC19SB06-SO-0204	NTC19SB06-SO-0608

The samples were collected by TetraTech NUS on December 2, 2008 and analyzed by Empirical Laboratories. All analyses were conducted using USEPA SW-846 Methods 8260B and 8270C SIM analytical and reporting protocols. The data contained in this SDG were validated with regard to the following parameters:

* • Data Completeness
* • Holding Times
* • GC/MS Tuning
• Initial and Continuing Calibration

- Laboratory Blank Analyses
- Surrogate Recoveries
- Blank Spike/Blank Spike Duplicate Results
- Internal Standard Recoveries
- * Compound Quantitation
- * Compound Identification
- * Detection Limits

The symbol (*) indicates that quality control criteria were met for this parameter. Problems affecting data quality are discussed below; documentation supporting these findings is presented in Appendix C. Qualified Analytical results are presented in Appendix A. Results as reported by the laboratory are presented in Appendix B.

Volatile

The following analyte was detected in the laboratory method blank.

Analyte	Maximum Concentration	Action Level
Methylene chloride [1]	5.1 µg/kg	51.0 µg/kg

[1] Maximum concentration detected in the method blank V1BLK1209 affecting all SDG samples.

Blank Actions

- Value < Reporting Limit (RL); value followed by a U.
- Value > RL and < Action level; report value followed by a U.
- Value > RL and > action level; report value followed by a J.

An action level of 10X the maximum contaminant level for the common laboratory contaminant methylene chloride has been used to evaluate sample data for blank contamination. Sample aliquot, dilution factors, and % moisture, if applicable, were taken into consideration when evaluating for blank contamination for each individual sample.

A continuing calibration verification percent difference (%D) was greater than the 25% quality control limit for acetone on instrument VOA1 on 12/09/08 at 10:37. The positive and non-detected sample results reported for acetone for affected samples NTC19SB01-SO-0608, NTC19SB02-SO-0204, NTC19SB03-SO-0103, NTC19SB04-SO-0204, NTC19SB05-SO-0608, NTC19SB06-SO-0204, and NTC19SB06-SO-0608 were qualified estimated, (J) and (UJ), respectively.

A continuing calibration verification percent difference (%D) was greater than the 25% quality control limit for acetone, bromomethane and 2-hexanone on instrument VOA1 on 12/11/08 at 13:24. The positive and non-detected sample results reported for acetone, bromomethane and 2-hexanone for affected samples NTC19SB03-SO-0810 and NTC19SB05-SO-0406 were qualified estimated, (J) and (UJ), respectively.

A continuing calibration verification %D was greater than the 25% quality control limit for bromomethane on instrument VOA3 on 12/15/08 @ 15:55. The affected sample NTC19TB120208 non-detected bromomethane result was qualified estimated, (UJ).

The internal standard area was less than the quality control limit for 1,4-dichlorobenzene-d4 for samples NTC19SB03-SO-0810 and NTC19SB05-SO-0406 on instrument VOA1 on 12/11/08. The associated internal standard compounds 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,2,4-trichlorobenzene, and 1,2-dibromo-3-chloropropane non-detected results were qualified estimated, (UJ).

The VOC system monitoring compound (surrogate) bromofluorobenzene % recovery was greater than 10%

and less than the quality control limit for sample NTC19SB03-SO-0810. The sample positive and non-detected results were qualified estimated, (J) and (UJ), respectively, except for methylene chloride which was previously qualified for blank contamination

The VOC laboratory control sample (LCS)/laboratory control sample duplicate (LCSD) V1BLK1211 had %RPDs greater than the quality control limit for acetone, chloromethane, dichlorodifluoromethane, and vinyl chloride. No action was taken as the LCS and LCSD had % recoveries within the QC limits.

There was a LCS/LCSD QC limit exceedance for methylene chloride associated with the methanol extraction sample analysis run on instrument VOA3. No action was taken as the data from the diluted sample was not reported as it was not necessary.

Semi-volatile

Sample NTC19SB11-SO-0002 was re-analyzed at a dilution of 5X due to fluoranthene and chrysene exceeding the calibration curve for the undiluted sample. The re-analysis diluted results for fluoranthene and chrysene for the sample were reported.

Additional Comments:

The methanol extraction and re-analysis of samples NTC19SB03-SO-0810DL and NTC19SB05-SO-0406DL was unnecessary as all detected compounds on the samples' original VOC analyses were within the calibration limits. The methanol extraction sample results were not used in this report nor were they qualified.

There was no matrix spike/matrix spike duplicate analysis for either the VOC or SVOC analyses.

EXECUTIVE SUMMARY

Laboratory Performance Issues: Several compounds in the VOC fraction exceeded the continuing calibration %D criteria resulting in qualification of the data. Methylene chloride was detected in the VOC method blank. There were VOC surrogate recovery quality control limit exceedances. There was a VOC internal standard quality control exceedance.

Other factors affecting data quality: The VOC trip blank NTC19TB120208 had detections for methylene chloride and 1,2,4-trichlorobenzene.

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (October 1999) and the Department of Defense (DoD) document entitled "Quality Systems Manual (QSM) for Environmental Laboratories" (January 2006). The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the DoD QSM."

Tetra Tech NUS

Joseph Kalinyak
Chemist/Data Validator

TetraTech NUS

Joseph A. Samchuck
Data Validation Quality Assurance Officer

Attachments:

Appendix A – Qualified Analytical Results
Appendix B – Results as Reported by the Laboratory
Appendix C – Support Documentation

APPENDIX A

QUALIFIED ANALYTICAL RESULTS

Qualifier Codes:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration Noncompliance (i.e., % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01 = GC/MS Tuning Noncompliance
D = MS/MSD Recovery Noncompliance
E = LCS/LCSD Recovery Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = GFAA PDS - GFAA MSA's $r < 0.995$
K = ICP Interference - includes ICS % R Noncompliance
L = Instrument Calibration Range Exceedance
M = Sample Preservation Noncompliance
N = Internal Standard Noncompliance
N01 = Internal Standard Recovery Noncompliance Dioxins
N02 = Recovery Standard Noncompliance Dioxins
N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (i.e., base-time drifting)
P = Uncertainty near detection limit (< 2 x IDL for inorganics and <CRQL for organics)
Q = Other problems (can encompass a number of issues; i.e.chromatography,interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient $r < 0.995$
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is less than sample activity

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB01-SO-0608
samp_date	12/2/2008
lab_id	0812036-01
qc_type	NM
units	UG/KG
Pct_Solids	82.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.790000	U	
1,1,2,2-TETRACHLOROETHANE	0.380000	U	
1,1,2-TRICHLOROETHANE	0.300000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.480000	U	
1,1-DICHLOROETHANE	0.470000	U	
1,1-DICHLOROETHENE	1.000000	U	
1,2,4-TRICHLOROBENZENE	0.160000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.000000	U	
1,2-DIBROMOETHANE	0.380000	U	
1,2-DICHLOROBENZENE	0.320000	U	
1,2-DICHLOROETHANE	0.400000	U	
1,2-DICHLOROPROPANE	0.400000	U	
1,3-DICHLOROBENZENE	0.730000	U	
1,4-DICHLOROBENZENE	0.480000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	2.000000	U	
4-METHYL-2-PENTANONE	0.510000	U	
ACETONE	2.4	J	C
BENZENE	0.410000	U	
BROMODICHLOROMETHANE	0.260000	U	
BROMOFORM	0.870000	U	
BROMOMETHANE	0.630000	U	
CARBON DISULFIDE	1.100000	U	
CARBON TETRACHLORIDE	0.770000	U	
CHLOROBENZENE	0.300000	U	
CHLORODIBROMOMETHANE	0.300000	U	
CHLOROETHANE	0.960000	U	
CHLOROFORM	0.480000	U	
CHLOROMETHANE	0.450000	U	
CIS-1,2-DICHLOROETHENE	1.000000	U	
CIS-1,3-DICHLOROPROPENE	0.440000	U	
CYCLOHEXANE	0.470000	U	

nsample	NTC19SB01-SO-0608
samp_date	12/2/2008
lab_id	0812036-01
qc_type	NM
units	UG/KG
Pct_Solids	82.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.960000	U	
ETHYLBENZENE	0.660000	U	
ISOPROPYLBENZENE	0.770000	U	
METHYL ACETATE	1.400000	U	
METHYL CYCLOHEXANE	0.260000	U	
METHYL TERT-BUTYL ETHER	0.280000	U	
METHYLENE CHLORIDE	4.0	U	A
STYRENE	0.300000	U	
TETRACHLOROETHENE	0.850000	U	
TOLUENE	0.750000	U	
TOTAL XYLENES	0.610000	U	
TRANS-1,2-DICHLOROETHENE	0.960000	U	
TRANS-1,3-DICHLOROPROPENE	0.280000	U	
TRICHLOROETHENE	0.740000	U	
TRICHLOROFLUOROMETHANE	0.830000	U	
VINYL CHLORIDE	0.960000	U	

nsample	NTC19SB02-SO-0204
samp_date	12/2/2008
lab_id	0812036-02
qc_type	NM
units	UG/KG
Pct_Solids	80.8
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.000000	U	
1,1,2,2-TETRACHLOROETHANE	0.480000	U	
1,1,2-TRICHLOROETHANE	0.390000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.620000	U	
1,1-DICHLOROETHANE	0.610000	U	
1,1-DICHLOROETHENE	1.400000	U	
1,2,4-TRICHLOROBENZENE	0.200000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.400000	U	
1,2-DIBROMOETHANE	0.480000	U	
1,2-DICHLOROBENZENE	0.420000	U	
1,2-DICHLOROETHANE	0.520000	U	
1,2-DICHLOROPROPANE	0.520000	U	
1,3-DICHLOROBENZENE	0.950000	U	
1,4-DICHLOROBENZENE	0.620000	U	
2-BUTANONE	1.600000	U	
2-HEXANONE	2.600000	U	
4-METHYL-2-PENTANONE	0.650000	U	
ACETONE	2.200000	UJ	C
BENZENE	0.530000	U	
BROMODICHLOROMETHANE	0.340000	U	
BROMOFORM	1.100000	U	
BROMOMETHANE	0.810000	U	
CARBON DISULFIDE	1.500000	U	
CARBON TETRACHLORIDE	0.990000	U	
CHLOROBENZENE	0.380000	U	
CHLORODIBROMOMETHANE	0.380000	U	
CHLOROETHANE	1.200000	U	
CHLOROFORM	0.620000	U	
CHLOROMETHANE	0.580000	U	
CIS-1,2-DICHLOROETHENE	1.400000	U	
CIS-1,3-DICHLOROPROPENE	0.560000	U	
CYCLOHEXANE	0.610000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB02-SO-0204
samp_date	12/2/2008
lab_id	0812036-02
qc_type	NM
units	UG/KG
Pct_Solids	80.8
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.200000	U	
ETHYLBENZENE	0.840000	U	
ISOPROPYLBENZENE	0.990000	U	
METHYL ACETATE	1.800000	U	
METHYL CYCLOHEXANE	0.340000	U	
METHYL TERT-BUTYL ETHER	0.360000	U	
METHYLENE CHLORIDE	5.9	U	A
STYRENE	0.390000	U	
TETRACHLOROETHENE	1.100000	U	
TOLUENE	0.970000	U	
TOTAL XYLENES	0.790000	U	
TRANS-1,2-DICHLOROETHENE	1.200000	U	
TRANS-1,3-DICHLOROPROPENE	0.360000	U	
TRICHLOROETHENE	0.960000	U	
TRICHLOROFLUOROMETHANE	1.100000	U	
VINYL CHLORIDE	1.200000	U	

nsample	NTC19SB03-SO-0103
samp_date	12/2/2008
lab_id	0812036-03
qc_type	NM
units	UG/KG
Pct_Solids	84.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.960000	U	
1,1,2,2-TETRACHLOROETHANE	0.460000	U	
1,1,2-TRICHLOROETHANE	0.370000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.590000	U	
1,1-DICHLOROETHANE	0.580000	U	
1,1-DICHLOROETHENE	1.300000	U	
1,2,4-TRICHLOROBENZENE	0.190000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.300000	U	
1,2-DIBROMOETHANE	0.460000	U	
1,2-DICHLOROBENZENE	0.400000	U	
1,2-DICHLOROETHANE	0.490000	U	
1,2-DICHLOROPROPANE	0.490000	U	
1,3-DICHLOROBENZENE	0.900000	U	
1,4-DICHLOROBENZENE	0.590000	U	
2-BUTANONE	1.500000	U	
2-HEXANONE	2.500000	U	
4-METHYL-2-PENTANONE	0.620000	U	
ACETONE	2.100000	UJ	C
BENZENE	0.500000	U	
BROMODICHLOROMETHANE	0.320000	U	
BROMOFORM	1.100000	U	
BROMOMETHANE	0.770000	U	
CARBON DISULFIDE	1.400000	U	
CARBON TETRACHLORIDE	0.940000	U	
CHLOROBENZENE	0.360000	U	
CHLORODIBROMOMETHANE	0.360000	U	
CHLOROETHANE	1.200000	U	
CHLOROFORM	0.590000	U	
CHLOROMETHANE	0.560000	U	
CIS-1,2-DICHLOROETHENE	1.300000	U	
CIS-1,3-DICHLOROPROPENE	0.540000	U	
CYCLOHEXANE	0.580000	U	

nsample	NTC19SB03-SO-0103
samp_date	12/2/2008
lab_id	0812036-03
qc_type	NM
units	UG/KG
Pct_Solids	84.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.200000	U	
ETHYLBENZENE	0.800000	U	
ISOPROPYLBENZENE	0.940000	U	
METHYL ACETATE	1.700000	U	
METHYL CYCLOHEXANE	0.320000	U	
METHYL TERT-BUTYL ETHER	0.340000	U	
METHYLENE CHLORIDE	5.6	U	A
STYRENE	0.370000	U	
TETRACHLOROETHENE	1.000000	U	
TOLUENE	0.920000	U	
TOTAL XYLENES	0.750000	U	
TRANS-1,2-DICHLOROETHENE	1.200000	U	
TRANS-1,3-DICHLOROPROPENE	0.340000	U	
TRICHLOROETHENE	0.910000	U	
TRICHLOROFLUOROMETHANE	1.000000	U	
VINYL CHLORIDE	1.200000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB03-SO-0810
samp_date	12/2/2008
lab_id	0812036-04
qc_type	NM
units	UG/KG
Pct_Solids	87.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.770000	UJ	R
1,1,2,2-TETRACHLOROETHANE	0.370000	UJ	R
1,1,2-TRICHLOROETHANE	0.300000	UJ	R
1,1,2-TRICHLOROTRIFLUOROETHANE	0.470000	UJ	R
1,1-DICHLOROETHANE	0.460000	UJ	R
1,1-DICHLOROETHENE	1.000000	UJ	R
1,2,4-TRICHLOROBENZENE	0.150000	UJ	NR
1,2-DIBROMO-3-CHLOROPROPANE	1.000000	UJ	NR
1,2-DIBROMOETHANE	0.370000	UJ	R
1,2-DICHLOROBENZENE	0.320000	UJ	NR
1,2-DICHLOROETHANE	0.390000	UJ	R
1,2-DICHLOROPROPANE	0.390000	UJ	R
1,3-DICHLOROBENZENE	0.720000	UJ	NR
1,4-DICHLOROBENZENE	0.470000	UJ	NR
2-BUTANONE	1.200000	U	R
2-HEXANONE	2.000000	UJ	CR
4-METHYL-2-PENTANONE	0.500000	U	R
ACETONE	1.700000	UJ	CR
BENZENE	0.400000	UJ	R
BROMODICHLOROMETHANE	0.260000	UJ	R
BROMOFORM	0.860000	UJ	R
BROMOMETHANE	0.620000	UJ	CR
CARBON DISULFIDE	1.100000	UJ	R
CARBON TETRACHLORIDE	0.750000	UJ	R
CHLOROBENZENE	0.290000	UJ	R
CHLORODIBROMOMETHANE	0.290000	UJ	R
CHLOROETHANE	0.940000	UJ	R
CHLOROFORM	0.470000	UJ	R
CHLOROMETHANE	0.440000	UJ	R
CIS-1,2-DICHLOROETHENE	1.000000	UJ	R
CIS-1,3-DICHLOROPROPENE	0.430000	UJ	R
CYCLOHEXANE	0.460000	UJ	R

nsample	NTC19SB03-SO-0810
samp_date	12/2/2008
lab_id	0812036-04
qc_type	NM
units	UG/KG
Pct_Solids	87.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.940000	UJ	R
ETHYLBENZENE	0.640000	UJ	R
ISOPROPYLBENZENE	0.750000	UJ	R
METHYL ACETATE	1.400000	UJ	R
METHYL CYCLOHEXANE	0.260000	UJ	R
METHYL TERT-BUTYL ETHER	0.270000	UJ	R
METHYLENE CHLORIDE	3.5	U	A
STYRENE	0.300000	UJ	R
TETRACHLOROETHENE	0.830000	UJ	R
TOLUENE	0.740000	UJ	R
TOTAL XYLENES	0.600000	UJ	R
TRANS-1,2-DICHLOROETHENE	0.940000	UJ	R
TRANS-1,3-DICHLOROPROPENE	0.270000	UJ	R
TRICHLOROETHENE	0.730000	UJ	R
TRICHLOROFLUOROMETHANE	0.810000	UJ	R
VINYL CHLORIDE	0.940000	UJ	R

nsample	NTC19SB04-SO-0204
samp_date	12/2/2008
lab_id	0812036-05
qc_type	NM
units	UG/KG
Pct_Solids	83.4
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.000000	U	
1,1,2,2-TETRACHLOROETHANE	0.480000	U	
1,1,2-TRICHLOROETHANE	0.390000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.610000	U	
1,1-DICHLOROETHANE	0.600000	U	
1,1-DICHLOROETHENE	1.300000	U	
1,2,4-TRICHLOROBENZENE	0.200000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.300000	U	
1,2-DIBROMOETHANE	0.480000	U	
1,2-DICHLOROBENZENE	0.410000	U	
1,2-DICHLOROETHANE	0.510000	U	
1,2-DICHLOROPROPANE	0.510000	U	
1,3-DICHLOROBENZENE	0.930000	U	
1,4-DICHLOROBENZENE	0.610000	U	
2-BUTANONE	1.600000	U	
2-HEXANONE	2.600000	U	
4-METHYL-2-PENTANONE	0.640000	U	
ACETONE	2.200000	UJ	C
BENZENE	0.520000	U	
BROMODICHLOROMETHANE	0.330000	U	
BROMOFORM	1.100000	U	
BROMOMETHANE	0.800000	U	
CARBON DISULFIDE	1.400000	U	
CARBON TETRACHLORIDE	0.980000	U	
CHLOROBENZENE	0.380000	U	
CHLORODIBROMOMETHANE	0.380000	U	
CHLOROETHANE	1.200000	U	
CHLOROFORM	0.610000	U	
CHLOROMETHANE	0.580000	U	
CIS-1,2-DICHLOROETHENE	1.300000	U	
CIS-1,3-DICHLOROPROPENE	0.560000	U	
CYCLOHEXANE	0.600000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB04-SO-0204
samp_date	12/2/2008
lab_id	0812036-05
qc_type	NM
units	UG/KG
Pct_Solids	83.4
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.200000	U	
ETHYLBENZENE	0.830000	U	
ISOPROPYLBENZENE	0.980000	U	
METHYL ACETATE	1.800000	U	
METHYL CYCLOHEXANE	0.330000	U	
METHYL TERT-BUTYL ETHER	0.360000	U	
METHYLENE CHLORIDE	7.7	U	A
STYRENE	0.390000	U	
TETRACHLOROETHENE	1.100000	U	
TOLUENE	0.950000	U	
TOTAL XYLENES	0.780000	U	
TRANS-1,2-DICHLOROETHENE	1.200000	U	
TRANS-1,3-DICHLOROPROPENE	0.360000	U	
TRICHLOROETHENE	0.940000	U	
TRICHLOROFLUOROMETHANE	1.000000	U	
VINYL CHLORIDE	1.200000	U	

nsample	NTC19SB05-SO-0406
samp_date	12/2/2008
lab_id	0812036-06
qc_type	NM
units	UG/KG
Pct_Solids	90.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.830000	U	
1,1,2,2-TETRACHLOROETHANE	0.400000	U	
1,1,2-TRICHLOROETHANE	0.320000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.500000	U	
1,1-DICHLOROETHANE	0.500000	U	
1,1-DICHLOROETHENE	1.100000	U	
1,2,4-TRICHLOROBENZENE	0.160000	UJ	N
1,2-DIBROMO-3-CHLOROPROPANE	1.100000	UJ	N
1,2-DIBROMOETHANE	0.400000	U	
1,2-DICHLOROBENZENE	0.340000	UJ	N
1,2-DICHLOROETHANE	0.420000	U	
1,2-DICHLOROPROPANE	0.420000	U	
1,3-DICHLOROBENZENE	0.770000	UJ	N
1,4-DICHLOROBENZENE	0.500000	UJ	N
2-BUTANONE	1.300000	U	
2-HEXANONE	2.100000	UJ	C
4-METHYL-2-PENTANONE	0.530000	U	
ACETONE	5.8	J	C
BENZENE	0.430000	U	
BROMODICHLOROMETHANE	0.280000	U	
BROMOFORM	0.920000	U	
BROMOMETHANE	0.660000	UJ	C
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.810000	U	
CHLOROBENZENE	0.310000	U	
CHLORODIBROMOMETHANE	0.310000	U	
CHLOROETHANE	1.000000	U	
CHLOROFORM	0.500000	U	
CHLOROMETHANE	0.480000	U	
CIS-1,2-DICHLOROETHENE	1.100000	U	
CIS-1,3-DICHLOROPROPENE	0.460000	U	
CYCLOHEXANE	0.500000	U	

nsample	NTC19SB05-SO-0406
samp_date	12/2/2008
lab_id	0812036-06
qc_type	NM
units	UG/KG
Pct_Solids	90.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.000000	U	
ETHYLBENZENE	0.690000	U	
ISOPROPYLBENZENE	0.810000	U	
METHYL ACETATE	1.500000	U	
METHYL CYCLOHEXANE	0.280000	U	
METHYL TERT-BUTYL ETHER	0.290000	U	
METHYLENE CHLORIDE	7.2	U	A
STYRENE	0.320000	U	
TETRACHLOROETHENE	0.890000	U	
TOLUENE	0.790000	U	
TOTAL XYLENES	0.640000	U	
TRANS-1,2-DICHLOROETHENE	1.000000	U	
TRANS-1,3-DICHLOROPROPENE	0.290000	U	
TRICHLOROETHENE	0.780000	U	
TRICHLOROFLUOROMETHANE	0.870000	U	
VINYL CHLORIDE	1.000000	U	

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SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB05-SO-0608
samp_date	12/2/2008
lab_id	0812036-07
qc_type	NM
units	UG/KG
Pct_Solids	88.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.800000	U	
1,1,2,2-TETRACHLOROETHANE	0.380000	U	
1,1,2-TRICHLOROETHANE	0.310000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.490000	U	
1,1-DICHLOROETHANE	0.480000	U	
1,1-DICHLOROETHENE	1.100000	U	
1,2,4-TRICHLOROBENZENE	0.160000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.100000	U	
1,2-DIBROMOETHANE	0.380000	U	
1,2-DICHLOROBENZENE	0.330000	U	
1,2-DICHLOROETHANE	0.410000	U	
1,2-DICHLOROPROPANE	0.410000	U	
1,3-DICHLOROBENZENE	0.750000	U	
1,4-DICHLOROBENZENE	0.490000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	2.000000	U	
4-METHYL-2-PENTANONE	0.520000	U	
ACETONE	2.3	J	C
BENZENE	0.420000	U	
BROMODICHLOROMETHANE	0.270000	U	
BROMOFORM	0.890000	U	
BROMOMETHANE	0.640000	U	
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.780000	U	
CHLOROBENZENE	0.300000	U	
CHLORODIBROMOMETHANE	0.300000	U	
CHLOROETHANE	0.980000	U	
CHLOROFORM	0.490000	U	
CHLOROMETHANE	0.460000	U	
CIS-1,2-DICHLOROETHENE	1.100000	U	
CIS-1,3-DICHLOROPROPENE	0.450000	U	
CYCLOHEXANE	0.480000	U	

nsample	NTC19SB05-SO-0608
samp_date	12/2/2008
lab_id	0812036-07
qc_type	NM
units	UG/KG
Pct_Solids	88.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.980000	U	
ETHYLBENZENE	0.670000	U	
ISOPROPYLBENZENE	0.780000	U	
METHYL ACETATE	1.400000	U	
METHYL CYCLOHEXANE	0.270000	U	
METHYL TERT-BUTYL ETHER	0.280000	U	
METHYLENE CHLORIDE	5.6	U	A
STYRENE	0.310000	U	
TETRACHLOROETHENE	0.860000	U	
TOLUENE	0.770000	U	
TOTAL XYLENES	0.620000	U	
TRANS-1,2-DICHLOROETHENE	0.980000	U	
TRANS-1,3-DICHLOROPROPENE	0.280000	U	
TRICHLOROETHENE	0.760000	U	
TRICHLOROFLUOROMETHANE	0.850000	U	
VINYL CHLORIDE	0.980000	U	

nsample	NTC19SB06-SO-0204
samp_date	12/2/2008
lab_id	0812036-08
qc_type	NM
units	UG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.300000	U	
1,1,2,2-TETRACHLOROETHANE	0.600000	U	
1,1,2-TRICHLOROETHANE	0.490000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.770000	U	
1,1-DICHLOROETHANE	0.760000	U	
1,1-DICHLOROETHENE	1.700000	U	
1,2,4-TRICHLOROBENZENE	0.250000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.700000	U	
1,2-DIBROMOETHANE	0.600000	U	
1,2-DICHLOROBENZENE	0.520000	U	
1,2-DICHLOROETHANE	0.640000	U	
1,2-DICHLOROPROPANE	0.640000	U	
1,3-DICHLOROBENZENE	1.200000	U	
1,4-DICHLOROBENZENE	0.770000	U	
2-BUTANONE	2.000000	U	
2-HEXANONE	3.200000	U	
4-METHYL-2-PENTANONE	0.810000	U	
ACETONE	2.800000	UJ	C
BENZENE	0.660000	U	
BROMODICHLOROMETHANE	0.420000	U	
BROMOFORM	1.400000	U	
BROMOMETHANE	1.000000	U	
CARBON DISULFIDE	1.800000	U	
CARBON TETRACHLORIDE	1.200000	U	
CHLOROBENZENE	0.480000	U	
CHLORODIBROMOMETHANE	0.480000	U	
CHLOROETHANE	1.500000	U	
CHLOROFORM	0.770000	U	
CHLOROMETHANE	0.730000	U	
CIS-1,2-DICHLOROETHENE	1.700000	U	
CIS-1,3-DICHLOROPROPENE	0.700000	U	
CYCLOHEXANE	0.760000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB06-SO-0204
samp_date	12/2/2008
lab_id	0812036-08
qc_type	NM
units	UG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.500000	U	
ETHYLBENZENE	1.000000	U	
ISOPROPYLBENZENE	1.200000	U	
METHYL ACETATE	2.200000	U	
METHYL CYCLOHEXANE	0.420000	U	
METHYL TERT-BUTYL ETHER	0.450000	U	
METHYLENE CHLORIDE	9.9	U	A
STYRENE	0.490000	U	
TETRACHLOROETHENE	1.400000	U	
TOLUENE	1.200000	U	
TOTAL XYLENES	0.980000	U	
TRANS-1,2-DICHLOROETHENE	1.500000	U	
TRANS-1,3-DICHLOROPROPENE	0.450000	U	
TRICHLOROETHENE	1.200000	U	
TRICHLOROFLUOROMETHANE	1.300000	U	
VINYL CHLORIDE	1.500000	U	

nsample	NTC19SB06-SO-0608
samp_date	12/2/2008
lab_id	0812036-09
qc_type	NM
units	UG/KG
Pct_Solids	89.2
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.870000	U	
1,1,2,2-TETRACHLOROETHANE	0.420000	U	
1,1,2-TRICHLOROETHANE	0.340000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.530000	U	
1,1-DICHLOROETHANE	0.520000	U	
1,1-DICHLOROETHENE	1.200000	U	
1,2,4-TRICHLOROBENZENE	0.170000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.200000	U	
1,2-DIBROMOETHANE	0.420000	U	
1,2-DICHLOROBENZENE	0.360000	U	
1,2-DICHLOROETHANE	0.440000	U	
1,2-DICHLOROPROPANE	0.440000	U	
1,3-DICHLOROBENZENE	0.810000	U	
1,4-DICHLOROBENZENE	0.530000	U	
2-BUTANONE	1.400000	U	
2-HEXANONE	2.200000	U	
4-METHYL-2-PENTANONE	0.560000	U	
ACETONE	1.900000	UJ	C
BENZENE	0.450000	U	
BROMODICHLOROMETHANE	0.290000	U	
BROMOFORM	0.970000	U	
BROMOMETHANE	0.700000	U	
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.850000	U	
CHLOROBENZENE	0.330000	U	
CHLORODIBROMOMETHANE	0.330000	U	
CHLOROETHANE	1.100000	U	
CHLOROFORM	0.530000	U	
CHLOROMETHANE	0.500000	U	
CIS-1,2-DICHLOROETHENE	1.200000	U	
CIS-1,3-DICHLOROPROPENE	0.480000	U	
CYCLOHEXANE	0.520000	U	

nsample	NTC19SB06-SO-0608
samp_date	12/2/2008
lab_id	0812036-09
qc_type	NM
units	UG/KG
Pct_Solids	89.2
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.100000	U	
ETHYLBENZENE	0.720000	U	
ISOPROPYLBENZENE	0.850000	U	
METHYL ACETATE	1.500000	U	
METHYL CYCLOHEXANE	0.290000	U	
METHYL TERT-BUTYL ETHER	0.310000	U	
METHYLENE CHLORIDE	6.8	U	A
STYRENE	0.340000	U	
TETRACHLOROETHENE	0.940000	U	
TOLUENE	0.830000	U	
TOTAL XYLENES	0.680000	U	
TRANS-1,2-DICHLOROETHENE	1.100000	U	
TRANS-1,3-DICHLOROPROPENE	0.310000	U	
TRICHLOROETHENE	0.820000	U	
TRICHLOROFLUOROMETHANE	0.920000	U	
VINYL CHLORIDE	1.100000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB07-SO-0507
samp_date	12/2/2008
lab_id	0812036-10
qc_type	NM
units	UG/KG
Pct_Solids	89.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.910000	U	
1,1,2,2-TETRACHLOROETHANE	0.440000	U	
1,1,2-TRICHLOROETHANE	0.350000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.560000	U	
1,1-DICHLOROETHANE	0.550000	U	
1,1-DICHLOROETHENE	1.200000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.200000	U	
1,2-DIBROMOETHANE	0.440000	U	
1,2-DICHLOROBENZENE	0.370000	U	
1,2-DICHLOROETHANE	0.460000	U	
1,2-DICHLOROPROPANE	0.460000	U	
1,3-DICHLOROBENZENE	0.850000	U	
1,4-DICHLOROBENZENE	0.560000	U	
2-BUTANONE	1.400000	U	
2-HEXANONE	2.300000	U	
4-METHYL-2-PENTANONE	0.590000	U	
ACETONE	3.2		
BENZENE	0.480000	U	
BROMODICHLOROMETHANE	0.300000	U	
BROMOFORM	1.000000	U	
BROMOMETHANE	0.730000	U	
CARBON DISULFIDE	1.300000	U	
CARBON TETRACHLORIDE	0.890000	U	
CHLOROBENZENE	0.340000	U	
CHLORODIBROMOMETHANE	0.340000	U	
CHLOROETHANE	1.100000	U	
CHLOROFORM	0.560000	U	
CHLOROMETHANE	0.530000	U	
CIS-1,2-DICHLOROETHENE	1.200000	U	
CIS-1,3-DICHLOROPROPENE	0.510000	U	
CYCLOHEXANE	0.550000	U	

nsample	NTC19SB07-SO-0507
samp_date	12/2/2008
lab_id	0812036-10
qc_type	NM
units	UG/KG
Pct_Solids	89.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.100000	U	
ETHYLBENZENE	0.760000	U	
ISOPROPYLBENZENE	0.890000	U	
METHYL ACETATE	1.600000	U	
METHYL CYCLOHEXANE	0.300000	U	
METHYL TERT-BUTYL ETHER	0.320000	U	
METHYLENE CHLORIDE	6.1	U	A
STYRENE	0.350000	U	
TETRACHLOROETHENE	0.980000	U	
TOLUENE	0.870000	U	
TOTAL XYLENES	0.710000	U	
TRANS-1,2-DICHLOROETHENE	1.100000	U	
TRANS-1,3-DICHLOROPROPENE	0.320000	U	
TRICHLOROETHENE	0.860000	U	
TRICHLOROFLUOROMETHANE	3.9		
VINYL CHLORIDE	1.100000	U	

nsample	NTC19SB08-SO-0103
samp_date	12/2/2008
lab_id	0812036-11
qc_type	NM
units	UG/KG
Pct_Solids	88.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.850000	U	
1,1,2,2-TETRACHLOROETHANE	0.410000	U	
1,1,2-TRICHLOROETHANE	0.330000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.520000	U	
1,1-DICHLOROETHANE	0.510000	U	
1,1-DICHLOROETHENE	1.100000	U	
1,2,4-TRICHLOROBENZENE	0.170000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.100000	U	
1,2-DIBROMOETHANE	0.410000	U	
1,2-DICHLOROBENZENE	0.350000	U	
1,2-DICHLOROETHANE	0.440000	U	
1,2-DICHLOROPROPANE	0.440000	U	
1,3-DICHLOROBENZENE	0.790000	U	
1,4-DICHLOROBENZENE	0.520000	U	
2-BUTANONE	1.300000	U	
2-HEXANONE	2.200000	U	
4-METHYL-2-PENTANONE	0.550000	U	
ACETONE	1.900000	U	
BENZENE	0.440000	U	
BROMODICHLOROMETHANE	0.280000	U	
BROMOFORM	0.940000	U	
BROMOMETHANE	0.680000	U	
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.830000	U	
CHLOROBENZENE	0.320000	U	
CHLORODIBROMOMETHANE	0.320000	U	
CHLOROETHANE	1.000000	U	
CHLOROFORM	0.520000	U	
CHLOROMETHANE	0.490000	U	
CIS-1,2-DICHLOROETHENE	1.100000	U	
CIS-1,3-DICHLOROPROPENE	0.470000	U	
CYCLOHEXANE	0.510000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB08-SO-0103
samp_date	12/2/2008
lab_id	0812036-11
qc_type	NM
units	UG/KG
Pct_Solids	88.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.000000	U	
ETHYLBENZENE	0.710000	U	
ISOPROPYLBENZENE	0.830000	U	
METHYL ACETATE	1.500000	U	
METHYL CYCLOHEXANE	0.280000	U	
METHYL TERT-BUTYL ETHER	0.300000	U	
METHYLENE CHLORIDE	6.2	U	A
STYRENE	0.330000	U	
TETRACHLOROETHENE	0.920000	U	
TOLUENE	0.810000	U	
TOTAL XYLENES	0.660000	U	
TRANS-1,2-DICHLOROETHENE	1.000000	U	
TRANS-1,3-DICHLOROPROPENE	0.300000	U	
TRICHLOROETHENE	0.800000	U	
TRICHLOROFLUOROMETHANE	0.900000	U	
VINYL CHLORIDE	1.000000	U	

nsample	NTC19SB08-SO-0406
samp_date	12/2/2008
lab_id	0812036-12
qc_type	NM
units	UG/KG
Pct_Solids	88.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.200000	U	
1,1,2,2-TETRACHLOROETHANE	0.580000	U	
1,1,2-TRICHLOROETHANE	0.470000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.740000	U	
1,1-DICHLOROETHANE	0.720000	U	
1,1-DICHLOROETHENE	1.600000	U	
1,2,4-TRICHLOROBENZENE	0.240000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.600000	U	
1,2-DIBROMOETHANE	0.580000	U	
1,2-DICHLOROBENZENE	0.500000	U	
1,2-DICHLOROETHANE	0.620000	U	
1,2-DICHLOROPROPANE	0.620000	U	
1,3-DICHLOROBENZENE	1.100000	U	
1,4-DICHLOROBENZENE	0.740000	U	
2-BUTANONE	1.900000	U	
2-HEXANONE	3.100000	U	
4-METHYL-2-PENTANONE	0.780000	U	
ACETONE	2.700000	U	
BENZENE	0.630000	U	
BROMODICHLOROMETHANE	0.400000	U	
BROMOFORM	1.300000	U	
BROMOMETHANE	0.970000	U	
CARBON DISULFIDE	1.700000	U	
CARBON TETRACHLORIDE	1.200000	U	
CHLOROBENZENE	0.460000	U	
CHLORODIBROMOMETHANE	0.460000	U	
CHLOROETHANE	1.500000	U	
CHLOROFORM	0.740000	U	
CHLOROMETHANE	0.700000	U	
CIS-1,2-DICHLOROETHENE	1.600000	U	
CIS-1,3-DICHLOROPROPENE	0.670000	U	
CYCLOHEXANE	0.720000	U	

nsample	NTC19SB08-SO-0406
samp_date	12/2/2008
lab_id	0812036-12
qc_type	NM
units	UG/KG
Pct_Solids	88.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.500000	U	
ETHYLBENZENE	1.000000	U	
ISOPROPYLBENZENE	1.200000	U	
METHYL ACETATE	2.100000	U	
METHYL CYCLOHEXANE	0.400000	U	
METHYL TERT-BUTYL ETHER	0.430000	U	
METHYLENE CHLORIDE	8.6	U	A
STYRENE	0.470000	U	
TETRACHLOROETHENE	1.300000	U	
TOLUENE	1.200000	U	
TOTAL XYLENES	0.940000	U	
TRANS-1,2-DICHLOROETHENE	1.500000	U	
TRANS-1,3-DICHLOROPROPENE	0.430000	U	
TRICHLOROETHENE	1.100000	U	
TRICHLOROFLUOROMETHANE	1.300000	U	
VINYL CHLORIDE	1.500000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB09-SO-0002
samp_date	12/2/2008
lab_id	0812036-13
qc_type	NM
units	UG/KG
Pct_Solids	86.5
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.910000	U	
1,1,2,2-TETRACHLOROETHANE	0.440000	U	
1,1,2-TRICHLOROETHANE	0.350000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.560000	U	
1,1-DICHLOROETHANE	0.550000	U	
1,1-DICHLOROETHENE	1.200000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.200000	U	
1,2-DIBROMOETHANE	0.440000	U	
1,2-DICHLOROBENZENE	0.380000	U	
1,2-DICHLOROETHANE	0.470000	U	
1,2-DICHLOROPROPANE	0.470000	U	
1,3-DICHLOROBENZENE	0.850000	U	
1,4-DICHLOROBENZENE	0.560000	U	
2-BUTANONE	1.400000	U	
2-HEXANONE	2.300000	U	
4-METHYL-2-PENTANONE	0.590000	U	
ACETONE	15		
BENZENE	0.480000	U	
BROMODICHLOROMETHANE	0.300000	U	
BROMOFORM	1.000000	U	
BROMOMETHANE	0.730000	U	
CARBON DISULFIDE	1.300000	U	
CARBON TETRACHLORIDE	0.890000	U	
CHLOROBENZENE	0.340000	U	
CHLORODIBROMOMETHANE	0.340000	U	
CHLOROETHANE	1.100000	U	
CHLOROFORM	0.560000	U	
CHLOROMETHANE	0.530000	U	
CIS-1,2-DICHLOROETHENE	1.200000	U	
CIS-1,3-DICHLOROPROPENE	0.510000	U	
CYCLOHEXANE	0.550000	U	

nsample	NTC19SB09-SO-0002
samp_date	12/2/2008
lab_id	0812036-13
qc_type	NM
units	UG/KG
Pct_Solids	86.5
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.100000	U	
ETHYLBENZENE	0.760000	U	
ISOPROPYLBENZENE	0.890000	U	
METHYL ACETATE	1.600000	U	
METHYL CYCLOHEXANE	0.300000	U	
METHYL TERT-BUTYL ETHER	0.320000	U	
METHYLENE CHLORIDE	5.6	U	A
STYRENE	0.350000	U	
TETRACHLOROETHENE	0.980000	U	
TOLUENE	0.870000	U	
TOTAL XYLENES	0.710000	U	
TRANS-1,2-DICHLOROETHENE	1.100000	U	
TRANS-1,3-DICHLOROPROPENE	0.320000	U	
TRICHLOROETHENE	0.860000	U	
TRICHLOROFLUOROMETHANE	0.960000	U	
VINYL CHLORIDE	1.100000	U	

nsample	NTC19SB09-SO-0406
samp_date	12/2/2008
lab_id	0812036-14
qc_type	NM
units	UG/KG
Pct_Solids	89.3
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.750000	U	
1,1,2,2-TETRACHLOROETHANE	0.360000	U	
1,1,2-TRICHLOROETHANE	0.290000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.460000	U	
1,1-DICHLOROETHANE	0.450000	U	
1,1-DICHLOROETHENE	1.000000	U	
1,2,4-TRICHLOROBENZENE	0.150000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.000000	U	
1,2-DIBROMOETHANE	0.360000	U	
1,2-DICHLOROBENZENE	0.310000	U	
1,2-DICHLOROETHANE	0.380000	U	
1,2-DICHLOROPROPANE	0.380000	U	
1,3-DICHLOROBENZENE	0.700000	U	
1,4-DICHLOROBENZENE	0.460000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	1.900000	U	
4-METHYL-2-PENTANONE	0.480000	U	
ACETONE	2.6		
BENZENE	0.390000	U	
BROMODICHLOROMETHANE	0.250000	U	
BROMOFORM	0.840000	U	
BROMOMETHANE	0.600000	U	
CARBON DISULFIDE	1.100000	U	
CARBON TETRACHLORIDE	0.740000	U	
CHLOROBENZENE	0.280000	U	
CHLORODIBROMOMETHANE	0.280000	U	
CHLOROETHANE	0.920000	U	
CHLOROFORM	0.460000	U	
CHLOROMETHANE	0.430000	U	
CIS-1,2-DICHLOROETHENE	1.000000	U	
CIS-1,3-DICHLOROPROPENE	0.420000	U	
CYCLOHEXANE	0.450000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB09-SO-0406
samp_date	12/2/2008
lab_id	0812036-14
qc_type	NM
units	UG/KG
Pct_Solids	89.3
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.920000	U	
ETHYLBENZENE	0.630000	U	
ISOPROPYLBENZENE	0.740000	U	
METHYL ACETATE	1.300000	U	
METHYL CYCLOHEXANE	0.250000	U	
METHYL TERT-BUTYL ETHER	0.270000	U	
METHYLENE CHLORIDE	5.5	U	A
STYRENE	0.290000	U	
TETRACHLOROETHENE	0.810000	U	
TOLUENE	0.720000	U	
TOTAL XYLENES	0.580000	U	
TRANS-1,2-DICHLOROETHENE	0.920000	U	
TRANS-1,3-DICHLOROPROPENE	0.270000	U	
TRICHLOROETHENE	0.710000	U	
TRICHLOROFLUOROMETHANE	0.790000	U	
VINYL CHLORIDE	0.920000	U	

nsample	NTC19SB10-SO-0002
samp_date	12/2/2008
lab_id	0812036-15
qc_type	NM
units	UG/KG
Pct_Solids	84.7
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.100000	U	
1,1,2,2-TETRACHLOROETHANE	0.540000	U	
1,1,2-TRICHLOROETHANE	0.440000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.690000	U	
1,1-DICHLOROETHANE	0.680000	U	
1,1-DICHLOROETHENE	1.500000	U	
1,2,4-TRICHLOROBENZENE	0.230000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.500000	U	
1,2-DIBROMOETHANE	0.540000	U	
1,2-DICHLOROBENZENE	0.460000	U	
1,2-DICHLOROETHANE	0.580000	U	
1,2-DICHLOROPROPANE	0.580000	U	
1,3-DICHLOROBENZENE	1.000000	U	
1,4-DICHLOROBENZENE	0.690000	U	
2-BUTANONE	1.800000	U	
2-HEXANONE	2.900000	U	
4-METHYL-2-PENTANONE	0.730000	U	
ACETONE	16		
BENZENE	0.590000	U	
BROMODICHLOROMETHANE	0.380000	U	
BROMOFORM	1.200000	U	
BROMOMETHANE	0.900000	U	
CARBON DISULFIDE	1.600000	U	
CARBON TETRACHLORIDE	1.100000	U	
CHLOROBENZENE	0.430000	U	
CHLORODIBROMOMETHANE	0.430000	U	
CHLOROETHANE	1.400000	U	
CHLOROFORM	0.690000	U	
CHLOROMETHANE	0.650000	U	
CIS-1,2-DICHLOROETHENE	1.500000	U	
CIS-1,3-DICHLOROPROPENE	0.630000	U	
CYCLOHEXANE	0.680000	U	

nsample	NTC19SB10-SO-0002
samp_date	12/2/2008
lab_id	0812036-15
qc_type	NM
units	UG/KG
Pct_Solids	84.7
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.400000	U	
ETHYLBENZENE	0.940000	U	
ISOPROPYLBENZENE	1.100000	U	
METHYL ACETATE	2.000000	U	
METHYL CYCLOHEXANE	0.380000	U	
METHYL TERT-BUTYL ETHER	0.400000	U	
METHYLENE CHLORIDE	9.2	U	A
STYRENE	0.440000	U	
TETRACHLOROETHENE	1.200000	U	
TOLUENE	1.100000	U	
TOTAL XYLENES	0.880000	U	
TRANS-1,2-DICHLOROETHENE	1.400000	U	
TRANS-1,3-DICHLOROPROPENE	0.400000	U	
TRICHLOROETHENE	1.100000	U	
TRICHLOROFLUOROMETHANE	1.200000	U	
VINYL CHLORIDE	1.400000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB10-SO-0507
samp_date	12/2/2008
lab_id	0812036-16
qc_type	NM
units	UG/KG
Pct_Solids	85.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.800000	U	
1,1,2,2-TETRACHLOROETHANE	0.380000	U	
1,1,2-TRICHLOROETHANE	0.310000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.490000	U	
1,1-DICHLOROETHANE	0.480000	U	
1,1-DICHLOROETHENE	1.100000	U	
1,2,4-TRICHLOROBENZENE	0.160000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.100000	U	
1,2-DIBROMOETHANE	0.380000	U	
1,2-DICHLOROBENZENE	0.330000	U	
1,2-DICHLOROETHANE	0.410000	U	
1,2-DICHLOROPROPANE	0.410000	U	
1,3-DICHLOROBENZENE	0.740000	U	
1,4-DICHLOROBENZENE	0.490000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	2.000000	U	
4-METHYL-2-PENTANONE	0.510000	U	
ACETONE	1.800000	U	
BENZENE	0.420000	U	
BROMODICHLOROMETHANE	0.260000	U	
BROMOFORM	0.880000	U	
BROMOMETHANE	0.640000	U	
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.780000	U	
CHLOROBENZENE	0.300000	U	
CHLORODIBROMOMETHANE	0.300000	U	
CHLOROETHANE	0.970000	U	
CHLOROFORM	0.490000	U	
CHLOROMETHANE	0.460000	U	
CIS-1,2-DICHLOROETHENE	1.100000	U	
CIS-1,3-DICHLOROPROPENE	0.440000	U	
CYCLOHEXANE	0.480000	U	

nsample	NTC19SB10-SO-0507
samp_date	12/2/2008
lab_id	0812036-16
qc_type	NM
units	UG/KG
Pct_Solids	85.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.970000	U	
ETHYLBENZENE	0.660000	U	
ISOPROPYLBENZENE	0.780000	U	
METHYL ACETATE	1.400000	U	
METHYL CYCLOHEXANE	0.260000	U	
METHYL TERT-BUTYL ETHER	0.280000	U	
METHYLENE CHLORIDE	4.3	U	A
STYRENE	0.310000	U	
TETRACHLOROETHENE	0.860000	U	
TOLUENE	0.760000	U	
TOTAL XYLENES	0.620000	U	
TRANS-1,2-DICHLOROETHENE	0.970000	U	
TRANS-1,3-DICHLOROPROPENE	0.280000	U	
TRICHLOROETHENE	0.750000	U	
TRICHLOROFLUOROMETHANE	0.840000	U	
VINYL CHLORIDE	0.970000	U	

nsample	NTC19SB11-SO-0002
samp_date	12/2/2008
lab_id	0812036-17
qc_type	NM
units	UG/KG
Pct_Solids	79.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.200000	U	
1,1,2,2-TETRACHLOROETHANE	0.570000	U	
1,1,2-TRICHLOROETHANE	0.460000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.720000	U	
1,1-DICHLOROETHANE	0.710000	U	
1,1-DICHLOROETHENE	1.600000	U	
1,2,4-TRICHLOROBENZENE	0.240000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.600000	U	
1,2-DIBROMOETHANE	0.570000	U	
1,2-DICHLOROBENZENE	0.490000	U	
1,2-DICHLOROETHANE	0.600000	U	
1,2-DICHLOROPROPANE	0.600000	U	
1,3-DICHLOROBENZENE	1.100000	U	
1,4-DICHLOROBENZENE	0.720000	U	
2-BUTANONE	2.5		
2-HEXANONE	3.000000	U	
4-METHYL-2-PENTANONE	0.760000	U	
ACETONE	29		
BENZENE	0.620000	U	
BROMODICHLOROMETHANE	0.400000	U	
BROMOFORM	1.300000	U	
BROMOMETHANE	0.950000	U	
CARBON DISULFIDE	1.700000	U	
CARBON TETRACHLORIDE	1.200000	U	
CHLOROBENZENE	0.450000	U	
CHLORODIBROMOMETHANE	0.450000	U	
CHLOROETHANE	1.400000	U	
CHLOROFORM	0.720000	U	
CHLOROMETHANE	0.680000	U	
CIS-1,2-DICHLOROETHENE	1.600000	U	
CIS-1,3-DICHLOROPROPENE	0.660000	U	
CYCLOHEXANE	0.710000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB11-SO-0002
samp_date	12/2/2008
lab_id	0812036-17
qc_type	NM
units	UG/KG
Pct_Solids	79.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.400000	U	
ETHYLBENZENE	0.990000	U	
ISOPROPYLBENZENE	1.200000	U	
METHYL ACETATE	2.100000	U	
METHYL CYCLOHEXANE	0.400000	U	
METHYL TERT-BUTYL ETHER	0.420000	U	
METHYLENE CHLORIDE	8.1	U	A
STYRENE	0.460000	U	
TETRACHLOROETHENE	1.300000	U	
TOLUENE	1.100000	U	
TOTAL XYLENES	0.920000	U	
TRANS-1,2-DICHLOROETHENE	1.400000	U	
TRANS-1,3-DICHLOROPROPENE	0.420000	U	
TRICHLOROETHENE	1.100000	U	
TRICHLOROFLUOROMETHANE	1.200000	U	
VINYL CHLORIDE	1.400000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: WATER DATA FRACTION: OV

nsample	NTC19TB120208
samp_date	12/2/2008
lab_id	0812036-18
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.170000	U	
1,1,2,2-TETRACHLOROETHANE	0.100000	U	
1,1,2-TRICHLOROETHANE	0.100000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.180000	U	
1,1-DICHLOROETHANE	0.120000	U	
1,1-DICHLOROETHENE	0.150000	U	
1,2,4-TRICHLOROBENZENE	0.14		
1,2-DIBROMO-3-CHLOROPROPANE	0.110000	U	
1,2-DIBROMOETHANE	0.100000	U	
1,2-DICHLOROBENZENE	0.100000	U	
1,2-DICHLOROETHANE	0.100000	U	
1,2-DICHLOROPROPANE	0.100000	U	
1,3-DICHLOROBENZENE	0.130000	U	
1,4-DICHLOROBENZENE	0.100000	U	
2-BUTANONE	1.000000	U	
2-HEXANONE	0.300000	U	
4-METHYL-2-PENTANONE	0.290000	U	
ACETONE	0.840000	U	
BENZENE	0.110000	U	
BROMODICHLOROMETHANE	0.100000	U	
BROMOFORM	0.100000	U	
BROMOMETHANE	0.320000	UJ	C
CARBON DISULFIDE	0.130000	U	
CARBON TETRACHLORIDE	0.150000	U	
CHLOROBENZENE	0.100000	U	
CHLORODIBROMOMETHANE	0.100000	U	
CHLOROETHANE	0.180000	U	
CHLOROFORM	0.110000	U	
CHLOROMETHANE	0.290000	U	
CIS-1,2-DICHLOROETHENE	0.130000	U	
CIS-1,3-DICHLOROPROPENE	0.110000	U	
CYCLOHEXANE	0.200000	U	

nsample	NTC19TB120208
samp_date	12/2/2008
lab_id	0812036-18
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.220000	U	
ETHYLBENZENE	0.130000	U	
ISOPROPYLBENZENE	0.150000	U	
METHYL ACETATE	0.300000	U	
METHYL CYCLOHEXANE	0.170000	U	
METHYL TERT-BUTYL ETHER	0.100000	U	
METHYLENE CHLORIDE	2.1	U	A
STYRENE	0.100000	U	
TETRACHLOROETHENE	0.150000	U	
TOLUENE	0.100000	U	
TOTAL XYLENES	0.220000	U	
TRANS-1,2-DICHLOROETHENE	0.130000	U	
TRANS-1,3-DICHLOROPROPENE	0.100000	U	
TRICHLOROETHENE	0.130000	U	
TRICHLOROFLUOROMETHANE	0.170000	U	
VINYL CHLORIDE	0.180000	U	

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB01-SO-0608	nsample	NTC19SB02-SO-0204	nsample	NTC19SB03-SO-0103
samp_date	12/2/2008	samp_date	12/2/2008	samp_date	12/2/2008
lab_id	0812036-01	lab_id	0812036-02	lab_id	0812036-03
qc_type	NM	qc_type	NM	qc_type	NM
units	UG/KG	units	UG/KG	units	UG/KG
Pct_Solids	82.9	Pct_Solids	80.8	Pct_Solids	84.9
DUP_OF:		DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.400000	U	
ANTHRACENE	0.960000	U	
BENZO(A)ANTHRACENE	1.700000	U	
BENZO(A)PYRENE	1.200000	U	
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	3.7		
BENZO(K)FLUORANTHENE	1.500000	U	
CHRYSENE	1.300000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	2.000000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.800000	U	
PHENANTHRENE	5.7		
PYRENE	4.5		

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.100000	U	
ACENAPHTHENE	1.500000	U	
ACENAPHTHYLENE	1.400000	U	
ANTHRACENE	0.990000	U	
BENZO(A)ANTHRACENE	1.700000	U	
BENZO(A)PYRENE	1.200000	U	
BENZO(B)FLUORANTHENE	1.900000	U	
BENZO(G,H,I)PERYLENE	2.2		
BENZO(K)FLUORANTHENE	1.600000	U	
CHRYSENE	2.4		
DIBENZO(A,H)ANTHRACENE	1.900000	U	
FLUORANTHENE	2.100000	U	
FLUORENE	1.500000	U	
INDENO(1,2,3-CD)PYRENE	1.900000	U	
NAPHTHALENE	2.900000	U	
PHENANTHRENE	2.100000	U	
PYRENE	1.900000	U	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.4		
ANTHRACENE	0.940000	U	
BENZO(A)ANTHRACENE	19		
BENZO(A)PYRENE	21		
BENZO(B)FLUORANTHENE	18		
BENZO(G,H,I)PERYLENE	13		
BENZO(K)FLUORANTHENE	8.5		
CHRYSENE	19		
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	26		
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	9.5		
NAPHTHALENE	2.700000	U	
PHENANTHRENE	7		
PYRENE	29		

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB03-SO-0810
samp_date	12/2/2008
lab_id	0812036-04
qc_type	NM
units	UG/KG
Pct_Solids	87.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.920000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	5.6		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.700000	U	
PHENANTHRENE	17		
PYRENE	1.800000	U	

nsample	NTC19SB04-SO-0204
samp_date	12/2/2008
lab_id	0812036-05
qc_type	NM
units	UG/KG
Pct_Solids	83.4
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.7		
ANTHRACENE	0.960000	U	
BENZO(A)ANTHRACENE	16		
BENZO(A)PYRENE	18		
BENZO(B)FLUORANTHENE	15		
BENZO(G,H,I)PERYLENE	11		
BENZO(K)FLUORANTHENE	6.1		
CHRYSENE	17		
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	28		
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	6.5		
NAPHTHALENE	2.800000	U	
PHENANTHRENE	16		
PYRENE	27		

nsample	NTC19SB05-SO-0406
samp_date	12/2/2008
lab_id	0812036-06
qc_type	NM
units	UG/KG
Pct_Solids	90.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.800000	U	
ACENAPHTHENE	1.300000	U	
ACENAPHTHYLENE	1.200000	U	
ANTHRACENE	0.880000	U	
BENZO(A)ANTHRACENE	1.500000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	5.8		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	1.800000	U	
FLUORENE	1.300000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	1.800000	U	
PYRENE	5.8		

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB05-SO-0608	nsample	NTC19SB06-SO-0204	nsample	NTC19SB06-SO-0608
samp_date	12/2/2008	samp_date	12/2/2008	samp_date	12/2/2008
lab_id	0812036-07	lab_id	0812036-08	lab_id	0812036-09
qc_type	NM	qc_type	NM	qc_type	NM
units	UG/KG	units	UG/KG	units	UG/KG
Pct_Solids	88.9	Pct_Solids	85.0	Pct_Solids	89.2
DUP_OF:		DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.300000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.900000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	4		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.300000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	7.8		
PYRENE	1.700000	U	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.940000	U	
BENZO(A)ANTHRACENE	20		
BENZO(A)PYRENE	20		
BENZO(B)FLUORANTHENE	18		
BENZO(G,H,I)PERYLENE	11		
BENZO(K)FLUORANTHENE	8.3		
CHRYSENE	18		
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	24		
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	7.3		
NAPHTHALENE	2.700000	U	
PHENANTHRENE	12		
PYRENE	24		

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	5.2		
ACENAPHTHENE	1.300000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.900000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	3.7		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.300000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	12		
PYRENE	5.3		

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB07-SO-0507
samp_date	12/2/2008
lab_id	0812036-10
qc_type	NM
units	UG/KG
Pct_Solids	89.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.800000	U	
ACENAPHTHENE	1.300000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.890000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	5.4		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	1.800000	U	
FLUORENE	1.300000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	6.7		
PYRENE	6.8		

nsample	NTC19SB08-SO-0103
samp_date	12/2/2008
lab_id	0812036-11
qc_type	NM
units	UG/KG
Pct_Solids	88.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.910000	U	
BENZO(A)ANTHRACENE	2.3		
BENZO(A)PYRENE	4.2		
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	1.700000	U	
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	2.4		
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	2.2		
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	1.900000	U	
PYRENE	2.4		

nsample	NTC19SB08-SO-0406
samp_date	12/2/2008
lab_id	0812036-12
qc_type	NM
units	UG/KG
Pct_Solids	88.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.2		
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.900000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	6		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	11		
PYRENE	4.6		

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB09-SO-0002	nsample	NTC19SB09-SO-0406	nsample	NTC19SB10-SO-0002
samp_date	12/2/2008	samp_date	12/2/2008	samp_date	12/2/2008
lab_id	0812036-13	lab_id	0812036-14	lab_id	0812036-15
qc_type	NM	qc_type	NM	qc_type	NM
units	UG/KG	units	UG/KG	units	UG/KG
Pct_Solids	86.5	Pct_Solids	89.3	Pct_Solids	84.7
DUP_OF:		DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.1		
ACENAPHTHENE	1.6		
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	3.6		
BENZO(A)ANTHRACENE	27		
BENZO(A)PYRENE	26		
BENZO(B)FLUORANTHENE	23		
BENZO(G,H,I)PERYLENE	14		
BENZO(K)FLUORANTHENE	8.3		
CHRYSENE	28		
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	50		
FLUORENE	1.8		
INDENO(1,2,3-CD)PYRENE	8.8		
NAPHTHALENE	2.700000	U	
PHENANTHRENE	29		
PYRENE	44		

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.300000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.900000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	5.8		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	6.7		
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	3.5		
FLUORENE	1.300000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	4.8		
PYRENE	4.6		

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	2.1		
BENZO(A)ANTHRACENE	7.5		
BENZO(A)PYRENE	9.6		
BENZO(B)FLUORANTHENE	6.7		
BENZO(G,H,I)PERYLENE	7		
BENZO(K)FLUORANTHENE	2.7		
CHRYSENE	6.2		
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	20		
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	4.4		
NAPHTHALENE	2.800000	U	
PHENANTHRENE	9.6		
PYRENE	15		

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB10-SO-0507
samp_date	12/2/2008
lab_id	0812036-16
qc_type	NM
units	UG/KG
Pct_Solids	85.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.930000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.200000	U	
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	5.2		
BENZO(K)FLUORANTHENE	1.500000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	3		
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.700000	U	
PHENANTHRENE	3.1		
PYRENE	6.3		

nsample	NTC19SB11-SO-0002
samp_date	12/2/2008
lab_id	0812036-17
qc_type	NM
units	UG/KG
Pct_Solids	79.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	53		
ACENAPHTHENE	240		
ACENAPHTHYLENE	74		
ANTHRACENE	590		
BENZO(A)ANTHRACENE	1700		
BENZO(A)PYRENE	1200		
BENZO(B)FLUORANTHENE	1400		
BENZO(G,H,I)PERYLENE	670		
BENZO(K)FLUORANTHENE	360		
DIBENZO(A,H)ANTHRACENE	160		
FLUORENE	250		
INDENO(1,2,3-CD)PYRENE	590		
NAPHTHALENE	62		
PHENANTHRENE	3200		
PYRENE	3500		

nsample	NTC19SB11-SO-0002DL
samp_date	12/2/2008
lab_id	0812036-17DL
qc_type	NM
units	UG/KG
Pct_Solids	79.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
CHRYSENE	1900		
FLUORANTHENE	5100		

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**B. DAVIS**	**DATE:**	**FEBRUARY 4, 2009**
FROM:	**JOSEPH KALINYAK**	**COPIES:**	**DV FILE**

SUBJECT: **ORGANIC DATA VALIDATION- VOC/SVOC**
CTO 468, NTC GREAT LAKES
SDG GL002

SAMPLES: 3/Aqueous/VOC

NTC19-RB120308-01	NTC19-SB120308-01	NTC19-TB120308

20/Soil/VOC/SVOC

NTC19-FD120308-01	NTC19-FD120308-02	NTC19-FD120308-03
NTC19SB12-SO-0002	NTC19SB12-SO-0507	NTC19SB13-SO-0103
NTC19SB14-SO-0204	NTC19SB14-SO-0507	NTC19SB15-SO-0103
NTC19SB15-SO-0406	NTC19SB16-SO-0103	NTC19SB16-SO-0507
NTC19SB17-SO-0002	NTC19SB17-SO-0406	NTC19SB18-SO-0204
NTC19SB18-SO-0406	NTC19SB19-SO-0002	NTC19SB19-SO-0406
NTC19SB20-SO-0002	NTC19SB20-SO-0406	

2/Aqueous/SVOC

NTC19-RB120308-01	NTC19-SB120308-01

OVERVIEW

The sample set for CTO 468 NTC Great Lakes, SDG GL002 consists of one (1) trip blank, one (1) rinsate blank, one (1) source blank and twenty (20) soil environmental samples. The samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOC). The one trip blank, NTC19-TB120308, was analyzed for TCL VOCs only. The remaining two blanks were analyzed for both VOCs and SVOCs. There were three field duplicate pairs included in this sample delivery group (SDG): NTC19-FD120308-01 / NTC19SB15-SO-0406; NTC19-FD120308-02 / NTC19SB16-SO-0103; and NTC19-FD120308-03 / NTC19SB17-SO-0002.

A full validation was performed on all of the VOC/SVOC analyses for the aqueous samples and only 10 of the 20 VOC/SVOC soil samples as listed below. The remaining samples were given a cursory validation review.

Full Validation: 3/Aqueous/VOC/SVOC

NTC19-RB120308-01	NTC19-SB120308-01	NTC19-TB120308 (VOC only)

Full Validation: 10/Soil/VOC/SVOC

NTC19-FD120308-01	NTC19-FD120308-02	NTC19-FD120308-03
NTC19SB12-SO-0002	NTC19SB12-SO-0507	NTC19SB13-SO-0103
NTC19SB14-SO-0204	NTC19SB14-SO-0507	NTC19SB15-SO-0103
NTC19SB15-SO-0406		

The samples were collected by TetraTech NUS on December 3, 2008 and analyzed by Empirical Laboratories. All analyses were conducted using USEPA SW-846 Methods 8260B and 8270C SIM analytical and reporting protocols. The data contained in this SDG were validated with regard to the following parameters:

* • Data Completeness
* • Holding Times
* • GC/MS Tuning
  • Initial and Continuing Calibration
  • Laboratory Blank Analyses
  • Surrogate Recoveries
  • Blank Spike/Blank Spike Duplicate Results
  • Internal Standard Recoveries
  • Matrix Spike/Spike Duplicate Results
  • Field Duplicate Results
* • Compound Quantitation
* • Compound Identification
* • Detection Limits

The symbol (*) indicates that quality control criteria were met for this parameter. Problems affecting data quality are discussed below; documentation supporting these findings is presented in Appendix C. Qualified Analytical results are presented in Appendix A. Results as reported by the laboratory are presented in Appendix B.

Volatile

The following analyte was detected in the laboratory method blanks.

Analyte	Maximum Concentration	Action Level
Methylene chloride (1)	6.5 µg/kg	65.0 µg/kg
Methylene chloride (2)	0.27 µg/l	2.70 µg/l
1,2,4-Trichlorobenzene (2)	3.5 µg/l	17.5 µg/l

(1) Maximum concentration detected in the soil method blank V1BLK1210E affecting all SDG soil samples.
(2) Maximum concentration detected in the aqueous method blank V4BLK1208 affecting aqueous samples NTC19-RB120308-01, NTC19-SB120308-01, and NTC19-TB120308.

Blank Actions

- Value < Reporting Limit (RL); value followed by a U.
- Value > RL and < Action level; report value followed by a U.
- Value > RL and > action level; report value followed by a J.

An action level of 10X the maximum contaminant level for the common laboratory contaminant methylene chloride and 5X for other contaminants has been used to evaluate sample data for blank contamination. Sample aliquot, dilution factors, and % moisture, if applicable, were taken into consideration when evaluating for blank contamination for each individual sample.

A continuing calibration verification percent difference (%D) was greater than the 25% quality control limit for acetone, bromomethane, and carbon tetrachloride on instrument VOA4 on 12/08/08 at 10:08. The positive and non-detected sample results reported for acetone, bromomethane, and carbon tetrachloride for affected samples NTC19-TB120308, NTC19-RB120308-01, and NTC19-SB120308-01 were qualified estimated, (J) and (UJ), respectively.

A continuing calibration verification percent difference (%D) was greater than the 25% quality control limit for acetone and 2-hexanone on instrument VOA1 on 12/10/08 at 10:45. The positive and non-detected sample results reported for acetone and 2-hexanone for affected samples NTC19-FD120308-02, NTC19-FD120308-

03, NTC19SB12-SO-0002, NTC19SB12-SO-0507, NTC19SB13-SO-0103, NTC19SB14-SO-0204, NTC19SB14-SO-0507, NTC19SB15-SO-0103, and NTC19SB15-SO-0406 were qualified estimated, (J) and (UJ), respectively.

A continuing calibration verification %D was greater than the 25% quality control limit for bromomethane on instrument VOA1 on 12/12/08 @ 02:16. The affected sample NTC19-FD120308-01DL was not qualified as the result from the methanol extraction/dilution was not reported.

The internal standard area was less than the quality control limit for 1,4-dichlorobenzene-d4 for sample NTC19-FD120308-01 on instrument VOA1 on 12/12/08. The associated internal standard compounds 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,2,4-trichlorobenzene, and 1,2-dibromo-3-chloropropane non-detected results were qualified estimated, (UJ).

The matrix spike (MS)/matrix spike duplicates (MSD) associated with the VOC analyses were not reviewed in detail as they were performed on samples which had a cursory validation performed on them. There were a significant number of % recoveries less than the quality control limit. No action was taken as only a cursory validation was performed on those samples.

Semi-volatile

The following analyte was detected in the laboratory method blank.

Analyte	Maximum Concentration	Action Level
Naphthalene [1]	0.017 µg/l	0.085 µg/l

[1] Maximum concentration detected in the aqueous method blank SBLK1210BW2 affecting SDG samples NTC19-RB120308-01 and NTC19-SB120308-01.

Blank Actions

- Value < Reporting Limit (RL); value followed by a U.
- Value > RL and < Action level; report value followed by a U.
- Value > RL and > action level; report value followed by a J.

An action level of 5X the maximum contaminant level for the laboratory contaminant naphthalene has been used to evaluate sample data for blank contamination. Sample aliquot and dilution factors, if applicable, were taken into consideration when evaluating for blank contamination for each individual sample.

A continuing calibration verification %D was greater than the 25% quality control limit for benzo(a)anthracene on instrument BNA4 on 12/16/08 @ 02:25. The affected samples NTC19-FD120308-01, NTC19-FD120308-03, NTC19SB12-SO-0002, NTC19SB12-SO-0507, NTC19SB13-SO-0103, NTC19SB14-SO-0204, and NTC19SB14-SO-0507 positive and non-detected results were qualified estimated, (J) and (UJ), respectively.

The SVOC surrogate % recovery was greater than the quality control limit for surrogate terphenyl-d14 for samples NTC19-FD120308-01, NTC19-FD120308-03, NTC19SB12-SO-0002, NTC19SB12-SO-0507, NTC19SB13-SO-0103, NTC19SB14-SO-0204, NTC19SB14-SO-0507 and NTC19SB15-SO-0406. No action is taken for single surrogate spike QC limit exceedances when % recovery is greater than the QC limit.

The sample duplicate pair NTC19-FD120308-01 / NTC19SB15-SO-0406 had a RPD greater than the 50% quality control limit for benzo(g,h,i)perylene. The positive associated sample results for benzo(g,h,i)perylene were qualified estimated, (J), for the aforementioned samples.

The sample duplicate pair NTC19-FD120308-02 / NTC19SB16-SO-0103 had RPDs greater than the 50% quality control limit for acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. The positive associated sample results for the aforementioned compounds were qualified estimated, (J), for the aforementioned samples.

The sample duplicate pair NTC19-FD120308-03 / NTC19SB17-SO-0002 had a RPD greater than the 50% quality control limit for dibenzo(a,h)anthracene. The positive and non-detected sample results for dibenzo(a,h)anthracene for the aforementioned samples were qualified estimated, (J) and (UJ), respectively, for the aforementioned samples.

Additional Comments:

Sample NTC19SB20-SO-0002 was analyzed at a 10X dilution for SVOCs.

The VOC laboratory control sample (LCS) V4BLK1208 had a % recovery that was greater than the quality control limit for bromomethane on instrument VOA4 on 12/08/08. No samples data was qualified as all associated sample bromomethane results were non-detected.

The VOC methanol extraction and re-analysis of sample NTC19-FD120308-01 was unnecessary as all detected compounds on the samples' original VOC analyses were within the calibration limits and the internal standard area problem with the sample was not significant. The methanol extraction sample results were not used in this report nor were they qualified.

Only 2 surrogate compounds were added to the SVOC samples prior to analysis.

The VOC MS/MSDs were analyzed outside the 12 hour time limit for the associated tuning standard. One MS/MSD was started @ 12hours 20minutes/12hours 56minutes after the tuning standard and the other one was started 13hours 35minutes/14hours 14minutes after the tuning standard. No action was taken for this as both associated samples received only a cursory review.

Sample NTC19-FD120308-01 was analyzed for VOCs 12hours 16minutes after the associated tuning standard. No action was taken for this as it was analyzed only 16 minutes outside the QC limit.

EXECUTIVE SUMMARY

Laboratory Performance Issues: Several compounds in the VOC fraction exceeded the continuing calibration %D criteria resulting in qualification of the data. Methylene chloride and 1,2,4-trichlorobenzene were detected in the VOC method blanks. There was a VOC LCS % recovery quality control limit exceedance. There was a VOC internal standard area quality control exceedance.

Naphthalene was detected in the SVOC laboratory method blank. There was a SVOC continuing calibration verification %D quality control limit exceedance which resulted in data qualification. There were SVOC duplicate RPD quality control limit exceedances.

Other factors affecting data quality: The VOC rinsate blank, NTC19-RB120308-01, and souce blank, NTC19-SB120308-01, had detections for acetone. The SVOC rinsate blank, NTC19-RB120308-01, had detections for 2-methylnaphthalene, anthracene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and phenanthrene. The SVOC source blank, NTC19-SB120308-01, had detections for 2-methylnaphthalene and phenanthrene.

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (October 1999) and the Department of Defense (DoD) document entitled "Quality Systems Manual (QSM) for Environmental Laboratories" (January 2006). The text of this report has been formulated to address only those problem areas affecting data quality.

Tetra Tech NUS

Joseph Kalinyak
Chemist/Data Validator

TetraTech NUS

Joseph A. Samchuck
Data Validation Quality Assurance Officer

Attachments:

Appendix A – Qualified Analytical Results
Appendix B – Results as Reported by the Laboratory
Appendix C – Support Documentation

APPENDIX A

QUALIFIED ANALYTICAL RESULTS

Qualifier Codes:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration Noncompliance (i.e., % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01 = GC/MS Tuning Noncompliance
D = MS/MSD Recovery Noncompliance
E = LCS/LCSD Recovery Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = GFAA PDS - GFAA MSA's $r < 0.995$
K = ICP Interference - includes ICS % R Noncompliance
L = Instrument Calibration Range Exceedance
M = Sample Preservation Noncompliance
N = Internal Standard Noncompliance
N01 = Internal Standard Recovery Noncompliance Dioxins
N02 = Recovery Standard Noncompliance Dioxins
N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (i.e., base-time drifting)
P = Uncertainty near detection limit (< 2 x IDL for inorganics and <CRQL for organics)
Q = Other problems (can encompass a number of issues; i.e.chromatography,interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient $r < 0.995$
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is less than sample activity

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19-FD120308-01
samp_date	12/3/2008
lab_id	0812060-01
qc_type	NM
units	UG/KG
Pct_Solids	87.0
DUP_OF:	NTC19SB15-SO-0406

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.100000	U	
1,1,2,2-TETRACHLOROETHANE	0.550000	U	
1,1,2-TRICHLOROETHANE	0.440000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.700000	U	
1,1-DICHLOROETHANE	0.690000	U	
1,1-DICHLOROETHENE	1.500000	U	
1,2,4-TRICHLOROBENZENE	0.230000	UJ	N
1,2-DIBROMO-3-CHLOROPROPANE	1.500000	UJ	N
1,2-DIBROMOETHANE	0.550000	U	
1,2-DICHLOROBENZENE	0.470000	UJ	N
1,2-DICHLOROETHANE	0.590000	U	
1,2-DICHLOROPROPANE	0.590000	U	
1,3-DICHLOROBENZENE	1.100000	UJ	N
1,4-DICHLOROBENZENE	0.700000	UJ	N
2-BUTANONE	1.800000	U	
2-HEXANONE	2.900000	U	
4-METHYL-2-PENTANONE	0.740000	U	
ACETONE	12		
BENZENE	0.600000	U	
BROMODICHLOROMETHANE	0.380000	U	
BROMOFORM	1.300000	U	
BROMOMETHANE	0.920000	U	
CARBON DISULFIDE	1.600000	U	
CARBON TETRACHLORIDE	1.100000	U	
CHLOROBENZENE	0.430000	U	
CHLORODIBROMOMETHANE	0.430000	U	
CHLOROETHANE	1.400000	U	
CHLOROFORM	0.700000	U	
CHLOROMETHANE	0.660000	U	
CIS-1,2-DICHLOROETHENE	1.500000	U	
CIS-1,3-DICHLOROPROPENE	0.640000	U	
CYCLOHEXANE	0.690000	U	

nsample	NTC19-FD120308-01
samp_date	12/3/2008
lab_id	0812060-01
qc_type	NM
units	UG/KG
Pct_Solids	87.0
DUP_OF:	NTC19SB15-SO-0406

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.400000	U	
ETHYLBENZENE	0.960000	U	
ISOPROPYLBENZENE	1.100000	U	
METHYL ACETATE	2.000000	U	
METHYL CYCLOHEXANE	0.380000	U	
METHYL TERT-BUTYL ETHER	0.410000	U	
METHYLENE CHLORIDE	3.4	U	A
STYRENE	0.440000	U	
TETRACHLOROETHENE	1.200000	U	
TOLUENE	1.100000	U	
TOTAL XYLENES	0.890000	U	
TRANS-1,2-DICHLOROETHENE	1.400000	U	
TRANS-1,3-DICHLOROPROPENE	0.410000	U	
TRICHLOROETHENE	1.100000	U	
TRICHLOROFLUOROMETHANE	1.200000	U	
VINYL CHLORIDE	1.400000	U	

nsample	NTC19-FD120308-02
samp_date	12/3/2008
lab_id	0812060-02
qc_type	NM
units	UG/KG
Pct_Solids	87.0
DUP_OF:	NTC19SB16-SO-0103

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.970000	U	
1,1,2,2-TETRACHLOROETHANE	0.460000	U	
1,1,2-TRICHLOROETHANE	0.380000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.600000	U	
1,1-DICHLOROETHANE	0.580000	U	
1,1-DICHLOROETHENE	1.300000	U	
1,2,4-TRICHLOROBENZENE	0.190000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.300000	U	
1,2-DIBROMOETHANE	0.460000	U	
1,2-DICHLOROBENZENE	0.400000	U	
1,2-DICHLOROETHANE	0.500000	U	
1,2-DICHLOROPROPANE	0.500000	U	
1,3-DICHLOROBENZENE	0.910000	U	
1,4-DICHLOROBENZENE	0.600000	U	
2-BUTANONE	1.6		
2-HEXANONE	2.500000	UJ	C
4-METHYL-2-PENTANONE	0.630000	U	
ACETONE	17		
BENZENE	0.510000	U	
BROMODICHLOROMETHANE	0.320000	U	
BROMOFORM	1.100000	U	
BROMOMETHANE	0.780000	U	
CARBON DISULFIDE	1.400000	U	
CARBON TETRACHLORIDE	0.950000	U	
CHLOROBENZENE	0.370000	U	
CHLORODIBROMOMETHANE	0.370000	U	
CHLOROETHANE	1.200000	U	
CHLOROFORM	0.600000	U	
CHLOROMETHANE	0.560000	U	
CIS-1,2-DICHLOROETHENE	1.300000	U	
CIS-1,3-DICHLOROPROPENE	0.540000	U	
CYCLOHEXANE	0.580000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19-FD120308-02
samp_date	12/3/2008
lab_id	0812060-02
qc_type	NM
units	UG/KG
Pct_Solids	87.0
DUP_OF:	NTC19SB16-SO-0103

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.200000	U	
ETHYLBENZENE	0.810000	U	
ISOPROPYLBENZENE	0.950000	U	
METHYL ACETATE	1.700000	U	
METHYL CYCLOHEXANE	0.320000	U	
METHYL TERT-BUTYL ETHER	0.350000	U	
METHYLENE CHLORIDE	3.6	U	A
STYRENE	0.380000	U	
TETRACHLOROETHENE	1.000000	U	
TOLUENE	0.930000	U	
TOTAL XYLENES	0.760000	U	
TRANS-1,2-DICHLOROETHENE	1.200000	U	
TRANS-1,3-DICHLOROPROPENE	0.350000	U	
TRICHLOROETHENE	0.920000	U	
TRICHLOROFLUOROMETHANE	1.000000	U	
VINYL CHLORIDE	1.200000	U	

nsample	NTC19-FD120308-03
samp_date	12/3/2008
lab_id	0812060-03
qc_type	NM
units	UG/KG
Pct_Solids	88.0
DUP_OF:	NTC19SB17-SO-0002

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.000000	U	
1,1,2,2-TETRACHLOROETHANE	0.480000	U	
1,1,2-TRICHLOROETHANE	0.390000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.610000	U	
1,1-DICHLOROETHANE	0.600000	U	
1,1-DICHLOROETHENE	1.300000	U	
1,2,4-TRICHLOROBENZENE	0.200000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.300000	U	
1,2-DIBROMOETHANE	0.480000	U	
1,2-DICHLOROBENZENE	0.410000	U	
1,2-DICHLOROETHANE	0.510000	U	
1,2-DICHLOROPROPANE	0.510000	U	
1,3-DICHLOROBENZENE	0.930000	U	
1,4-DICHLOROBENZENE	0.610000	U	
2-BUTANONE	1.600000	U	
2-HEXANONE	2.600000	UJ	C
4-METHYL-2-PENTANONE	0.640000	U	
ACETONE	2.200000	U	
BENZENE	0.520000	U	
BROMODICHLOROMETHANE	0.330000	U	
BROMOFORM	1.100000	U	
BROMOMETHANE	0.800000	U	
CARBON DISULFIDE	1.400000	U	
CARBON TETRACHLORIDE	0.980000	U	
CHLOROBENZENE	0.380000	U	
CHLORODIBROMOMETHANE	0.380000	U	
CHLOROETHANE	1.200000	U	
CHLOROFORM	0.610000	U	
CHLOROMETHANE	0.580000	U	
CIS-1,2-DICHLOROETHENE	1.300000	U	
CIS-1,3-DICHLOROPROPENE	0.550000	U	
CYCLOHEXANE	0.600000	U	

nsample	NTC19-FD120308-03
samp_date	12/3/2008
lab_id	0812060-03
qc_type	NM
units	UG/KG
Pct_Solids	88.0
DUP_OF:	NTC19SB17-SO-0002

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.200000	U	
ETHYLBENZENE	0.830000	U	
ISOPROPYLBENZENE	0.980000	U	
METHYL ACETATE	1.800000	U	
METHYL CYCLOHEXANE	0.330000	U	
METHYL TERT-BUTYL ETHER	0.350000	U	
METHYLENE CHLORIDE	3.8	U	A
STYRENE	0.390000	U	
TETRACHLOROETHENE	1.100000	U	
TOLUENE	0.950000	U	
TOTAL XYLENES	0.780000	U	
TRANS-1,2-DICHLOROETHENE	1.200000	U	
TRANS-1,3-DICHLOROPROPENE	0.350000	U	
TRICHLOROETHENE	0.940000	U	
TRICHLOROFLUOROMETHANE	1.000000	U	
VINYL CHLORIDE	1.200000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB12-SO-0002
samp_date	12/3/2008
lab_id	0812060-07
qc_type	NM
units	UG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.910000	U	
1,1,2,2-TETRACHLOROETHANE	0.430000	U	
1,1,2-TRICHLOROETHANE	0.350000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.550000	U	
1,1-DICHLOROETHANE	0.540000	U	
1,1-DICHLOROETHENE	1.200000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.200000	U	
1,2-DIBROMOETHANE	0.430000	U	
1,2-DICHLOROBENZENE	0.370000	U	
1,2-DICHLOROETHANE	0.460000	U	
1,2-DICHLOROPROPANE	0.460000	U	
1,3-DICHLOROBENZENE	0.850000	U	
1,4-DICHLOROBENZENE	0.550000	U	
2-BUTANONE	1.400000	U	
2-HEXANONE	2.300000	UJ	C
4-METHYL-2-PENTANONE	0.580000	U	
ACETONE	2.000000	UJ	C
BENZENE	0.470000	U	
BROMODICHLOROMETHANE	0.300000	U	
BROMOFORM	1.000000	U	
BROMOMETHANE	0.720000	U	
CARBON DISULFIDE	1.300000	U	
CARBON TETRACHLORIDE	0.890000	U	
CHLOROBENZENE	0.340000	U	
CHLORODIBROMOMETHANE	0.340000	U	
CHLOROETHANE	1.100000	U	
CHLOROFORM	0.550000	U	
CHLOROMETHANE	0.520000	U	
CIS-1,2-DICHLOROETHENE	1.200000	U	
CIS-1,3-DICHLOROPROPENE	0.500000	U	
CYCLOHEXANE	0.540000	U	

nsample	NTC19SB12-SO-0002
samp_date	12/3/2008
lab_id	0812060-07
qc_type	NM
units	UG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.100000	U	
ETHYLBENZENE	0.760000	U	
ISOPROPYLBENZENE	0.890000	U	
METHYL ACETATE	1.600000	U	
METHYL CYCLOHEXANE	0.300000	U	
METHYL TERT-BUTYL ETHER	0.320000	U	
METHYLENE CHLORIDE	3.0	U	A
STYRENE	0.350000	U	
TETRACHLOROETHENE	0.980000	U	
TOLUENE	0.870000	U	
TOTAL XYLENES	0.700000	U	
TRANS-1,2-DICHLOROETHENE	1.100000	U	
TRANS-1,3-DICHLOROPROPENE	0.320000	U	
TRICHLOROETHENE	0.860000	U	
TRICHLOROFLUOROMETHANE	0.960000	U	
VINYL CHLORIDE	1.100000	U	

nsample	NTC19SB12-SO-0507
samp_date	12/3/2008
lab_id	0812060-08
qc_type	NM
units	UG/KG
Pct_Solids	83.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.820000	U	
1,1,2,2-TETRACHLOROETHANE	0.390000	U	
1,1,2-TRICHLOROETHANE	0.320000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.500000	U	
1,1-DICHLOROETHANE	0.490000	U	
1,1-DICHLOROETHENE	1.100000	U	
1,2,4-TRICHLOROBENZENE	0.160000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.100000	U	
1,2-DIBROMOETHANE	0.390000	U	
1,2-DICHLOROBENZENE	0.340000	U	
1,2-DICHLOROETHANE	0.420000	U	
1,2-DICHLOROPROPANE	0.420000	U	
1,3-DICHLOROBENZENE	0.770000	U	
1,4-DICHLOROBENZENE	0.500000	U	
2-BUTANONE	1.300000	U	
2-HEXANONE	2.100000	UJ	C
4-METHYL-2-PENTANONE	0.530000	U	
ACETONE	5.5	J	C
BENZENE	0.430000	U	
BROMODICHLOROMETHANE	0.270000	U	
BROMOFORM	0.910000	U	
BROMOMETHANE	0.660000	U	
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.800000	U	
CHLOROBENZENE	0.310000	U	
CHLORODIBROMOMETHANE	0.310000	U	
CHLOROETHANE	1.000000	U	
CHLOROFORM	0.500000	U	
CHLOROMETHANE	0.480000	U	
CIS-1,2-DICHLOROETHENE	1.100000	U	
CIS-1,3-DICHLOROPROPENE	0.460000	U	
CYCLOHEXANE	0.490000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB12-SO-0507
samp_date	12/3/2008
lab_id	0812060-08
qc_type	NM
units	UG/KG
Pct_Solids	83.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.000000	U	
ETHYLBENZENE	0.690000	U	
ISOPROPYLBENZENE	0.800000	U	
METHYL ACETATE	1.500000	U	
METHYL CYCLOHEXANE	0.270000	U	
METHYL TERT-BUTYL ETHER	0.290000	U	
METHYLENE CHLORIDE	3.1	U	A
STYRENE	0.320000	U	
TETRACHLOROETHENE	0.890000	U	
TOLUENE	0.790000	U	
TOTAL XYLENES	0.640000	U	
TRANS-1,2-DICHLOROETHENE	1.000000	U	
TRANS-1,3-DICHLOROPROPENE	0.290000	U	
TRICHLOROETHENE	0.780000	U	
TRICHLOROFLUOROMETHANE	0.870000	U	
VINYL CHLORIDE	1.000000	U	

nsample	NTC19SB13-SO-0103
samp_date	12/3/2008
lab_id	0812060-09
qc_type	NM
units	UG/KG
Pct_Solids	82.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.830000	U	
1,1,2,2-TETRACHLOROETHANE	0.400000	U	
1,1,2-TRICHLOROETHANE	0.320000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.510000	U	
1,1-DICHLOROETHANE	0.500000	U	
1,1-DICHLOROETHENE	1.100000	U	
1,2,4-TRICHLOROBENZENE	0.170000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.100000	U	
1,2-DIBROMOETHANE	0.400000	U	
1,2-DICHLOROBENZENE	0.340000	U	
1,2-DICHLOROETHANE	0.420000	U	
1,2-DICHLOROPROPANE	0.420000	U	
1,3-DICHLOROBENZENE	0.780000	U	
1,4-DICHLOROBENZENE	0.510000	U	
2-BUTANONE	1.300000	U	
2-HEXANONE	2.100000	UJ	C
4-METHYL-2-PENTANONE	0.540000	U	
ACETONE	5.2	J	C
BENZENE	0.430000	U	
BROMODICHLOROMETHANE	0.280000	U	
BROMOFORM	0.920000	U	
BROMOMETHANE	0.660000	U	
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.810000	U	
CHLOROBENZENE	0.310000	U	
CHLORODIBROMOMETHANE	0.310000	U	
CHLOROETHANE	1.000000	U	
CHLOROFORM	0.510000	U	
CHLOROMETHANE	0.480000	U	
CIS-1,2-DICHLOROETHENE	1.100000	U	
CIS-1,3-DICHLOROPROPENE	0.460000	U	
CYCLOHEXANE	0.500000	U	

nsample	NTC19SB13-SO-0103
samp_date	12/3/2008
lab_id	0812060-09
qc_type	NM
units	UG/KG
Pct_Solids	82.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.000000	U	
ETHYLBENZENE	0.690000	U	
ISOPROPYLBENZENE	0.810000	U	
METHYL ACETATE	1.500000	U	
METHYL CYCLOHEXANE	0.280000	U	
METHYL TERT-BUTYL ETHER	0.300000	U	
METHYLENE CHLORIDE	3.2	U	A
STYRENE	0.320000	U	
TETRACHLOROETHENE	0.900000	U	
TOLUENE	0.790000	U	
TOTAL XYLENES	0.640000	U	
TRANS-1,2-DICHLOROETHENE	1.000000	U	
TRANS-1,3-DICHLOROPROPENE	0.300000	U	
TRICHLOROETHENE	0.780000	U	
TRICHLOROFLUOROMETHANE	0.880000	U	
VINYL CHLORIDE	1.000000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB14-SO-0204
samp_date	12/3/2008
lab_id	0812060-10
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.890000	U	
1,1,2,2-TETRACHLOROETHANE	0.420000	U	
1,1,2-TRICHLOROETHANE	0.340000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.540000	U	
1,1-DICHLOROETHANE	0.530000	U	
1,1-DICHLOROETHENE	1.200000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.200000	U	
1,2-DIBROMOETHANE	0.420000	U	
1,2-DICHLOROBENZENE	0.360000	U	
1,2-DICHLOROETHANE	0.450000	U	
1,2-DICHLOROPROPANE	0.450000	U	
1,3-DICHLOROBENZENE	0.830000	U	
1,4-DICHLOROBENZENE	0.540000	U	
2-BUTANONE	1.400000	U	
2-HEXANONE	2.300000	UJ	C
4-METHYL-2-PENTANONE	0.570000	U	
ACETONE	6.6	J	C
BENZENE	0.460000	U	
BROMODICHLOROMETHANE	0.300000	U	
BROMOFORM	0.990000	U	
BROMOMETHANE	0.710000	U	
CARBON DISULFIDE	1.300000	U	
CARBON TETRACHLORIDE	0.870000	U	
CHLOROBENZENE	0.340000	U	
CHLORODIBROMOMETHANE	0.340000	U	
CHLOROETHANE	1.100000	U	
CHLOROFORM	0.540000	U	
CHLOROMETHANE	0.510000	U	
CIS-1,2-DICHLOROETHENE	1.200000	U	
CIS-1,3-DICHLOROPROPENE	0.490000	U	
CYCLOHEXANE	0.530000	U	

nsample	NTC19SB14-SO-0204
samp_date	12/3/2008
lab_id	0812060-10
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.100000	U	
ETHYLBENZENE	0.740000	U	
ISOPROPYLBENZENE	0.870000	U	
METHYL ACETATE	1.600000	U	
METHYL CYCLOHEXANE	0.300000	U	
METHYL TERT-BUTYL ETHER	0.320000	U	
METHYLENE CHLORIDE	3.3	U	A
STYRENE	0.340000	U	
TETRACHLOROETHENE	0.960000	U	
TOLUENE	0.850000	U	
TOTAL XYLENES	0.690000	U	
TRANS-1,2-DICHLOROETHENE	1.100000	U	
TRANS-1,3-DICHLOROPROPENE	0.320000	U	
TRICHLOROETHENE	0.840000	U	
TRICHLOROFLUOROMETHANE	0.940000	U	
VINYL CHLORIDE	1.100000	U	

nsample	NTC19SB14-SO-0507
samp_date	12/3/2008
lab_id	0812060-11
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.830000	U	
1,1,2,2-TETRACHLOROETHANE	0.400000	U	
1,1,2-TRICHLOROETHANE	0.320000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.510000	U	
1,1-DICHLOROETHANE	0.500000	U	
1,1-DICHLOROETHENE	1.100000	U	
1,2,4-TRICHLOROBENZENE	0.170000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.100000	U	
1,2-DIBROMOETHANE	0.400000	U	
1,2-DICHLOROBENZENE	0.340000	U	
1,2-DICHLOROETHANE	0.420000	U	
1,2-DICHLOROPROPANE	0.420000	U	
1,3-DICHLOROBENZENE	0.780000	U	
1,4-DICHLOROBENZENE	0.510000	U	
2-BUTANONE	1.300000	U	
2-HEXANONE	2.100000	UJ	C
4-METHYL-2-PENTANONE	0.540000	U	
ACETONE	5.1	J	C
BENZENE	0.440000	U	
BROMODICHLOROMETHANE	0.280000	U	
BROMOFORM	0.930000	U	
BROMOMETHANE	0.670000	U	
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.810000	U	
CHLOROBENZENE	0.310000	U	
CHLORODIBROMOMETHANE	0.310000	U	
CHLOROETHANE	1.000000	U	
CHLOROFORM	0.510000	U	
CHLOROMETHANE	0.480000	U	
CIS-1,2-DICHLOROETHENE	1.100000	U	
CIS-1,3-DICHLOROPROPENE	0.460000	U	
CYCLOHEXANE	0.500000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB14-SO-0507
samp_date	12/3/2008
lab_id	0812060-11
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.000000	U	
ETHYLBENZENE	0.690000	U	
ISOPROPYLBENZENE	0.810000	U	
METHYL ACETATE	1.500000	U	
METHYL CYCLOHEXANE	0.280000	U	
METHYL TERT-BUTYL ETHER	0.300000	U	
METHYLENE CHLORIDE	3.1	U	A
STYRENE	0.320000	U	
TETRACHLOROETHENE	0.900000	U	
TOLUENE	0.800000	U	
TOTAL XYLENES	0.650000	U	
TRANS-1,2-DICHLOROETHENE	1.000000	U	
TRANS-1,3-DICHLOROPROPENE	0.300000	U	
TRICHLOROETHENE	0.790000	U	
TRICHLOROFLUOROMETHANE	0.880000	U	
VINYL CHLORIDE	1.000000	U	

nsample	NTC19SB15-SO-0103
samp_date	12/3/2008
lab_id	0812060-12
qc_type	NM
units	UG/KG
Pct_Solids	88.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.760000	U	
1,1,2,2-TETRACHLOROETHANE	0.360000	U	
1,1,2-TRICHLOROETHANE	0.300000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.460000	U	
1,1-DICHLOROETHANE	0.460000	U	
1,1-DICHLOROETHENE	1.000000	U	
1,2,4-TRICHLOROBENZENE	0.150000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.000000	U	
1,2-DIBROMOETHANE	0.360000	U	
1,2-DICHLOROBENZENE	0.310000	U	
1,2-DICHLOROETHANE	0.390000	U	
1,2-DICHLOROPROPANE	0.390000	U	
1,3-DICHLOROBENZENE	0.710000	U	
1,4-DICHLOROBENZENE	0.460000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	1.900000	UJ	C
4-METHYL-2-PENTANONE	0.490000	U	
ACETONE	4.3	J	C
BENZENE	0.400000	U	
BROMODICHLOROMETHANE	0.250000	U	
BROMOFORM	0.840000	U	
BROMOMETHANE	0.610000	U	
CARBON DISULFIDE	1.100000	U	
CARBON TETRACHLORIDE	0.740000	U	
CHLOROBENZENE	0.290000	U	
CHLORODIBROMOMETHANE	0.290000	U	
CHLOROETHANE	0.930000	U	
CHLOROFORM	0.460000	U	
CHLOROMETHANE	0.440000	U	
CIS-1,2-DICHLOROETHENE	1.000000	U	
CIS-1,3-DICHLOROPROPENE	0.420000	U	
CYCLOHEXANE	0.460000	U	

nsample	NTC19SB15-SO-0103
samp_date	12/3/2008
lab_id	0812060-12
qc_type	NM
units	UG/KG
Pct_Solids	88.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.930000	U	
ETHYLBENZENE	0.630000	U	
ISOPROPYLBENZENE	0.740000	U	
METHYL ACETATE	1.300000	U	
METHYL CYCLOHEXANE	0.250000	U	
METHYL TERT-BUTYL ETHER	0.270000	U	
METHYLENE CHLORIDE	3.1	U	A
STYRENE	0.300000	U	
TETRACHLOROETHENE	0.820000	U	
TOLUENE	0.720000	U	
TOTAL XYLENES	0.590000	U	
TRANS-1,2-DICHLOROETHENE	0.930000	U	
TRANS-1,3-DICHLOROPROPENE	0.270000	U	
TRICHLOROETHENE	0.720000	U	
TRICHLOROFLUOROMETHANE	0.800000	U	
VINYL CHLORIDE	0.930000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB15-SO-0406
samp_date	12/3/2008
lab_id	0812060-13
qc_type	NM
units	UG/KG
Pct_Solids	87.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.900000	U	
1,1,2,2-TETRACHLOROETHANE	0.430000	U	
1,1,2-TRICHLOROETHANE	0.350000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.550000	U	
1,1-DICHLOROETHANE	0.540000	U	
1,1-DICHLOROETHENE	1.200000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.200000	U	
1,2-DIBROMOETHANE	0.430000	U	
1,2-DICHLOROBENZENE	0.370000	U	
1,2-DICHLOROETHANE	0.460000	U	
1,2-DICHLOROPROPANE	0.460000	U	
1,3-DICHLOROBENZENE	0.840000	U	
1,4-DICHLOROBENZENE	0.550000	U	
2-BUTANONE	1.400000	U	
2-HEXANONE	2.300000	UJ	C
4-METHYL-2-PENTANONE	0.580000	U	
ACETONE	8	J	C
BENZENE	0.470000	U	
BROMODICHLOROMETHANE	0.300000	U	
BROMOFORM	1.000000	U	
BROMOMETHANE	0.720000	U	
CARBON DISULFIDE	1.300000	U	
CARBON TETRACHLORIDE	0.880000	U	
CHLOROBENZENE	0.340000	U	
CHLORODIBROMOMETHANE	0.340000	U	
CHLOROETHANE	1.100000	U	
CHLOROFORM	0.550000	U	
CHLOROMETHANE	0.520000	U	
CIS-1,2-DICHLOROETHENE	1.200000	U	
CIS-1,3-DICHLOROPROPENE	0.500000	U	
CYCLOHEXANE	0.540000	U	

nsample	NTC19SB15-SO-0406
samp_date	12/3/2008
lab_id	0812060-13
qc_type	NM
units	UG/KG
Pct_Solids	87.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.100000	U	
ETHYLBENZENE	0.750000	U	
ISOPROPYLBENZENE	0.880000	U	
METHYL ACETATE	1.600000	U	
METHYL CYCLOHEXANE	0.300000	U	
METHYL TERT-BUTYL ETHER	0.320000	U	
METHYLENE CHLORIDE	3.0	U	A
STYRENE	0.350000	U	
TETRACHLOROETHENE	0.970000	U	
TOLUENE	0.860000	U	
TOTAL XYLENES	0.700000	U	
TRANS-1,2-DICHLOROETHENE	1.100000	U	
TRANS-1,3-DICHLOROPROPENE	0.320000	U	
TRICHLOROETHENE	0.850000	U	
TRICHLOROFLUOROMETHANE	0.950000	U	
VINYL CHLORIDE	1.100000	U	

nsample	NTC19SB16-SO-0103
samp_date	12/3/2008
lab_id	0812060-14
qc_type	NM
units	UG/KG
Pct_Solids	80.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.000000	U	
1,1,2,2-TETRACHLOROETHANE	0.480000	U	
1,1,2-TRICHLOROETHANE	0.390000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.610000	U	
1,1-DICHLOROETHANE	0.600000	U	
1,1-DICHLOROETHENE	1.300000	U	
1,2,4-TRICHLOROBENZENE	0.200000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.300000	U	
1,2-DIBROMOETHANE	0.480000	U	
1,2-DICHLOROBENZENE	0.410000	U	
1,2-DICHLOROETHANE	0.510000	U	
1,2-DICHLOROPROPANE	0.510000	U	
1,3-DICHLOROBENZENE	0.940000	U	
1,4-DICHLOROBENZENE	0.610000	U	
2-BUTANONE	1.600000	U	
2-HEXANONE	2.600000	U	
4-METHYL-2-PENTANONE	0.650000	U	
ACETONE	12		
BENZENE	0.520000	U	
BROMODICHLOROMETHANE	0.330000	U	
BROMOFORM	1.100000	U	
BROMOMETHANE	0.800000	U	
CARBON DISULFIDE	1.400000	U	
CARBON TETRACHLORIDE	0.980000	U	
CHLOROBENZENE	0.380000	U	
CHLORODIBROMOMETHANE	0.380000	U	
CHLOROETHANE	1.200000	U	
CHLOROFORM	0.610000	U	
CHLOROMETHANE	0.580000	U	
CIS-1,2-DICHLOROETHENE	1.300000	U	
CIS-1,3-DICHLOROPROPENE	0.560000	U	
CYCLOHEXANE	0.600000	U	

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SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB16-SO-0103
samp_date	12/3/2008
lab_id	0812060-14
qc_type	NM
units	UG/KG
Pct_Solids	80.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.200000	U	
ETHYLBENZENE	0.840000	U	
ISOPROPYLBENZENE	0.980000	U	
METHYL ACETATE	1.800000	U	
METHYL CYCLOHEXANE	0.330000	U	
METHYL TERT-BUTYL ETHER	0.360000	U	
METHYLENE CHLORIDE	3.9	U	A
STYRENE	0.390000	U	
TETRACHLOROETHENE	1.100000	U	
TOLUENE	0.960000	U	
TOTAL XYLENES	0.780000	U	
TRANS-1,2-DICHLOROETHENE	1.200000	U	
TRANS-1,3-DICHLOROPROPENE	0.360000	U	
TRICHLOROETHENE	0.950000	U	
TRICHLOROFLUOROMETHANE	1.100000	U	
VINYL CHLORIDE	1.200000	U	

nsample	NTC19SB16-SO-0507
samp_date	12/3/2008
lab_id	0812060-15
qc_type	NM
units	UG/KG
Pct_Solids	88.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.770000	U	
1,1,2,2-TETRACHLOROETHANE	0.370000	U	
1,1,2-TRICHLOROETHANE	0.300000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.470000	U	
1,1-DICHLOROETHANE	0.460000	U	
1,1-DICHLOROETHENE	1.000000	U	
1,2,4-TRICHLOROBENZENE	0.150000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.000000	U	
1,2-DIBROMOETHANE	0.370000	U	
1,2-DICHLOROBENZENE	0.320000	U	
1,2-DICHLOROETHANE	0.390000	U	
1,2-DICHLOROPROPANE	0.390000	U	
1,3-DICHLOROBENZENE	0.720000	U	
1,4-DICHLOROBENZENE	0.470000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	2.000000	U	
4-METHYL-2-PENTANONE	0.500000	U	
ACETONE	1.700000	U	
BENZENE	0.400000	U	
BROMODICHLOROMETHANE	0.260000	U	
BROMOFORM	0.860000	U	
BROMOMETHANE	0.620000	U	
CARBON DISULFIDE	1.100000	U	
CARBON TETRACHLORIDE	0.760000	U	
CHLOROBENZENE	0.290000	U	
CHLORODIBROMOMETHANE	0.290000	U	
CHLOROETHANE	0.940000	U	
CHLOROFORM	0.470000	U	
CHLOROMETHANE	0.450000	U	
CIS-1,2-DICHLOROETHENE	1.000000	U	
CIS-1,3-DICHLOROPROPENE	0.430000	U	
CYCLOHEXANE	0.460000	U	

nsample	NTC19SB16-SO-0507
samp_date	12/3/2008
lab_id	0812060-15
qc_type	NM
units	UG/KG
Pct_Solids	88.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.940000	U	
ETHYLBENZENE	0.640000	U	
ISOPROPYLBENZENE	0.760000	U	
METHYL ACETATE	1.400000	U	
METHYL CYCLOHEXANE	0.260000	U	
METHYL TERT-BUTYL ETHER	0.270000	U	
METHYLENE CHLORIDE	3.5	U	A
STYRENE	0.300000	U	
TETRACHLOROETHENE	0.830000	U	
TOLUENE	0.740000	U	
TOTAL XYLENES	0.600000	U	
TRANS-1,2-DICHLOROETHENE	0.940000	U	
TRANS-1,3-DICHLOROPROPENE	0.270000	U	
TRICHLOROETHENE	0.730000	U	
TRICHLOROFLUOROMETHANE	0.820000	U	
VINYL CHLORIDE	0.940000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB17-SO-0002
samp_date	12/3/2008
lab_id	0812060-16
qc_type	NM
units	UG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.840000	U	
1,1,2,2-TETRACHLOROETHANE	0.400000	U	
1,1,2-TRICHLOROETHANE	0.320000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.510000	U	
1,1-DICHLOROETHANE	0.500000	U	
1,1-DICHLOROETHENE	1.100000	U	
1,2,4-TRICHLOROBENZENE	0.170000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.100000	U	
1,2-DIBROMOETHANE	0.400000	U	
1,2-DICHLOROBENZENE	0.340000	U	
1,2-DICHLOROETHANE	0.430000	U	
1,2-DICHLOROPROPANE	0.430000	U	
1,3-DICHLOROBENZENE	0.780000	U	
1,4-DICHLOROBENZENE	0.510000	U	
2-BUTANONE	1.300000	U	
2-HEXANONE	2.100000	U	
4-METHYL-2-PENTANONE	0.540000	U	
ACETONE	1.900000	U	
BENZENE	0.440000	U	
BROMODICHLOROMETHANE	0.280000	U	
BROMOFORM	0.930000	U	
BROMOMETHANE	0.670000	U	
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.820000	U	
CHLOROBENZENE	0.320000	U	
CHLORODIBROMOMETHANE	0.320000	U	
CHLOROETHANE	1.000000	U	
CHLOROFORM	0.510000	U	
CHLOROMETHANE	0.480000	U	
CIS-1,2-DICHLOROETHENE	1.100000	U	
CIS-1,3-DICHLOROPROPENE	0.460000	U	
CYCLOHEXANE	0.500000	U	

nsample	NTC19SB17-SO-0002
samp_date	12/3/2008
lab_id	0812060-16
qc_type	NM
units	UG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.000000	U	
ETHYLBENZENE	0.700000	U	
ISOPROPYLBENZENE	0.820000	U	
METHYL ACETATE	1.500000	U	
METHYL CYCLOHEXANE	0.280000	U	
METHYL TERT-BUTYL ETHER	0.300000	U	
METHYLENE CHLORIDE	3.1	U	A
STYRENE	0.320000	U	
TETRACHLOROETHENE	0.900000	U	
TOLUENE	0.800000	U	
TOTAL XYLENES	0.650000	U	
TRANS-1,2-DICHLOROETHENE	1.000000	U	
TRANS-1,3-DICHLOROPROPENE	0.300000	U	
TRICHLOROETHENE	0.790000	U	
TRICHLOROFLUOROMETHANE	0.880000	U	
VINYL CHLORIDE	1.000000	U	

nsample	NTC19SB17-SO-0406
samp_date	12/3/2008
lab_id	0812060-17
qc_type	NM
units	UG/KG
Pct_Solids	89.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.740000	U	
1,1,2,2-TETRACHLOROETHANE	0.360000	U	
1,1,2-TRICHLOROETHANE	0.290000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.450000	U	
1,1-DICHLOROETHANE	0.450000	U	
1,1-DICHLOROETHENE	0.990000	U	
1,2,4-TRICHLOROBENZENE	0.150000	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.990000	U	
1,2-DIBROMOETHANE	0.360000	U	
1,2-DICHLOROBENZENE	0.310000	U	
1,2-DICHLOROETHANE	0.380000	U	
1,2-DICHLOROPROPANE	0.380000	U	
1,3-DICHLOROBENZENE	0.690000	U	
1,4-DICHLOROBENZENE	0.450000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	1.900000	U	
4-METHYL-2-PENTANONE	0.65		
ACETONE	9.1		
BENZENE	0.390000	U	
BROMODICHLOROMETHANE	0.250000	U	
BROMOFORM	0.830000	U	
BROMOMETHANE	0.600000	U	
CARBON DISULFIDE	1.100000	U	
CARBON TETRACHLORIDE	0.730000	U	
CHLOROBENZENE	0.280000	U	
CHLORODIBROMOMETHANE	0.280000	U	
CHLOROETHANE	0.910000	U	
CHLOROFORM	0.450000	U	
CHLOROMETHANE	0.430000	U	
CIS-1,2-DICHLOROETHENE	0.990000	U	
CIS-1,3-DICHLOROPROPENE	0.410000	U	
CYCLOHEXANE	0.450000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB17-SO-0406
samp_date	12/3/2008
lab_id	0812060-17
qc_type	NM
units	UG/KG
Pct_Solids	89.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.910000	U	
ETHYLBENZENE	0.620000	U	
ISOPROPYLBENZENE	0.730000	U	
METHYL ACETATE	1.300000	U	
METHYL CYCLOHEXANE	0.250000	U	
METHYL TERT-BUTYL ETHER	0.260000	U	
METHYLENE CHLORIDE	3.8	U	A
STYRENE	0.290000	U	
TETRACHLOROETHENE	0.800000	U	
TOLUENE	0.710000	U	
TOTAL XYLENES	0.580000	U	
TRANS-1,2-DICHLOROETHENE	0.910000	U	
TRANS-1,3-DICHLOROPROPENE	0.260000	U	
TRICHLOROETHENE	0.700000	U	
TRICHLOROFLUOROMETHANE	0.780000	U	
VINYL CHLORIDE	0.910000	U	

nsample	NTC19SB18-SO-0204
samp_date	12/3/2008
lab_id	0812060-18
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.900000	U	
1,1,2,2-TETRACHLOROETHANE	0.430000	U	
1,1,2-TRICHLOROETHANE	0.350000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.550000	U	
1,1-DICHLOROETHANE	0.540000	U	
1,1-DICHLOROETHENE	1.200000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.200000	U	
1,2-DIBROMOETHANE	0.430000	U	
1,2-DICHLOROBENZENE	0.370000	U	
1,2-DICHLOROETHANE	0.460000	U	
1,2-DICHLOROPROPANE	0.460000	U	
1,3-DICHLOROBENZENE	0.840000	U	
1,4-DICHLOROBENZENE	0.550000	U	
2-BUTANONE	1.400000	U	
2-HEXANONE	2.300000	U	
4-METHYL-2-PENTANONE	0.580000	U	
ACETONE	10		
BENZENE	0.470000	U	
BROMODICHLOROMETHANE	0.300000	U	
BROMOFORM	1.000000	U	
BROMOMETHANE	0.720000	U	
CARBON DISULFIDE	1.300000	U	
CARBON TETRACHLORIDE	0.880000	U	
CHLOROBENZENE	0.340000	U	
CHLORODIBROMOMETHANE	0.340000	U	
CHLOROETHANE	1.100000	U	
CHLOROFORM	0.550000	U	
CHLOROMETHANE	0.520000	U	
CIS-1,2-DICHLOROETHENE	1.200000	U	
CIS-1,3-DICHLOROPROPENE	0.500000	U	
CYCLOHEXANE	0.540000	U	

nsample	NTC19SB18-SO-0204
samp_date	12/3/2008
lab_id	0812060-18
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.100000	U	
ETHYLBENZENE	0.750000	U	
ISOPROPYLBENZENE	0.880000	U	
METHYL ACETATE	1.600000	U	
METHYL CYCLOHEXANE	0.300000	U	
METHYL TERT-BUTYL ETHER	0.320000	U	
METHYLENE CHLORIDE	3.6	U	A
STYRENE	0.350000	U	
TETRACHLOROETHENE	0.970000	U	
TOLUENE	0.860000	U	
TOTAL XYLENES	0.700000	U	
TRANS-1,2-DICHLOROETHENE	1.100000	U	
TRANS-1,3-DICHLOROPROPENE	0.320000	U	
TRICHLOROETHENE	0.850000	U	
TRICHLOROFLUOROMETHANE	0.950000	U	
VINYL CHLORIDE	1.100000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB18-SO-0406
samp_date	12/3/2008
lab_id	0812060-19
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.780000	U	
1,1,2,2-TETRACHLOROETHANE	0.370000	U	
1,1,2-TRICHLOROETHANE	0.300000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.480000	U	
1,1-DICHLOROETHANE	0.470000	U	
1,1-DICHLOROETHENE	1.000000	U	
1,2,4-TRICHLOROBENZENE	0.160000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.000000	U	
1,2-DIBROMOETHANE	0.370000	U	
1,2-DICHLOROBENZENE	0.320000	U	
1,2-DICHLOROETHANE	0.400000	U	
1,2-DICHLOROPROPANE	0.400000	U	
1,3-DICHLOROBENZENE	0.730000	U	
1,4-DICHLOROBENZENE	0.480000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	2.000000	U	
4-METHYL-2-PENTANONE	0.500000	U	
ACETONE	1.700000	U	
BENZENE	0.410000	U	
BROMODICHLOROMETHANE	0.260000	U	
BROMOFORM	0.860000	U	
BROMOMETHANE	0.620000	U	
CARBON DISULFIDE	1.100000	U	
CARBON TETRACHLORIDE	0.760000	U	
CHLOROBENZENE	0.290000	U	
CHLORODIBROMOMETHANE	0.290000	U	
CHLOROETHANE	0.950000	U	
CHLOROFORM	0.480000	U	
CHLOROMETHANE	0.450000	U	
CIS-1,2-DICHLOROETHENE	1.000000	U	
CIS-1,3-DICHLOROPROPENE	0.430000	U	
CYCLOHEXANE	0.470000	U	

nsample	NTC19SB18-SO-0406
samp_date	12/3/2008
lab_id	0812060-19
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.950000	U	
ETHYLBENZENE	0.650000	U	
ISOPROPYLBENZENE	0.760000	U	
METHYL ACETATE	1.400000	U	
METHYL CYCLOHEXANE	0.260000	U	
METHYL TERT-BUTYL ETHER	0.280000	U	
METHYLENE CHLORIDE	3.1	U	A
STYRENE	0.300000	U	
TETRACHLOROETHENE	0.840000	U	
TOLUENE	0.740000	U	
TOTAL XYLENES	0.610000	U	
TRANS-1,2-DICHLOROETHENE	0.950000	U	
TRANS-1,3-DICHLOROPROPENE	0.280000	U	
TRICHLOROETHENE	0.740000	U	
TRICHLOROFLUOROMETHANE	0.820000	U	
VINYL CHLORIDE	0.950000	U	

nsample	NTC19SB19-SO-0002
samp_date	12/3/2008
lab_id	0812060-20
qc_type	NM
units	UG/KG
Pct_Solids	81.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	1.100000	U	
1,1,2,2-TETRACHLOROETHANE	0.530000	U	
1,1,2-TRICHLOROETHANE	0.430000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.680000	U	
1,1-DICHLOROETHANE	0.660000	U	
1,1-DICHLOROETHENE	1.500000	U	
1,2,4-TRICHLOROBENZENE	0.220000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.500000	U	
1,2-DIBROMOETHANE	0.530000	U	
1,2-DICHLOROBENZENE	0.460000	U	
1,2-DICHLOROETHANE	0.560000	U	
1,2-DICHLOROPROPANE	0.560000	U	
1,3-DICHLOROBENZENE	1.000000	U	
1,4-DICHLOROBENZENE	0.680000	U	
2-BUTANONE	1.700000	U	
2-HEXANONE	2.800000	U	
4-METHYL-2-PENTANONE	0.710000	U	
ACETONE	2.500000	U	
BENZENE	0.580000	U	
BROMODICHLOROMETHANE	0.370000	U	
BROMOFORM	1.200000	U	
BROMOMETHANE	0.880000	U	
CARBON DISULFIDE	1.600000	U	
CARBON TETRACHLORIDE	1.100000	U	
CHLOROBENZENE	0.420000	U	
CHLORODIBROMOMETHANE	0.420000	U	
CHLOROETHANE	1.400000	U	
CHLOROFORM	0.680000	U	
CHLOROMETHANE	0.640000	U	
CIS-1,2-DICHLOROETHENE	1.500000	U	
CIS-1,3-DICHLOROPROPENE	0.620000	U	
CYCLOHEXANE	0.660000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB19-SO-0002
samp_date	12/3/2008
lab_id	0812060-20
qc_type	NM
units	UG/KG
Pct_Solids	81.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.400000	U	
ETHYLBENZENE	0.920000	U	
ISOPROPYLBENZENE	1.100000	U	
METHYL ACETATE	2.000000	U	
METHYL CYCLOHEXANE	0.370000	U	
METHYL TERT-BUTYL ETHER	0.390000	U	
METHYLENE CHLORIDE	5.5	U	A
STYRENE	0.430000	U	
TETRACHLOROETHENE	1.200000	U	
TOLUENE	1.000000	U	
TOTAL XYLENES	0.860000	U	
TRANS-1,2-DICHLOROETHENE	1.400000	U	
TRANS-1,3-DICHLOROPROPENE	0.390000	U	
TRICHLOROETHENE	1.000000	U	
TRICHLOROFLUOROMETHANE	1.200000	U	
VINYL CHLORIDE	1.400000	U	

nsample	NTC19SB19-SO-0406
samp_date	12/3/2008
lab_id	0812060-21
qc_type	NM
units	UG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.760000	U	
1,1,2,2-TETRACHLOROETHANE	0.360000	U	
1,1,2-TRICHLOROETHANE	0.300000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.470000	U	
1,1-DICHLOROETHANE	0.460000	U	
1,1-DICHLOROETHENE	1.000000	U	
1,2,4-TRICHLOROBENZENE	0.150000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.000000	U	
1,2-DIBROMOETHANE	0.360000	U	
1,2-DICHLOROBENZENE	0.310000	U	
1,2-DICHLOROETHANE	0.390000	U	
1,2-DICHLOROPROPANE	0.390000	U	
1,3-DICHLOROBENZENE	0.710000	U	
1,4-DICHLOROBENZENE	0.470000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	2.000000	U	
4-METHYL-2-PENTANONE	0.490000	U	
ACETONE	3		
BENZENE	0.400000	U	
BROMODICHLOROMETHANE	0.250000	U	
BROMOFORM	0.850000	U	
BROMOMETHANE	0.610000	U	
CARBON DISULFIDE	1.100000	U	
CARBON TETRACHLORIDE	0.750000	U	
CHLOROBENZENE	0.290000	U	
CHLORODIBROMOMETHANE	0.290000	U	
CHLOROETHANE	0.930000	U	
CHLOROFORM	0.470000	U	
CHLOROMETHANE	0.440000	U	
CIS-1,2-DICHLOROETHENE	1.000000	U	
CIS-1,3-DICHLOROPROPENE	0.420000	U	
CYCLOHEXANE	0.460000	U	

nsample	NTC19SB19-SO-0406
samp_date	12/3/2008
lab_id	0812060-21
qc_type	NM
units	UG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.930000	U	
ETHYLBENZENE	0.640000	U	
ISOPROPYLBENZENE	0.750000	U	
METHYL ACETATE	1.400000	U	
METHYL CYCLOHEXANE	0.250000	U	
METHYL TERT-BUTYL ETHER	0.270000	U	
METHYLENE CHLORIDE	2.9	U	A
STYRENE	0.300000	U	
TETRACHLOROETHENE	0.820000	U	
TOLUENE	0.730000	U	
TOTAL XYLENES	0.590000	U	
TRANS-1,2-DICHLOROETHENE	0.930000	U	
TRANS-1,3-DICHLOROPROPENE	0.270000	U	
TRICHLOROETHENE	0.720000	U	
TRICHLOROFLUOROMETHANE	0.810000	U	
VINYL CHLORIDE	0.930000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB20-SO-0002
samp_date	12/3/2008
lab_id	0812060-22
qc_type	NM
units	UG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.990000	U	
1,1,2,2-TETRACHLOROETHANE	0.470000	U	
1,1,2-TRICHLOROETHANE	0.380000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.600000	U	
1,1-DICHLOROETHANE	0.590000	U	
1,1-DICHLOROETHENE	1.300000	U	
1,2,4-TRICHLOROBENZENE	0.200000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.300000	U	
1,2-DIBROMOETHANE	0.470000	U	
1,2-DICHLOROBENZENE	0.400000	U	
1,2-DICHLOROETHANE	0.500000	U	
1,2-DICHLOROPROPANE	0.500000	U	
1,3-DICHLOROBENZENE	0.920000	U	
1,4-DICHLOROBENZENE	0.600000	U	
2-BUTANONE	1.500000	U	
2-HEXANONE	2.500000	U	
4-METHYL-2-PENTANONE	0.640000	U	
ACETONE	2.200000	U	
BENZENE	0.520000	U	
BROMODICHLOROMETHANE	0.330000	U	
BROMOFORM	1.100000	U	
BROMOMETHANE	0.790000	U	
CARBON DISULFIDE	1.400000	U	
CARBON TETRACHLORIDE	0.960000	U	
CHLOROBENZENE	0.370000	U	
CHLORODIBROMOMETHANE	0.370000	U	
CHLOROETHANE	1.200000	U	
CHLOROFORM	0.600000	U	
CHLOROMETHANE	0.570000	U	
CIS-1,2-DICHLOROETHENE	1.300000	U	
CIS-1,3-DICHLOROPROPENE	0.550000	U	
CYCLOHEXANE	0.590000	U	

nsample	NTC19SB20-SO-0002
samp_date	12/3/2008
lab_id	0812060-22
qc_type	NM
units	UG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	1.200000	U	
ETHYLBENZENE	0.820000	U	
ISOPROPYLBENZENE	0.960000	U	
METHYL ACETATE	1.800000	U	
METHYL CYCLOHEXANE	0.330000	U	
METHYL TERT-BUTYL ETHER	0.350000	U	
METHYLENE CHLORIDE	3.7	U	A
STYRENE	0.380000	U	
TETRACHLOROETHENE	1.100000	U	
TOLUENE	0.940000	U	
TOTAL XYLENES	0.770000	U	
TRANS-1,2-DICHLOROETHENE	1.200000	U	
TRANS-1,3-DICHLOROPROPENE	0.350000	U	
TRICHLOROETHENE	0.930000	U	
TRICHLOROFLUOROMETHANE	1.000000	U	
VINYL CHLORIDE	1.200000	U	

nsample	NTC19SB20-SO-0406
samp_date	12/3/2008
lab_id	0812060-23
qc_type	NM
units	UG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.810000	U	
1,1,2,2-TETRACHLOROETHANE	0.390000	U	
1,1,2-TRICHLOROETHANE	0.310000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.490000	U	
1,1-DICHLOROETHANE	0.480000	U	
1,1-DICHLOROETHENE	1.100000	U	
1,2,4-TRICHLOROBENZENE	0.160000	U	
1,2-DIBROMO-3-CHLOROPROPANE	1.100000	U	
1,2-DIBROMOETHANE	0.390000	U	
1,2-DICHLOROBENZENE	0.330000	U	
1,2-DICHLOROETHANE	0.410000	U	
1,2-DICHLOROPROPANE	0.410000	U	
1,3-DICHLOROBENZENE	0.750000	U	
1,4-DICHLOROBENZENE	0.490000	U	
2-BUTANONE	1.200000	U	
2-HEXANONE	2.100000	U	
4-METHYL-2-PENTANONE	0.520000	U	
ACETONE	1.800000	U	
BENZENE	0.420000	U	
BROMODICHLOROMETHANE	0.270000	U	
BROMOFORM	0.900000	U	
BROMOMETHANE	0.650000	U	
CARBON DISULFIDE	1.200000	U	
CARBON TETRACHLORIDE	0.790000	U	
CHLOROBENZENE	0.300000	U	
CHLORODIBROMOMETHANE	0.300000	U	
CHLOROETHANE	0.990000	U	
CHLOROFORM	0.490000	U	
CHLOROMETHANE	0.470000	U	
CIS-1,2-DICHLOROETHENE	1.100000	U	
CIS-1,3-DICHLOROPROPENE	0.450000	U	
CYCLOHEXANE	0.480000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: OV

nsample	NTC19SB20-SO-0406
samp_date	12/3/2008
lab_id	0812060-23
qc_type	NM
units	UG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.990000	U	
ETHYLBENZENE	0.670000	U	
ISOPROPYLBENZENE	0.790000	U	
METHYL ACETATE	1.400000	U	
METHYL CYCLOHEXANE	0.270000	U	
METHYL TERT-BUTYL ETHER	0.290000	U	
METHYLENE CHLORIDE	4.0	U	A
STYRENE	0.310000	U	
TETRACHLOROETHENE	0.870000	U	
TOLUENE	0.770000	U	
TOTAL XYLENES	0.630000	U	
TRANS-1,2-DICHLOROETHENE	0.990000	U	
TRANS-1,3-DICHLOROPROPENE	0.290000	U	
TRICHLOROETHENE	0.760000	U	
TRICHLOROFLUOROMETHANE	0.850000	U	
VINYL CHLORIDE	0.990000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: WATER DATA FRACTION: OV

nsample	NTC19-RB120308-01
samp_date	12/3/2008
lab_id	0812060-04
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.200000	U	
1,1,2,2-TETRACHLOROETHANE	0.230000	U	
1,1,2-TRICHLOROETHANE	0.140000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.120000	U	
1,1-DICHLOROETHANE	0.190000	U	
1,1-DICHLOROETHENE	0.240000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.230000	U	
1,2-DIBROMOETHANE	0.140000	U	
1,2-DICHLOROBENZENE	0.160000	U	
1,2-DICHLOROETHANE	0.220000	U	
1,2-DICHLOROPROPANE	0.170000	U	
1,3-DICHLOROBENZENE	0.130000	U	
1,4-DICHLOROBENZENE	0.100000	U	
2-BUTANONE	1.100000	U	
2-HEXANONE	0.420000	U	
4-METHYL-2-PENTANONE	0.500000	U	
ACETONE	2.4	J	C
BENZENE	0.120000	U	
BROMODICHLOROMETHANE	0.180000	U	
BROMOFORM	0.100000	U	
BROMOMETHANE	0.270000	UJ	C
CARBON DISULFIDE	0.170000	U	
CARBON TETRACHLORIDE	0.220000	UJ	C
CHLOROBENZENE	0.100000	U	
CHLORODIBROMOMETHANE	0.100000	U	
CHLOROETHANE	0.250000	U	
CHLOROFORM	0.170000	U	
CHLOROMETHANE	0.360000	U	
CIS-1,2-DICHLOROETHENE	0.160000	U	
CIS-1,3-DICHLOROPROPENE	0.120000	U	
CYCLOHEXANE	0.140000	U	

nsample	NTC19-RB120308-01
samp_date	12/3/2008
lab_id	0812060-04
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.200000	U	
ETHYLBENZENE	0.100000	U	
ISOPROPYLBENZENE	0.110000	U	
METHYL ACETATE	0.510000	U	
METHYL CYCLOHEXANE	0.120000	U	
METHYL TERT-BUTYL ETHER	0.100000	U	
METHYLENE CHLORIDE	0.270000	U	
STYRENE	0.110000	U	
TETRACHLOROETHENE	0.160000	U	
TOLUENE	0.140000	U	
TOTAL XYLENES	0.210000	U	
TRANS-1,2-DICHLOROETHENE	0.210000	U	
TRANS-1,3-DICHLOROPROPENE	0.170000	U	
TRICHLOROETHENE	0.500000	U	
TRICHLOROFLUOROMETHANE	0.220000	U	
VINYL CHLORIDE	0.190000	U	

nsample	NTC19-SB120308-01
samp_date	12/3/2008
lab_id	0812060-05
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.200000	U	
1,1,2,2-TETRACHLOROETHANE	0.230000	U	
1,1,2-TRICHLOROETHANE	0.140000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.120000	U	
1,1-DICHLOROETHANE	0.190000	U	
1,1-DICHLOROETHENE	0.240000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.230000	U	
1,2-DIBROMOETHANE	0.140000	U	
1,2-DICHLOROBENZENE	0.160000	U	
1,2-DICHLOROETHANE	0.220000	U	
1,2-DICHLOROPROPANE	0.170000	U	
1,3-DICHLOROBENZENE	0.130000	U	
1,4-DICHLOROBENZENE	0.100000	U	
2-BUTANONE	1.100000	U	
2-HEXANONE	0.420000	U	
4-METHYL-2-PENTANONE	0.500000	U	
ACETONE	2.4	J	C
BENZENE	0.120000	U	
BROMODICHLOROMETHANE	0.180000	U	
BROMOFORM	0.100000	U	
BROMOMETHANE	0.270000	UJ	C
CARBON DISULFIDE	0.170000	U	
CARBON TETRACHLORIDE	0.220000	UJ	C
CHLOROBENZENE	0.100000	U	
CHLORODIBROMOMETHANE	0.100000	U	
CHLOROETHANE	0.250000	U	
CHLOROFORM	0.170000	U	
CHLOROMETHANE	0.360000	U	
CIS-1,2-DICHLOROETHENE	0.160000	U	
CIS-1,3-DICHLOROPROPENE	0.120000	U	
CYCLOHEXANE	0.140000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: WATER DATA FRACTION: OV

nsample	NTC19-SB120308-01
samp_date	12/3/2008
lab_id	0812060-05
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.200000	U	
ETHYLBENZENE	0.100000	U	
ISOPROPYLBENZENE	0.110000	U	
METHYL ACETATE	0.510000	U	
METHYL CYCLOHEXANE	0.120000	U	
METHYL TERT-BUTYL ETHER	0.100000	U	
METHYLENE CHLORIDE	0.270000	U	
STYRENE	0.110000	U	
TETRACHLOROETHENE	0.160000	U	
TOLUENE	0.140000	U	
TOTAL XYLENES	0.210000	U	
TRANS-1,2-DICHLOROETHENE	0.210000	U	
TRANS-1,3-DICHLOROPROPENE	0.170000	U	
TRICHLOROETHENE	0.500000	U	
TRICHLOROFLUOROMETHANE	0.220000	U	
VINYL CHLORIDE	0.190000	U	

nsample	NTC19-TB120308
samp_date	12/3/2008
lab_id	0812060-06
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.200000	U	
1,1,2,2-TETRACHLOROETHANE	0.230000	U	
1,1,2-TRICHLOROETHANE	0.140000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.120000	U	
1,1-DICHLOROETHANE	0.190000	U	
1,1-DICHLOROETHENE	0.240000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.230000	U	
1,2-DIBROMOETHANE	0.140000	U	
1,2-DICHLOROBENZENE	0.160000	U	
1,2-DICHLOROETHANE	0.220000	U	
1,2-DICHLOROPROPANE	0.170000	U	
1,3-DICHLOROBENZENE	0.130000	U	
1,4-DICHLOROBENZENE	0.100000	U	
2-BUTANONE	1.100000	U	
2-HEXANONE	0.420000	U	
4-METHYL-2-PENTANONE	0.500000	U	
ACETONE	1.800000	UJ	C
BENZENE	0.120000	U	
BROMODICHLOROMETHANE	0.180000	U	
BROMOFORM	0.100000	U	
BROMOMETHANE	0.270000	UJ	C
CARBON DISULFIDE	0.170000	U	
CARBON TETRACHLORIDE	0.220000	UJ	C
CHLOROBENZENE	0.100000	U	
CHLORODIBROMOMETHANE	0.100000	U	
CHLOROETHANE	0.250000	U	
CHLOROFORM	0.170000	U	
CHLOROMETHANE	0.360000	U	
CIS-1,2-DICHLOROETHENE	0.160000	U	
CIS-1,3-DICHLOROPROPENE	0.120000	U	
CYCLOHEXANE	0.140000	U	

nsample	NTC19-TB120308
samp_date	12/3/2008
lab_id	0812060-06
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.200000	U	
ETHYLBENZENE	0.100000	U	
ISOPROPYLBENZENE	0.110000	U	
METHYL ACETATE	0.510000	U	
METHYL CYCLOHEXANE	0.120000	U	
METHYL TERT-BUTYL ETHER	0.100000	U	
METHYLENE CHLORIDE	0.94	U	A
STYRENE	0.110000	U	
TETRACHLOROETHENE	0.160000	U	
TOLUENE	0.140000	U	
TOTAL XYLENES	0.210000	U	
TRANS-1,2-DICHLOROETHENE	0.210000	U	
TRANS-1,3-DICHLOROPROPENE	0.170000	U	
TRICHLOROETHENE	0.500000	U	
TRICHLOROFLUOROMETHANE	0.220000	U	
VINYL CHLORIDE	0.190000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19-FD120308-01	nsample	NTC19-FD120308-02	nsample	NTC19-FD120308-03
samp_date	12/3/2008	samp_date	12/3/2008	samp_date	12/3/2008
lab_id	0812060-01	lab_id	0812060-02	lab_id	0812060-03
qc_type	NM	qc_type	NM	qc_type	NM
units	UG/KG	units	UG/KG	units	UG/KG
Pct_Solids	87.0	Pct_Solids	87.0	Pct_Solids	88.0
DUP_OF:	NTC19SB15-SO-0406	DUP_OF:	NTC19SB16-SO-0103	DUP_OF:	NTC19SB17-SO-0002

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	6.5		
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.920000	U	
BENZO(A)ANTHRACENE	1.600000	UJ	C
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	4.8	J	G
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.700000	U	
PHENANTHRENE	7.9		
PYRENE	1.800000	U	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2		
ACENAPHTHENE	14	J	G
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	42	J	G
BENZO(A)ANTHRACENE	130	J	G
BENZO(A)PYRENE	100	J	G
BENZO(B)FLUORANTHENE	140	J	G
BENZO(G,H,I)PERYLENE	60	J	G
BENZO(K)FLUORANTHENE	39	J	G
CHRYSENE	110	J	G
DIBENZO(A,H)ANTHRACENE	15	J	G
FLUORANTHENE	320	J	G
FLUORENE	16	J	G
INDENO(1,2,3-CD)PYRENE	53	J	G
NAPHTHALENE	2.700000	U	
PHENANTHRENE	220	J	G
PYRENE	250	J	G

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	5.9		
ACENAPHTHENE	13		
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	33		
BENZO(A)ANTHRACENE	110	J	C
BENZO(A)PYRENE	68		
BENZO(B)FLUORANTHENE	64		
BENZO(G,H,I)PERYLENE	36		
BENZO(K)FLUORANTHENE	29		
CHRYSENE	85		
DIBENZO(A,H)ANTHRACENE	1.700000	UJ	G
FLUORANTHENE	140		
FLUORENE	13		
INDENO(1,2,3-CD)PYRENE	33		
NAPHTHALENE	4.9		
PHENANTHRENE	120		
PYRENE	120		

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB12-SO-0002
samp_date	12/3/2008
lab_id	0812060-07
qc_type	NM
units	UG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	5.8		
ACENAPHTHENE	78		
ACENAPHTHYLENE	12		
ANTHRACENE	250		
BENZO(A)ANTHRACENE	940	J	C
BENZO(A)PYRENE	480		
BENZO(B)FLUORANTHENE	510		
BENZO(G,H,I)PERYLENE	250		
BENZO(K)FLUORANTHENE	240		
CHRYSENE	740		
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	1300		
FLUORENE	93		
INDENO(1,2,3-CD)PYRENE	230		
NAPHTHALENE	7		
PHENANTHRENE	1200		
PYRENE	1100		

nsample	NTC19SB12-SO-0507
samp_date	12/3/2008
lab_id	0812060-08
qc_type	NM
units	UG/KG
Pct_Solids	83.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.400000	U	
ANTHRACENE	0.970000	U	
BENZO(A)ANTHRACENE	1.700000	UJ	C
BENZO(A)PYRENE	1.200000	U	
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	1.800000	U	
BENZO(K)FLUORANTHENE	1.500000	U	
CHRYSENE	1.300000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	2.000000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.800000	U	
PHENANTHRENE	2.000000	U	
PYRENE	1.800000	U	

nsample	NTC19SB13-SO-0103
samp_date	12/3/2008
lab_id	0812060-09
qc_type	NM
units	UG/KG
Pct_Solids	82.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	1.500000	U	
ACENAPHTHYLENE	1.400000	U	
ANTHRACENE	0.970000	U	
BENZO(A)ANTHRACENE	1.700000	UJ	C
BENZO(A)PYRENE	1.200000	U	
BENZO(B)FLUORANTHENE	1.900000	U	
BENZO(G,H,I)PERYLENE	1.800000	U	
BENZO(K)FLUORANTHENE	1.500000	U	
CHRYSENE	1.300000	U	
DIBENZO(A,H)ANTHRACENE	1.900000	U	
FLUORANTHENE	2.000000	U	
FLUORENE	1.500000	U	
INDENO(1,2,3-CD)PYRENE	1.900000	U	
NAPHTHALENE	2.800000	U	
PHENANTHRENE	2.000000	U	
PYRENE	1.900000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB14-SO-0204
samp_date	12/3/2008
lab_id	0812060-10
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.930000	U	
BENZO(A)ANTHRACENE	1.600000	UJ	C
BENZO(A)PYRENE	1.200000	U	
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	2.5		
BENZO(K)FLUORANTHENE	1.500000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.700000	U	
PHENANTHRENE	2.4		
PYRENE	2		

nsample	NTC19SB14-SO-0507
samp_date	12/3/2008
lab_id	0812060-11
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.930000	U	
BENZO(A)ANTHRACENE	1.600000	UJ	C
BENZO(A)PYRENE	1.200000	U	
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	2.6		
BENZO(K)FLUORANTHENE	1.500000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.700000	U	
PHENANTHRENE	6.7		
PYRENE	1.800000	U	

nsample	NTC19SB15-SO-0103
samp_date	12/3/2008
lab_id	0812060-12
qc_type	NM
units	UG/KG
Pct_Solids	88.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.900000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	3.4		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	7.1		
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	4.2		
PYRENE	4		

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB15-SO-0406
samp_date	12/3/2008
lab_id	0812060-13
qc_type	NM
units	UG/KG
Pct_Solids	87.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.4		
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.920000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	8.6	J	G
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.700000	U	
PHENANTHRENE	12		
PYRENE	1.800000	U	

nsample	NTC19SB16-SO-0103
samp_date	12/3/2008
lab_id	0812060-14
qc_type	NM
units	UG/KG
Pct_Solids	80.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.100000	U	
ACENAPHTHENE	3.2	J	G
ACENAPHTHYLENE	1.8		
ANTHRACENE	9.2	J	G
BENZO(A)ANTHRACENE	36	J	G
BENZO(A)PYRENE	38	J	G
BENZO(B)FLUORANTHENE	41	J	G
BENZO(G,H,I)PERYLENE	20	J	G
BENZO(K)FLUORANTHENE	11	J	G
CHRYSENE	29	J	G
DIBENZO(A,H)ANTHRACENE	4.8	J	G
FLUORANTHENE	72	J	G
FLUORENE	3.2	J	G
INDENO(1,2,3-CD)PYRENE	18	J	G
NAPHTHALENE	2.900000	U	
PHENANTHRENE	40	J	G
PYRENE	61	J	G

nsample	NTC19SB16-SO-0507
samp_date	12/3/2008
lab_id	0812060-15
qc_type	NM
units	UG/KG
Pct_Solids	88.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.910000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	5.4		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	8.9		
PYRENE	1.700000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB17-SO-0002
samp_date	12/3/2008
lab_id	0812060-16
qc_type	NM
units	UG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	6.7		
ACENAPHTHENE	9.1		
ACENAPHTHYLENE	5		
ANTHRACENE	29		
BENZO(A)ANTHRACENE	120		
BENZO(A)PYRENE	94		
BENZO(B)FLUORANTHENE	89		
BENZO(G,H,I)PERYLENE	50		
BENZO(K)FLUORANTHENE	33		
CHRYSENE	91		
DIBENZO(A,H)ANTHRACENE	12	J	G
FLUORANTHENE	200		
FLUORENE	10		
INDENO(1,2,3-CD)PYRENE	48		
NAPHTHALENE	5.2		
PHENANTHRENE	130		
PYRENE	160		

nsample	NTC19SB17-SO-0406
samp_date	12/3/2008
lab_id	0812060-17
qc_type	NM
units	UG/KG
Pct_Solids	89.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.8		
ACENAPHTHENE	1.300000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.900000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	1.100000	U	
BENZO(B)FLUORANTHENE	1.700000	U	
BENZO(G,H,I)PERYLENE	4.8		
BENZO(K)FLUORANTHENE	1.400000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.700000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.300000	U	
INDENO(1,2,3-CD)PYRENE	1.700000	U	
NAPHTHALENE	2.600000	U	
PHENANTHRENE	8.2		
PYRENE	1.700000	U	

nsample	NTC19SB18-SO-0204
samp_date	12/3/2008
lab_id	0812060-18
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	4.2		
BENZO(A)ANTHRACENE	15		
BENZO(A)PYRENE	22		
BENZO(B)FLUORANTHENE	15		
BENZO(G,H,I)PERYLENE	9		
BENZO(K)FLUORANTHENE	4.5		
CHRYSENE	12		
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	24		
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	7.4		
NAPHTHALENE	2.700000	U	
PHENANTHRENE	17		
PYRENE	21		

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB18-SO-0406
samp_date	12/3/2008
lab_id	0812060-19
qc_type	NM
units	UG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	1.900000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.930000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	7.6		
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	2.9		
BENZO(K)FLUORANTHENE	1.500000	U	
CHRYSENE	7.2		
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	1.900000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.700000	U	
PHENANTHRENE	3		
PYRENE	2.3		

nsample	NTC19SB19-SO-0002
samp_date	12/3/2008
lab_id	0812060-20
qc_type	NM
units	UG/KG
Pct_Solids	81.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	2.8		
ACENAPHTHYLENE	1.6		
ANTHRACENE	8.4		
BENZO(A)ANTHRACENE	47		
BENZO(A)PYRENE	50		
BENZO(B)FLUORANTHENE	37		
BENZO(G,H,I)PERYLENE	24		
BENZO(K)FLUORANTHENE	13		
CHRYSENE	37		
DIBENZO(A,H)ANTHRACENE	5		
FLUORANTHENE	74		
FLUORENE	2.6		
INDENO(1,2,3-CD)PYRENE	20		
NAPHTHALENE	2.900000	U	
PHENANTHRENE	41		
PYRENE	65		

nsample	NTC19SB19-SO-0406
samp_date	12/3/2008
lab_id	0812060-21
qc_type	NM
units	UG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.940000	U	
BENZO(A)ANTHRACENE	1.600000	U	
BENZO(A)PYRENE	7.1		
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	1.700000	U	
BENZO(K)FLUORANTHENE	1.500000	U	
CHRYSENE	1.200000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	2.000000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.700000	U	
PHENANTHRENE	2.000000	U	
PYRENE	1.800000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: PAH

nsample	NTC19SB20-SO-0002
samp_date	12/3/2008
lab_id	0812060-22
qc_type	NM
units	UG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	25		
ACENAPHTHENE	180		
ACENAPHTHYLENE	46		
ANTHRACENE	560		
BENZO(A)ANTHRACENE	1500		
BENZO(A)PYRENE	1200		
BENZO(B)FLUORANTHENE	1700		
BENZO(G,H,I)PERYLENE	940		
BENZO(K)FLUORANTHENE	460		
CHRYSENE	1200		
DIBENZO(A,H)ANTHRACENE	160		
FLUORANTHENE	3900		
FLUORENE	200		
INDENO(1,2,3-CD)PYRENE	730		
NAPHTHALENE	28.000000	U	
PHENANTHRENE	2900		
PYRENE	3300		

nsample	NTC19SB20-SO-0406
samp_date	12/3/2008
lab_id	0812060-23
qc_type	NM
units	UG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	2.000000	U	
ACENAPHTHENE	1.400000	U	
ACENAPHTHYLENE	1.300000	U	
ANTHRACENE	0.950000	U	
BENZO(A)ANTHRACENE	1.700000	U	
BENZO(A)PYRENE	12		
BENZO(B)FLUORANTHENE	1.800000	U	
BENZO(G,H,I)PERYLENE	1.700000	U	
BENZO(K)FLUORANTHENE	1.500000	U	
CHRYSENE	1.300000	U	
DIBENZO(A,H)ANTHRACENE	1.800000	U	
FLUORANTHENE	2.000000	U	
FLUORENE	1.400000	U	
INDENO(1,2,3-CD)PYRENE	1.800000	U	
NAPHTHALENE	2.800000	U	
PHENANTHRENE	2.000000	U	
PYRENE	1.800000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: WATER DATA FRACTION: PAH

nsample	NTC19-RB120308-01
samp_date	12/3/2008
lab_id	0812060-04
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	0.0098		
ACENAPHTHENE	0.005700	U	
ACENAPHTHYLENE	0.004700	U	
ANTHRACENE	0.012		
BENZO(A)ANTHRACENE	0.012000	U	
BENZO(A)PYRENE	0.005700	U	
BENZO(B)FLUORANTHENE	0.011000	U	
BENZO(G,H,I)PERYLENE	0.014		
BENZO(K)FLUORANTHENE	0.008500	U	
CHRYSENE	0.010000	U	
DIBENZO(A,H)ANTHRACENE	0.0056		
FLUORANTHENE	0.012000	U	
FLUORENE	0.006600	U	
INDENO(1,2,3-CD)PYRENE	0.0072		
NAPHTHALENE	0.034	U	A
PHENANTHRENE	0.016		
PYRENE	0.012000	U	

nsample	NTC19-SB120308-01
samp_date	12/3/2008
lab_id	0812060-05
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	0.011		
ACENAPHTHENE	0.005600	U	
ACENAPHTHYLENE	0.004700	U	
ANTHRACENE	0.009300	U	
BENZO(A)ANTHRACENE	0.012000	U	
BENZO(A)PYRENE	0.005600	U	
BENZO(B)FLUORANTHENE	0.011000	U	
BENZO(G,H,I)PERYLENE	0.006500	U	
BENZO(K)FLUORANTHENE	0.008400	U	
CHRYSENE	0.010000	U	
DIBENZO(A,H)ANTHRACENE	0.004700	U	
FLUORANTHENE	0.012000	U	
FLUORENE	0.006500	U	
INDENO(1,2,3-CD)PYRENE	0.003700	U	
NAPHTHALENE	0.031	U	A
PHENANTHRENE	0.012		
PYRENE	0.012000	U	

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**B. DAVIS**	**DATE:**	**FEBRUARY 4, 2009**
FROM:	**JOSEPH KALINYAK**	**COPIES:**	**DV FILE**

SUBJECT: **ORGANIC DATA VALIDATION- VOC/SVOC**
CTO 468, NTC GREAT LAKES
SDG GL003

SAMPLES: 4/Aqueous/VOC

NTC19-MW01-1208 NTC19-MW02-1208 NTC19-TB120809
NTC19FD120808-01

3/Aqueous/PAH

NTC19-MW01-1208 NTC19-MW02-1208 NTC19FD120808-01

OVERVIEW

The sample set for CTO 468 NTC Great Lakes, SDG GL003 consists of one aqueous (1) trip blank and three (3) aqueous environmental samples. The samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs) and polynuclear aromatic hydrocarbons (PAHs). The one trip blank, NTC19-TB120809, was analyzed for TCL VOCs only. There was one field duplicate pair included in this sample delivery group (SDG): NTC19-FD120808-01 / NTC19-MW01-1208.

The samples were collected by TetraTech NUS on December 8, 2008 and analyzed by Empirical Laboratories. All analyses were conducted using USEPA SW-846 Methods 8260B and 8270C SIM analytical and reporting protocols. The data contained in this SDG were validated with regard to the following parameters:

* • Data Completeness
* • Holding Times
* • GC/MS Tuning
• Initial and Continuing Calibration
• Laboratory Blank Analyses
* • Surrogate Recoveries
• Blank Spike/Blank Spike Duplicate Results
* • Internal Standard Recoveries
• Matrix Spike/Spike Duplicate Results
* • Field Duplicate Results
* • Compound Quantitation
* • Compound Identification
* • Detection Limits

The symbol (*) indicates that quality control criteria were met for this parameter. Problems affecting data quality are discussed below; documentation supporting these findings is presented in Appendix C. Qualified Analytical results are presented in Appendix A. Results as reported by the laboratory are presented in Appendix B.

Volatile

The following analyte was detected in the laboratory method blank.

Analyte	Maximum Concentration	Action Level
Methylene chloride [1]	0.33 µg/L	3.30 µg/L

[1] Maximum concentration detected in the aqueous method blank V4BLK1216E affecting all SDG samples.

Blank Actions

- Value < Reporting Limit (RL); value followed by a U.
- Value > RL and < Action level; report value followed by a U.
- Value > RL and > action level; report value followed by a J.

An action level of 10X the maximum contaminant level for the common laboratory contaminant methylene chloride has been used to evaluate sample data for blank contamination. Sample aliquot and dilution factors, if applicable, were taken into consideration when evaluating for blank contamination for each individual sample.

A continuing calibration verification percent difference (%D) was greater than the 25% quality control limit for bromomethane, chloromethane, and dichlorodifluoromethane on instrument VOA4 on 12/16/08 at 21:27. The non-detected sample results reported for bromomethane, chloromethane, and dichlorodifluoromethane for affected samples NTC19-MW01-1208, NTC19-MW02-1208, NTC19-TB120809, and NTC19FD120808 were qualified estimated, (UJ).

The VOC laboratory control sample (LCS) V4BLK1208 had a % recovery that was less than the quality control limit for dichlorodifluoromethane on instrument VOA4 on 12/16/08. The dichlorodifluoromethane non-detected results for the associated samples NTC19-MW01-1208, NTC19-MW02-1208, NTC19-TB120809, and NTC19FD120808 were qualified estimated, (UJ).

The matrix spike (MS) had a % recovery less than the quality control limit for the associated sample NTC19-MW01-1208 for bromomethane. Additionally, the MS/matrix spike duplicate (MSD) RPD for bromomethane for sample NTC19-MW01-1208 was greater than the quality control limit. The non-detected result for bromomethane for sample NTC19-MW01-1208 was qualified estimated, (UJ).

PAH

The following analyte was detected in the laboratory method blank.

Analyte	Maximum Concentration	Action Level
Naphthalene [1]	0.019 µg/L	0.095 µg/L

[1] Maximum concentration detected in the aqueous method blank SBLK1211BW2 affecting all SDG aqueous samples.

Blank Actions

- Value < Reporting Limit (RL); value followed by a U.
- Value > RL and < Action level; report value followed by a U.
- Value > RL and > action level; report value followed by a J.

An action level of 5X the maximum contaminant level for the laboratory contaminant

naphthalene has been used to evaluate sample data for blank contamination. Sample aliquot and dilution factors, if applicable, were taken into consideration when evaluating for blank contamination for each individual sample.

A continuing calibration verification %D was greater than the 25% quality control limit for benzo(a)anthracene on instrument BNA4 on 12/17/08 @ 21:19. The affected samples NTC19-MW01-1208, NTC19-MW02-1208, and NTC19FD120808 positive and non-detected results were qualified estimated, (J) and (UJ), respectively.

Additional Comments:

Only 2 surrogate compounds were added to the PAH samples prior to analysis.

EXECUTIVE SUMMARY

Laboratory Performance Issues: Several compounds in the VOC fraction exceeded the continuing calibration %D criteria resulting in qualification of the data. Methylene chloride was detected in the VOC method blank. There was a VOC LCS and a VOC matrix spike % recovery quality control limit exceedance.

Naphthalene was detected in the PAH laboratory method blank. There was a PAH continuing calibration verification %D quality control limit exceedance which resulted in data qualification.

Other factors affecting data quality: None.

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (October 1999) and the Department of Defense (DoD) document entitled "Quality Systems Manual (QSM) for Environmental Laboratories" (January 2006). The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the DoD QSM."

Tetra Tech NUS

Joseph Kalinyak
Chemist/Data Validator

TetraTech NUS

Joseph A. Samchuck
Data Validation Quality Assurance Officer

Attachments:

Appendix A – Qualified Analytical Results
Appendix B – Results as Reported by the Laboratory
Appendix C – Support Documentation

APPENDIX A

QUALIFIED ANALYTICAL RESULTS

Qualifier Codes:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration Noncompliance (i.e., % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01 = GC/MS Tuning Noncompliance
D = MS/MSD Recovery Noncompliance
E = LCS/LCSD Recovery Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = GFAA PDS - GFAA MSA's $r < 0.995$
K = ICP Interference - includes ICS % R Noncompliance
L = Instrument Calibration Range Exceedance
M = Sample Preservation Noncompliance
N = Internal Standard Noncompliance
N01 = Internal Standard Recovery Noncompliance Dioxins
N02 = Recovery Standard Noncompliance Dioxins
N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (i.e., base-time drifting)
P = Uncertainty near detection limit (< 2 x IDL for inorganics and <CRQL for organics)
Q = Other problems (can encompass a number of issues; i.e.chromatography,interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient $r < 0.995$
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is less than sample activity

PROJ_NO: 00936

SDG: GL003 MEDIA: WATER DATA FRACTION: OV

nsample	NTC19FD120808-01
samp_date	12/8/2008
lab_id	0812147-04
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	NTC19-MW01-1208

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.200000	U	
1,1,2,2-TETRACHLOROETHANE	0.230000	U	
1,1,2-TRICHLOROETHANE	0.140000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.120000	U	
1,1-DICHLOROETHANE	0.190000	U	
1,1-DICHLOROETHENE	0.240000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.230000	U	
1,2-DIBROMOETHANE	0.140000	U	
1,2-DICHLOROBENZENE	0.160000	U	
1,2-DICHLOROETHANE	0.220000	U	
1,2-DICHLOROPROPANE	0.170000	U	
1,3-DICHLOROBENZENE	0.130000	U	
1,4-DICHLOROBENZENE	0.100000	U	
2-BUTANONE	1.100000	U	
2-HEXANONE	0.420000	U	
4-METHYL-2-PENTANONE	0.500000	U	
ACETONE	1.800000	U	
BENZENE	0.120000	U	
BROMODICHLOROMETHANE	0.180000	U	
BROMOFORM	0.100000	U	
BROMOMETHANE	0.270000	UJ	C
CARBON DISULFIDE	0.170000	U	
CARBON TETRACHLORIDE	0.220000	U	
CHLOROBENZENE	0.100000	U	
CHLORODIBROMOMETHANE	0.100000	U	
CHLOROETHANE	0.250000	U	
CHLOROFORM	0.170000	U	
CHLOROMETHANE	0.360000	UJ	C
CIS-1,2-DICHLOROETHENE	0.160000	U	
CIS-1,3-DICHLOROPROPENE	0.120000	U	
CYCLOHEXANE	0.140000	U	

nsample	NTC19FD120808-01
samp_date	12/8/2008
lab_id	0812147-04
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	NTC19-MW01-1208

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.200000	UJ	CE
ETHYLBENZENE	0.100000	U	
ISOPROPYLBENZENE	0.110000	U	
METHYL ACETATE	0.510000	U	
METHYL CYCLOHEXANE	0.120000	U	
METHYL TERT-BUTYL ETHER	0.100000	U	
METHYLENE CHLORIDE	0.270000	U	
STYRENE	0.110000	U	
TETRACHLOROETHENE	0.160000	U	
TOLUENE	0.140000	U	
TOTAL XYLENES	0.210000	U	
TRANS-1,2-DICHLOROETHENE	0.210000	U	
TRANS-1,3-DICHLOROPROPENE	0.170000	U	
TRICHLOROETHENE	0.500000	U	
TRICHLOROFLUOROMETHANE	0.220000	U	
VINYL CHLORIDE	0.190000	U	

nsample	NTC19-MW01-1208
samp_date	12/8/2008
lab_id	0812147-01
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.200000	U	
1,1,2,2-TETRACHLOROETHANE	0.230000	U	
1,1,2-TRICHLOROETHANE	0.140000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.120000	U	
1,1-DICHLOROETHANE	0.190000	U	
1,1-DICHLOROETHENE	0.240000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.230000	U	
1,2-DIBROMOETHANE	0.140000	U	
1,2-DICHLOROBENZENE	0.160000	U	
1,2-DICHLOROETHANE	0.220000	U	
1,2-DICHLOROPROPANE	0.170000	U	
1,3-DICHLOROBENZENE	0.130000	U	
1,4-DICHLOROBENZENE	0.100000	U	
2-BUTANONE	1.100000	U	
2-HEXANONE	0.420000	U	
4-METHYL-2-PENTANONE	0.500000	U	
ACETONE	1.800000	U	
BENZENE	0.120000	U	
BROMODICHLOROMETHANE	0.180000	U	
BROMOFORM	0.100000	U	
BROMOMETHANE	0.270000	UJ	CD
CARBON DISULFIDE	0.170000	U	
CARBON TETRACHLORIDE	0.220000	U	
CHLOROBENZENE	0.100000	U	
CHLORODIBROMOMETHANE	0.100000	U	
CHLOROETHANE	0.250000	U	
CHLOROFORM	0.170000	U	
CHLOROMETHANE	0.360000	UJ	C
CIS-1,2-DICHLOROETHENE	0.160000	U	
CIS-1,3-DICHLOROPROPENE	0.120000	U	
CYCLOHEXANE	0.140000	U	

PROJ_NO: 00936

SDG: GL003 MEDIA: WATER DATA FRACTION: OV

nsample	NTC19-MW01-1208
samp_date	12/8/2008
lab_id	0812147-01
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.200000	UJ	CE
ETHYLBENZENE	0.100000	U	
ISOPROPYLBENZENE	0.110000	U	
METHYL ACETATE	0.510000	U	
METHYL CYCLOHEXANE	0.120000	U	
METHYL TERT-BUTYL ETHER	0.100000	U	
METHYLENE CHLORIDE	0.50	U	A
STYRENE	0.110000	U	
TETRACHLOROETHENE	0.160000	U	
TOLUENE	0.140000	U	
TOTAL XYLENES	0.210000	U	
TRANS-1,2-DICHLOROETHENE	0.210000	U	
TRANS-1,3-DICHLOROPROPENE	0.170000	U	
TRICHLOROETHENE	0.500000	U	
TRICHLOROFLUOROMETHANE	0.220000	U	
VINYL CHLORIDE	0.190000	U	

nsample	NTC19-MW02-1208
samp_date	12/8/2008
lab_id	0812147-02
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.200000	U	
1,1,2,2-TETRACHLOROETHANE	0.230000	U	
1,1,2-TRICHLOROETHANE	0.140000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.120000	U	
1,1-DICHLOROETHANE	0.190000	U	
1,1-DICHLOROETHENE	0.240000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.230000	U	
1,2-DIBROMOETHANE	0.140000	U	
1,2-DICHLOROBENZENE	0.160000	U	
1,2-DICHLOROETHANE	0.220000	U	
1,2-DICHLOROPROPANE	0.170000	U	
1,3-DICHLOROBENZENE	0.130000	U	
1,4-DICHLOROBENZENE	0.100000	U	
2-BUTANONE	1.100000	U	
2-HEXANONE	0.420000	U	
4-METHYL-2-PENTANONE	0.500000	U	
ACETONE	8.5		
BENZENE	0.120000	U	
BROMODICHLOROMETHANE	0.180000	U	
BROMOFORM	0.100000	U	
BROMOMETHANE	0.270000	UJ	C
CARBON DISULFIDE	0.170000	U	
CARBON TETRACHLORIDE	0.220000	U	
CHLOROBENZENE	0.100000	U	
CHLORODIBROMOMETHANE	0.100000	U	
CHLOROETHANE	0.250000	U	
CHLOROFORM	0.170000	U	
CHLOROMETHANE	0.360000	UJ	C
CIS-1,2-DICHLOROETHENE	0.160000	U	
CIS-1,3-DICHLOROPROPENE	0.120000	U	
CYCLOHEXANE	0.140000	U	

nsample	NTC19-MW02-1208
samp_date	12/8/2008
lab_id	0812147-02
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.200000	UJ	CE
ETHYLBENZENE	0.100000	U	
ISOPROPYLBENZENE	0.110000	U	
METHYL ACETATE	0.510000	U	
METHYL CYCLOHEXANE	0.120000	U	
METHYL TERT-BUTYL ETHER	0.100000	U	
METHYLENE CHLORIDE	0.30	U	A
STYRENE	0.110000	U	
TETRACHLOROETHENE	0.160000	U	
TOLUENE	0.22		
TOTAL XYLENES	0.210000	U	
TRANS-1,2-DICHLOROETHENE	0.210000	U	
TRANS-1,3-DICHLOROPROPENE	0.170000	U	
TRICHLOROETHENE	0.500000	U	
TRICHLOROFLUOROMETHANE	0.220000	U	
VINYL CHLORIDE	0.190000	U	

PROJ_NO: 00936

SDG: GL003 MEDIA: WATER DATA FRACTION: OV

nsample	NTC19-TB120809
samp_date	12/8/2008
lab_id	0812147-03
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
1,1,1-TRICHLOROETHANE	0.200000	U	
1,1,2,2-TETRACHLOROETHANE	0.230000	U	
1,1,2-TRICHLOROETHANE	0.140000	U	
1,1,2-TRICHLOROTRIFLUOROETHANE	0.120000	U	
1,1-DICHLOROETHANE	0.190000	U	
1,1-DICHLOROETHENE	0.240000	U	
1,2,4-TRICHLOROBENZENE	0.180000	U	
1,2-DIBROMO-3-CHLOROPROPANE	0.230000	U	
1,2-DIBROMOETHANE	0.140000	U	
1,2-DICHLOROBENZENE	0.160000	U	
1,2-DICHLOROETHANE	0.220000	U	
1,2-DICHLOROPROPANE	0.170000	U	
1,3-DICHLOROBENZENE	0.130000	U	
1,4-DICHLOROBENZENE	0.100000	U	
2-BUTANONE	1.100000	U	
2-HEXANONE	0.420000	U	
4-METHYL-2-PENTANONE	0.500000	U	
ACETONE	1.800000	U	
BENZENE	0.120000	U	
BROMODICHLOROMETHANE	0.180000	U	
BROMOFORM	0.100000	U	
BROMOMETHANE	0.270000	UJ	C
CARBON DISULFIDE	0.170000	U	
CARBON TETRACHLORIDE	0.220000	U	
CHLOROBENZENE	0.100000	U	
CHLORODIBROMOMETHANE	0.100000	U	
CHLOROETHANE	0.250000	U	
CHLOROFORM	0.170000	U	
CHLOROMETHANE	0.360000	UJ	C
CIS-1,2-DICHLOROETHENE	0.160000	U	
CIS-1,3-DICHLOROPROPENE	0.120000	U	
CYCLOHEXANE	0.140000	U	

nsample	NTC19-TB120809
samp_date	12/8/2008
lab_id	0812147-03
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
DICHLORODIFLUOROMETHANE	0.200000	UJ	CE
ETHYLBENZENE	0.100000	U	
ISOPROPYLBENZENE	0.110000	U	
METHYL ACETATE	0.510000	U	
METHYL CYCLOHEXANE	0.120000	U	
METHYL TERT-BUTYL ETHER	0.100000	U	
METHYLENE CHLORIDE	3.0	U	A
STYRENE	0.110000	U	
TETRACHLOROETHENE	0.160000	U	
TOLUENE	0.140000	U	
TOTAL XYLENES	0.210000	U	
TRANS-1,2-DICHLOROETHENE	0.210000	U	
TRANS-1,3-DICHLOROPROPENE	0.170000	U	
TRICHLOROETHENE	0.500000	U	
TRICHLOROFLUOROMETHANE	0.220000	U	
VINYL CHLORIDE	0.190000	U	

PROJ_NO: 00936

SDG: GL003 MEDIA: WATER DATA FRACTION: PAH

nsample	NTC19FD120808-01
samp_date	12/8/2008
lab_id	0812147-04
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	NTC19-MW01-1208

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	0.0093		
ACENAPHTHENE	0.005700	U	
ACENAPHTHYLENE	0.004700	U	
ANTHRACENE	0.009400	U	
BENZO(A)ANTHRACENE	0.012000	UJ	C
BENZO(A)PYRENE	0.005700	U	
BENZO(B)FLUORANTHENE	0.011000	U	
BENZO(G,H,I)PERYLENE	0.006600	U	
BENZO(K)FLUORANTHENE	0.008500	U	
CHRYSENE	0.010000	U	
DIBENZO(A,H)ANTHRACENE	0.004700	U	
FLUORANTHENE	0.012000	U	
FLUORENE	0.006600	U	
INDENO(1,2,3-CD)PYRENE	0.003800	U	
NAPHTHALENE	0.021	U	A
PHENANTHRENE	0.0097		
PYRENE	0.012000	U	

nsample	NTC19-MW01-1208
samp_date	12/8/2008
lab_id	0812147-01
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	0.0098	J	P
ACENAPHTHENE	0.005800	U	
ACENAPHTHYLENE	0.004800	U	
ANTHRACENE	0.009600	U	
BENZO(A)ANTHRACENE	0.012000	UJ	C
BENZO(A)PYRENE	0.005800	U	
BENZO(B)FLUORANTHENE	0.012000	U	
BENZO(G,H,I)PERYLENE	0.006700	U	
BENZO(K)FLUORANTHENE	0.008600	U	
CHRYSENE	0.010000	U	
DIBENZO(A,H)ANTHRACENE	0.004800	U	
FLUORANTHENE	0.012000	U	
FLUORENE	0.006700	U	
INDENO(1,2,3-CD)PYRENE	0.003800	U	
NAPHTHALENE	0.026	U	A
PHENANTHRENE	0.0091		
PYRENE	0.012000	U	

nsample	NTC19-MW02-1208
samp_date	12/8/2008
lab_id	0812147-02
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
2-METHYLNAPHTHALENE	0.017		
ACENAPHTHENE	0.02		
ACENAPHTHYLENE	0.016		
ANTHRACENE	0.026		
BENZO(A)ANTHRACENE	0.036	J	C
BENZO(A)PYRENE	0.018		
BENZO(B)FLUORANTHENE	0.019		
BENZO(G,H,I)PERYLENE	0.013		
BENZO(K)FLUORANTHENE	0.016		
CHRYSENE	0.035		
DIBENZO(A,H)ANTHRACENE	0.013		
FLUORANTHENE	0.03		
FLUORENE	0.028		
INDENO(1,2,3-CD)PYRENE	0.011		
NAPHTHALENE	0.013000	U	
PHENANTHRENE	0.038		
PYRENE	0.03		

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**B. DAVIS**	**DATE:**	**FEBRUARY 4, 2009**
FROM:	**MATTHEW D. KRAUS**	**COPIES:**	**DV FILE**

SUBJECT: **INORGANIC DATA VALIDATION – TAL METALS/MISCELLANEOUS**
NTC GREAT LAKES – CTO 468
SDG – GL001

SAMPLES: 17/Soil/

NTC19SB01-SO-0608	NTC19SB02-SO-0204	NTC19SB03-SO-0103
NTC19SB03-SO-0810	NTC19SB04-SO-0204	NTC19SB05-SO-0406
NTC19SB05-SO-0608	NTC19SB06-SO-0204	NTC19SB06-SO-0608
NTC19SB07-SO-0507	NTC19SB08-SO-0103	NTC19SB08-SO-0406
NTC19SB09-SO-0002	NTC19SB09-SO-0406	NTC19SB10-SO-0002
NTC19SB10-SO-0507	NTC19SB11-SO-0002	

Overview

The sample set for NTC Great Lakes, CTO 468, SDG GL001, consists of seventeen soil environmental samples. A full validation was performed on 9 of the samples in order to meet the fifty percent full data validation criteria. The remaining samples were given a cursory validation review. Samples that were fully validated are listed below:

NTC19SB01-SO-0608	NTC19SB02-SO-0204	NTC19SB03-SO-0103
NTC19SB03-SO-0810	NTC19SB04-SO-0204	NTC19SB05-SO-0406
NTC19SB05-SO-0608	NTC19SB06-SO-0204	NTC19SB06-SO-0608

All samples were analyzed for target analyte list (TAL) metals. Sample NTC19SB05-SO-0608 was also analyzed for grain size. Samples were collected by Tetra Tech NUS on December 2, 2008. Empirical Laboratories analyzed all sample for metals and subcontracted Beaver Engineering to perform the grain size analysis of sample NTC19SB05-SO-0608. Analyses were conducted under Naval Facilities Engineering Service Center (NFESC) Quality Assurance / Quality Control (QA/QC) criteria.

Metals and mercury analyses were conducted using SW-846 Methods 6010B and 7471A, respectively. The grain size analysis was performed in accordance with the ASTM D 422 analytical method. Metals and mercury analyses were conducted using Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES) and Cold Vapor Atomic Absorption (CVAA) instrumentation and methodologies, respectively.

Cursory data evaluations were based on the following parameters:

* • Data Completeness
* • Holding Times
* • Calibration Recoveries
• Laboratory Method/Preparation Blank Analyses
* • Detection Limits

Full data evaluations were based on the following parameters in addition to the parameters listed above:

- ICP Interference Check Sample Results
- Matrix Spike/Matrix Spike Duplicate Recoveries
- Laboratory Duplicate Precision
- * Laboratory Control Sample Recoveries
- Serial Dilution Results
- * Analyte Quantitation

* - All quality control criteria were met for this parameter.

Laboratory Blank Analyses

The following contaminants were detected in the laboratory method/preparation blanks at the following maximum concentrations:

Analyte	Maximum Concentration	Action Level
Thallium	3.10 µg/L	3.10 mg/kg

An action level of 5X the maximum concentration was used to evaluate the sample data for blank contamination. Sample aliquot, percent solids, and dilution factors, if applicable, were taken into consideration when evaluating for blank contamination. Thallium was qualified due to laboratory blank contamination.

ICP Interference Check Sample Results

The interfering analyte iron was present in samples NTC19SB04-SO-0204, NTC19SB06-SO-0204, NTC19SB06-SO-0608, NTC19SB01-SO-0608, and NTC19SB03-SO-0103 at concentrations greater than 50% of those found in the Interference Check Sample (ICS) solution. Several analytes, namely, cadmium, lead, selenium, thallium, and zinc were present in the ICS solution at a concentration greater than absolute value of the Method Detection Limit (MDL). Interference effects exist for cadmium, selenium, and thallium in the aforementioned samples. The positive results reported for cadmium in the affected samples were qualified as estimated, "J". The non-detected results reported for selenium and thallium were qualified as estimated, "UJ".

The interfering analyte iron was present in sample NTC19SB05-SO-0406 at concentrations greater than 50% of those found in the ICS solution. Several analytes, namely, cadmium, lead, selenium, thallium, and zinc were present in the ICS solution at a concentration greater than absolute value of the MDL. Interference effects exist for selenium and thallium in the aforementioned samples. The non-detected results reported for selenium and thallium were qualified as estimated, "UJ".

The interfering analyte iron was present in sample NTC19SB02-SO-0204 at concentrations greater than 50% of those found in the ICS solution. Several analytes, namely, cadmium, lead, selenium, thallium, and zinc were present in the ICS solution at a concentration greater than absolute value of the MDL. Interference effects exist for cadmium and selenium in the aforementioned samples. The positive and non-detected results reported for cadmium and selenium were qualified as estimated, "J" and "UJ", respectively.

Matrix Spike/Matrix Spike Duplicate Recoveries

The matrix spike (MS) and matrix spike duplicate (MSD) analyses of sample NTC19SB11-SO-0002 yielded %Rs for antimony less than 30%. The post-digestion matrix spike of that sample

yielded an antimony %R within quality control limits. Non-detected antimony results reported for fully validated samples were qualified as estimated, "UJ".

The MS and MSD analyses of sample NTC19SB11-SO-0002 yielded %Rs for lead and zinc that were greater than the upper quality control limit (125%). The positive lead and zinc results reported for fully validated samples were qualified as estimated, "J".

The MS and MSD analyses of sample NTC19SB11-SO-0002 yielded %Rs for potassium that were less than the lower quality control limit (75%). The positive potassium results reported for fully validated samples were qualified as estimated, "J".

Laboratory Duplicate Precision

Laboratory duplicate imprecision (samples results greater than 5X the Reporting Limit (RL) and Relative Percent Difference (RPD) between sample results greater than 35%) was noted for calcium and magnesium for the laboratory duplicate analyses of sample NTC19SB11-SO-0002. The positive calcium and magnesium results reported for fully validated samples were qualified as estimated, "J".

Serial Dilution Results

The ICP serial dilution of sample NTC19SB11-SO-0002 yielded a percent difference (%D) for calcium greater than the upper quality control limit (10%) and the initial sample result for calcium was greater than 50 times the MDL. The positive calcium results reported for fully validated samples were qualified as estimated, "J".

Notes

The MS and MSD analyses of sample NTC19SB11-SO-0002 yielded noncompliant %Rs for aluminum, calcium, iron, magnesium, and manganese; however, the original sample results for those analytes were greater than 4X the amount of corresponding spikes added therefore no validation action was taken.

Executive Summary

Laboratory Performance: Thallium was qualified due to laboratory blank contamination. Calcium and magnesium were qualified due to laboratory duplicate imprecision.

Other Factors Affecting Data Quality: Cadmium, selenium, and thallium were qualified due to ICP interference. Antimony, lead, potassium, and zinc were qualified due matrix spike noncompliance. Calcium was qualified due to serial dilution noncompliance.

The data for these analyses were reviewed with reference to the "National Functional Guidelines for Inorganic Data Review", October 2004 and the Department of Defense (DoD) document entitled "Quality Systems Manual (QSM) for Environmental Laboratories" (January 2006).

The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the DoD QSM Guidelines."

Tetra Tech NUS
Matthew D. Kraus
Environmental Chemist

Tetra Tech NUS
Joseph A. Samchuck
Quality Assurance Officer

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as reported by the Laboratory
3. Appendix C – Support Documentation

APPENDIX A

QUALIFIED ANALYTICAL RESULTS

Data Validation Qualifier Codes:

A	= Lab Blank Contamination
B	= Field Blank Contamination
C	= Calibration Noncompliance (e.g. %RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01	= GC/MS Tuning Noncompliance
D	= MS/MSD Recovery Noncompliance
E	= LCS/LCSD Recovery Noncompliance
F	= Laboratory Duplicate Imprecision
G	= Field Duplicate Imprecision
H	= Holding Time Exceedance
I	= ICP Serial Dilution Noncompliance
J	= GFAA PDS – GFAA MSA's r <0.995 / ICP PDS Recovery Noncompliance
K	= IPC Interference – included ICS %R Noncompliance
L	= Instrument Calibration Range Exceedance
M	= Sample Preservation Noncompliance
N	= Internal Standard Noncompliance
N01	= Internal Standard Recovery Noncompliance Dioxins
N02	= Recovery Standard Noncompliance Dioxins
N03	= Clean-up Standard Noncompliance Dioxins
O	= Poor Instrument Performance (e.g. base-line drifting)
P	= Uncertainty near detection limit (< 2 x IDL for inorganics and < CRDL for organics)
Q	= Other problems (can encompass a number of issues; e.g. chromatography, interferences, etc.)
R	= Surrogate Recovery Noncompliance
S	= Pesticide/PCB Resolution
T	= % Breakdown Noncompliance for DDT and Endrin
U	= % Difference between columns/detectors > 25% for positive results determined via GC/HPLC
V	= Non-linear calibrations; correlation coefficient r < 0.995
W	= EMPC result
X	= Signal to noise response drop
Y	= Percent solids <30%
Z	= Uncertainty at 2 sigma deviation is greater than sample activity

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB01-SO-0608
samp_date	12/2/2008
lab_id	0812036-01
qc_type	NM
units	MG/KG
Pct_Solids	82.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	14400		
ANTIMONY	1.2	UJ	D
ARSENIC	13.7		
BARIUM	66.5		
BERYLLIUM	0.94		
CADMIUM	0.24	J	K
CALCIUM	3010	J	FI
CHROMIUM	25.5		
COBALT	18.8		
COPPER	31.7		
IRON	33100		
LEAD	16.5	J	D
MAGNESIUM	6610	J	F
MANGANESE	1040		
MERCURY	0.026		
NICKEL	40.8		
POTASSIUM	2860	J	D
SELENIUM	0.96	UJ	K
SILVER	0.24	U	
SODIUM	241	U	
THALLIUM	0.72	UJ	K
VANADIUM	28.2		
ZINC	78.6	J	D

nsample	NTC19SB02-SO-0204
samp_date	12/2/2008
lab_id	0812036-02
qc_type	NM
units	MG/KG
Pct_Solids	80.8
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	14700		
ANTIMONY	1.2	UJ	D
ARSENIC	9.3		
BARIUM	81.9		
BERYLLIUM	0.94		
CADMIUM	0.37	J	K
CALCIUM	2850	J	FI
CHROMIUM	25.8		
COBALT	22.1		
COPPER	34.2		
IRON	31300		
LEAD	17.7	J	D
MAGNESIUM	6440	J	F
MANGANESE	1600		
MERCURY	0.032		
NICKEL	48.8		
POTASSIUM	2950	J	D
SELENIUM	1.2	UJ	K
SILVER	0.25	U	
SODIUM	249	U	
THALLIUM	0.78	U	A
VANADIUM	27.9		
ZINC	77.7	J	D

nsample	NTC19SB03-SO-0103
samp_date	12/2/2008
lab_id	0812036-03
qc_type	NM
units	MG/KG
Pct_Solids	84.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	15400		
ANTIMONY	1.2	UJ	D
ARSENIC	14.2		
BARIUM	91.4		
BERYLLIUM	1.0		
CADMIUM	0.52	J	K
CALCIUM	5210	J	FI
CHROMIUM	23.7		
COBALT	12.7		
COPPER	23.3		
IRON	34700		
LEAD	33.4	J	D
MAGNESIUM	5270	J	F
MANGANESE	896		
MERCURY	0.058		
NICKEL	29.8		
POTASSIUM	1970	J	D
SELENIUM	0.71	UJ	K
SILVER	0.23	U	
SODIUM	235	U	
THALLIUM	0.71	UJ	K
VANADIUM	36.9		
ZINC	125	J	D

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB03-SO-0810
samp_date	12/2/2008
lab_id	0812036-04
qc_type	NM
units	MG/KG
Pct_Solids	87.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	9810		
ANTIMONY	1.1	UJ	D
ARSENIC	11.8		
BARIUM	45		
BERYLLIUM	0.66		
CADMIUM	0.22	U	
CALCIUM	85000	J	FI
CHROMIUM	17.3		
COBALT	9.8		
COPPER	21		
IRON	19500		
LEAD	10.4	J	D
MAGNESIUM	40700	J	F
MANGANESE	589		
MERCURY	0.017		
NICKEL	25.6		
POTASSIUM	2760	J	D
SELENIUM	0.67	U	
SILVER	0.22	U	
SODIUM	223	U	
THALLIUM	0.67	U	
VANADIUM	19.8		
ZINC	45.3	J	D

nsample	NTC19SB04-SO-0204
samp_date	12/2/2008
lab_id	0812036-05
qc_type	NM
units	MG/KG
Pct_Solids	83.4
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	7110		
ANTIMONY	1.2	UJ	D
ARSENIC	20.7		
BARIUM	65.1		
BERYLLIUM	0.59		
CADMIUM	0.33	J	K
CALCIUM	12000	J	FI
CHROMIUM	15.2		
COBALT	9		
COPPER	22.6		
IRON	34900		
LEAD	37	J	D
MAGNESIUM	8020	J	F
MANGANESE	1150		
MERCURY	0.049		
NICKEL	25.7		
POTASSIUM	1370	J	D
SELENIUM	0.73	UJ	K
SILVER	0.24	U	
SODIUM	243	U	
THALLIUM	0.73	UJ	K
VANADIUM	26.5		
ZINC	108	J	D

nsample	NTC19SB05-SO-0406
samp_date	12/2/2008
lab_id	0812036-06
qc_type	NM
units	MG/KG
Pct_Solids	90.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	4580		
ANTIMONY	1.1	UJ	D
ARSENIC	25.1		
BARIUM	67.4		
BERYLLIUM	0.39		
CADMIUM	0.22	U	
CALCIUM	63600	J	FI
CHROMIUM	9.0		
COBALT	6.7		
COPPER	22.3		
IRON	24300		
LEAD	12.8	J	D
MAGNESIUM	33400	J	F
MANGANESE	802		
MERCURY	0.016		
NICKEL	17.5		
POTASSIUM	1240	J	D
SELENIUM	1.1	UJ	K
SILVER	0.22	U	
SODIUM	218	U	
THALLIUM	0.65	UJ	K
VANADIUM	14		
ZINC	57.9	J	D

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB05-SO-0608
samp_date	12/2/2008
lab_id	0812036-07
qc_type	NM
units	MG/KG
Pct_Solids	88.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	4740		
ANTIMONY	1.1	UJ	D
ARSENIC	4.0		
BARIUM	10.9		
BERYLLIUM	0.36		
CADMIUM	0.22	U	
CALCIUM	62000	J	FI
CHROMIUM	9.9		
COBALT	5.2		
COPPER	18.7		
IRON	12200		
LEAD	8.5	J	D
MAGNESIUM	31500	J	F
MANGANESE	435		
MERCURY	0.013	U	
NICKEL	14.9		
POTASSIUM	1310	J	D
SELENIUM	0.67	U	
SILVER	0.22	U	
SODIUM	222	U	
THALLIUM	1.1	U	
VANADIUM	12.7		
ZINC	39.3	J	D

nsample	NTC19SB06-SO-0204
samp_date	12/2/2008
lab_id	0812036-08
qc_type	NM
units	MG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	8970		
ANTIMONY	1.2	UJ	D
ARSENIC	13.4		
BARIUM	55		
BERYLLIUM	0.66		
CADMIUM	0.43	J	K
CALCIUM	19200	J	FI
CHROMIUM	19.1		
COBALT	8.9		
COPPER	22		
IRON	28900		
LEAD	54.8	J	D
MAGNESIUM	12500	J	F
MANGANESE	941		
MERCURY	0.041		
NICKEL	25		
POTASSIUM	1510	J	D
SELENIUM	0.92	UJ	K
SILVER	0.23	U	
SODIUM	233	U	
THALLIUM	0.70	UJ	K
VANADIUM	29.8		
ZINC	140	J	D

nsample	NTC19SB06-SO-0608
samp_date	12/2/2008
lab_id	0812036-09
qc_type	NM
units	MG/KG
Pct_Solids	89.2
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	5670		
ANTIMONY	1.1	UJ	D
ARSENIC	9.7		
BARIUM	13.4		
BERYLLIUM	0.43		
CADMIUM	0.28	J	K
CALCIUM	65600	J	FI
CHROMIUM	11.5		
COBALT	6.5		
COPPER	24.1		
IRON	24000		
LEAD	13.6	J	D
MAGNESIUM	34400	J	F
MANGANESE	534		
MERCURY	0.014	U	
NICKEL	20.2		
POTASSIUM	1550	J	D
SELENIUM	0.88	UJ	K
SILVER	0.22	U	
SODIUM	216	U	
THALLIUM	0.65	UJ	K
VANADIUM	16		
ZINC	80.3	J	D

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB07-SO-0507
samp_date	12/2/2008
lab_id	0812036-10
qc_type	NM
units	MG/KG
Pct_Solids	89.9
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	5500		
ANTIMONY	1.1	U	
ARSENIC	7.3		
BARIUM	20.3		
BERYLLIUM	0.41		
CADMIUM	0.38		
CALCIUM	73500		
CHROMIUM	12.9		
COBALT	6.6		
COPPER	24.9		
IRON	20800		
LEAD	15		
MAGNESIUM	40500		
MANGANESE	660		
MERCURY	0.013	U	
NICKEL	19		
POTASSIUM	1250		
SELENIUM	0.67	U	
SILVER	0.22	U	
SODIUM	224	U	
THALLIUM	0.67	U	
VANADIUM	17.3		
ZINC	87.8		

nsample	NTC19SB08-SO-0103
samp_date	12/2/2008
lab_id	0812036-11
qc_type	NM
units	MG/KG
Pct_Solids	88.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	6750		
ANTIMONY	1.1	U	
ARSENIC	13.1		
BARIUM	37.7		
BERYLLIUM	0.5		
CADMIUM	0.43		
CALCIUM	45300		
CHROMIUM	15		
COBALT	8.4		
COPPER	30.9		
IRON	26000		
LEAD	20.2		
MAGNESIUM	27300		
MANGANESE	946		
MERCURY	0.019		
NICKEL	24.5		
POTASSIUM	1520		
SELENIUM	0.67	U	
SILVER	0.22	U	
SODIUM	223	U	
THALLIUM	0.67	U	
VANADIUM	25.5		
ZINC	89.8		

nsample	NTC19SB08-SO-0406
samp_date	12/2/2008
lab_id	0812036-12
qc_type	NM
units	MG/KG
Pct_Solids	88.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	4910		
ANTIMONY	1.1	U	
ARSENIC	4.4		
BARIUM	28.5		
BERYLLIUM	0.36		
CADMIUM	0.22	U	
CALCIUM	78500		
CHROMIUM	9.2		
COBALT	6.9		
COPPER	15.4		
IRON	15500		
LEAD	8.1		
MAGNESIUM	42100		
MANGANESE	724		
MERCURY	0.015	U	
NICKEL	18.3		
POTASSIUM	1250		
SELENIUM	0.67	U	
SILVER	0.22	U	
SODIUM	241		
THALLIUM	0.88	U	
VANADIUM	13.9		
ZINC	41.4		

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB09-SO-0002
samp_date	12/2/2008
lab_id	0812036-13
qc_type	NM
units	MG/KG
Pct_Solids	86.5
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	8120		
ANTIMONY	1.2	U	
ARSENIC	16.4		
BARIUM	65		
BERYLLIUM	0.62		
CADMIUM	0.44		
CALCIUM	15100		
CHROMIUM	18.4		
COBALT	11.1		
COPPER	29.2		
IRON	32700		
LEAD	48.3		
MAGNESIUM	10000		
MANGANESE	1350		
MERCURY	0.026		
NICKEL	28.3		
POTASSIUM	1420		
SELENIUM	0.92	U	
SILVER	0.23	U	
SODIUM	233	U	
THALLIUM	0.70	U	
VANADIUM	26.2		
ZINC	113		

nsample	NTC19SB09-SO-0406
samp_date	12/2/2008
lab_id	0812036-14
qc_type	NM
units	MG/KG
Pct_Solids	89.3
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	4500		
ANTIMONY	1.1	U	
ARSENIC	9.5		
BARIUM	21.6		
BERYLLIUM	0.37		
CADMIUM	0.22	U	
CALCIUM	65100		
CHROMIUM	9.6		
COBALT	5.4		
COPPER	17.7		
IRON	17400		
LEAD	10.1		
MAGNESIUM	34700		
MANGANESE	520		
MERCURY	0.014	U	
NICKEL	16.5		
POTASSIUM	1210		
SELENIUM	0.88	U	
SILVER	0.22	U	
SODIUM	220	U	
THALLIUM	0.88	U	
VANADIUM	13.7		
ZINC	37.5		

nsample	NTC19SB10-SO-0002
samp_date	12/2/2008
lab_id	0812036-15
qc_type	NM
units	MG/KG
Pct_Solids	84.7
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	7420		
ANTIMONY	1.2	U	
ARSENIC	32.2		
BARIUM	90		
BERYLLIUM	0.57		
CADMIUM	0.51		
CALCIUM	7710		
CHROMIUM	14		
COBALT	13.3		
COPPER	29.4		
IRON	36800		
LEAD	64.2		
MAGNESIUM	5450		
MANGANESE	1730		
MERCURY	0.048		
NICKEL	33.6		
POTASSIUM	1030		
SELENIUM	0.69	U	
SILVER	0.23	U	
SODIUM	231	U	
THALLIUM	0.69	U	
VANADIUM	26.1		
ZINC	115		

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB10-SO-0507
samp_date	12/2/2008
lab_id	0812036-16
qc_type	NM
units	MG/KG
Pct_Solids	85.6
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	10200		
ANTIMONY	1.1	U	
ARSENIC	6.2		
BARIUM	38.4		
BERYLLIUM	0.66		
CADMIUM	0.26		
CALCIUM	81900		
CHROMIUM	18.1		
COBALT	9.2		
COPPER	21.5		
IRON	20000		
LEAD	11.6		
MAGNESIUM	41200		
MANGANESE	524		
MERCURY	0.014	U	
NICKEL	25.8		
POTASSIUM	2660		
SELENIUM	0.67	U	
SILVER	0.22	U	
SODIUM	224	U	
THALLIUM	0.67	U	
VANADIUM	20.7		
ZINC	48.6		

nsample	NTC19SB11-SO-0002
samp_date	12/2/2008
lab_id	0812036-17
qc_type	NM
units	MG/KG
Pct_Solids	79.1
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	17500		
ANTIMONY	1.2	U	
ARSENIC	8.1		
BARIUM	138		
BERYLLIUM	2		
CADMIUM	0.71		
CALCIUM	14100		
CHROMIUM	23.4		
COBALT	11.8		
COPPER	32.1		
IRON	27700		
LEAD	49.2		
MAGNESIUM	5510		
MANGANESE	673		
MERCURY	0.045		
NICKEL	26.9		
POTASSIUM	2720		
SELENIUM	0.74	U	
SILVER	0.25	U	
SODIUM	565		
THALLIUM	1.2	U	
VANADIUM	34.4		
ZINC	209		

PROJ_NO: 00936

SDG: GL001 MEDIA: SOIL DATA FRACTION: MISC

nsample	NTC19SB05-SO-0608
samp_date	12/2/2008
lab_id	0812036-07
qc_type	NM
Pct_Solids	
DUP_OF:	

Parameter	units	Result	Val Qual	Qual Code
SIEVE NO. 040	%	71		
SIEVE NO. 100	%	50		
SIEVE NO. 200	%	40		

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**R. DAVIS**	**DATE:**	**FEBRUARY 11, 2009**
FROM:	**TERRI L. SOLOMON**	**COPIES:**	**DV FILE**

SUBJECT: **INORGANIC DATA VALIDATION – METALS, GRAIN SIZE**
NTC GREAT LAKES CTO 468
SAMPLE DELIVERY GROUP (SDG) – GL002

SAMPLES: 20/Soil/

NTC19-FD120308-01	NTC19-FD120308-02	NTC19-FD120308-03
NTC19SB12-SO-0002	NTC19SB12-SO-0507	NTC19SB13-SO-0103
NTC19SB14-SO-0204	NTC19SB14-SO-0507	NTC19SB15-SO-0103
NTC19SB15-SO-0406	NTC19SB16-SO-0103	NTC19SB16-SO-0507
NTC19SB17-SO-0002	NTC19SB17-SO-0406	NTC19SB18-SO-0204
NTC19SB18-SO-0406	NTC19SB19-SO-0002	NTC19SB19-SO-0406
NTC19SB20-SO-0002	NTC19SB20-SO-0406	

2/Aqueous/

NTC19-RB120308-01 NTC19-SB120308-01

Overview

The sample set for NTC Great Lakes CTO 468, SDG GL002, consists of twenty (20) soil environmental samples, one (1) aqueous environmental sample and one (1) rinsate blank (NTC19-RB120308-01). Three (3) field duplicate pairs (NTC19SB15-SO-0406 / NTC19-FD120308-01, NTC19SB16-SO-0103 / NTC19-FD120308-02 and NTC19SB17-SO-0002 / NTC19-FD120308-03) were included within this SDG.

All samples were analyzed for target analyte list (TAL) metals. Samples NTC19SB12-SO-0507 and NTC19SB18-SO-0406 were also analyzed for grain size. The samples were collected by Tetra Tech NUS on December 3, 2008 and analyzed by Empirical Laboratories, Inc. Metals analyses were conducted using SW-846 method 6010B. Mercury analyses were conducted using SW-846 methods 7470A / 7471A. Grain size analyses were conducted using ASTM D 422.

Samples NTC19-FD120308-01, NTC19-FD120308-02, NTC19-FD120308-03, NTC19SB12-SO-0002, NTC19SB12-SO-0507, NTC19SB13-SO-0103, NTC19SB14-SO-0204, NTC19SB14-SO-0507, NTC19SB15-SO-0103, NTC19SB15-SO-0406, NTC19-RB120308-01 and NTC19-SB120308-01 received full validation. Samples NTC19SB16-SO-0103, NTC19SB16-SO-0507, NTC19SB17-SO-0002, NTC19SB17-SO-0406, NTC19SB18-SO-0204, NTC19SB18-SO-0406, NTC19SB19-SO-0002, NTC19SB19-SO-0406, NTC19SB20-SO-0002 and NTC19SB20-SO-0406 received cursory validation (holding times and blank contamination).

These data were evaluated based on the following parameters:

* • Data Completeness
  • Holding Times
  • Initial and Continuing Calibrations
  • Laboratory Method / Preparation Blanks
  • ICP Interference Analysis
* • Laboratory Control Sample Results
  • Matrix Spike / Matrix Spike Duplicate Results
* • Laboratory Duplicate Results
  • Field Duplicate Results
  • ICP Serial Dilution Results
* • Detection Limits
* • Analyte Quantitation

  * - All quality control criteria were met for this parameter.

Qualified (if applicable) analytical results are summarized in Appendix A. Results as reported by the laboratory are presented in Appendix B. Appendix C contains the documentation to support the findings as discussed in this validation report.

Holding Times

The 28 day holding time for mercury was exceeded by 7 days for samples NTC19-RB120308-01 and NTC19-SB120308-01. The nondetected results reported for mercury in the affected samples were qualified as estimated, "UJ".

Initial and Continuing Calibrations

The continuing calibration percent recovery for calcium was < 90% quality control limit affecting samples NTC19-RB120308-01 and NTC19-SB120308-01. The nondetected results reported for calcium in the affected samples were qualified as estimated, "UJ".

ICP Interference Analysis

The interfering analyte calcium was present in samples NTC19-FD120308-01, NTC19SB15-SO-0103 and NTC19SB12-SO-0507 at a concentration that was greater than 50% of the calcium concentration in the Interference Check Sample (ICS) solution. Several analytes, namely, cadmium, lead, selenium, thallium and zinc were present in the ICS solution at a concentration that exceeded the absolute value of the Method Detection Limit (MDL). Interference effects exist for selenium and thallium in the affected samples. The nondetected results reported for selenium and thallium were qualified as estimated, "UJ".

The interfering analyte calcium was present in samples NTC19-FD120308-02, NTC19SB15-SO-0406, NTC19SB13-SO-0103, NTC19SB14-SO-0204 and NTC19SB14-SO-0507 at a concentration that was greater than 50% of the calcium concentration in the Interference Check Sample (ICS) solution. Several analytes, namely, cadmium, lead, selenium, thallium and zinc were present in the ICS solution at a concentration that exceeded the absolute value of the Method Detection Limit (MDL). Interference effects exist for cadmium, selenium and thallium in the affected samples. The nondetected results reported for selenium and thallium were qualified as estimated, "UJ". The positive results reported for cadmium were qualified as estimated, "J".

The interfering analytes calcium and iron were present in sample NTC19-FD120308-03 at concentrations that were greater than 50% of the calcium and iron concentrations in the Interference Check Sample (ICS) solution. Several analytes, namely, cadmium, lead, selenium,

thallium and zinc were present in the ICS solution at a concentration that exceeded the absolute value of the Method Detection Limit (MDL). Interference effects exist for cadmium, selenium and thallium in the affected sample. The nondetected results reported for selenium and thallium were qualified as estimated, "UJ". The positive result reported for cadmium was qualified as estimated, "J".

Matrix Spike Results

The matrix spike / matrix spike duplicate percent recoveries for antimony were < 30% quality control limit affecting all soil samples. The nondetected results reported for antimony were qualified as rejected, "UR".

The matrix spike percent recovery for lead was > 125% quality control limit affecting all soil samples. The positive results reported for lead were qualified as estimated, "J".

ICP Serial Dilution Results

The ICP serial dilution percent differences for calcium were > 10% quality control limit affecting all soil samples. The positive results reported for calcium were qualified as estimated, "J".

Field Duplicate Results

Field duplicate imprecision (RPD > 50%) was noted for sample pair NTC19SB16-SO-0103 / NTC19-FD120308-02 for barium, lead and manganese. The positive results reported for barium, lead and manganese for samples NTC19SB16-SO-0103 and NTC19-FD120308-02 were qualified as estimated, "J".

Field duplicate imprecision (RPD > 50%) was noted for sample pair NTC19SB17-SO-0002 / NTC19-FD120308-03 for chromium, lead, manganese, nickel and zinc. The positive results reported for chromium, lead, manganese, nickel and zinc for samples NTC19SB17-SO-0002 and NTC19-FD120308-03 were qualified as estimated, "J".

Notes

Several Contract Required Detection Limit (CRDL) percent recoveries for arsenic, beryllium, selenium and thallium were > 110% quality control limits. However, no validation actions are required for CRDL noncompliances.

The following contaminants were detected in the laboratory method/preparation blanks at the following maximum concentrations:

Analyte	Maximum Concentration	Action Level
Lead	1.6 ug/L	1.6 mg/kg
Thallium	3.1 ug/L	3.1 mg/kg

An action level of 5X the maximum contaminant level has been used to evaluate sample data for blank contamination. Sample aliquot, percent solids and dilution factors, if applicable, were taken into consideration when evaluating for blank contamination. No validation actions were warranted as all sample results were either nondetects or were greater than the action level.

Executive Summary

Laboratory Performance: The 28 day holding time for mercury was exceeded by 7 days for samples NTC19-RB120308-01 and NTC19-SB120308-01. The continuing calibration percent recovery for calcium was < 90% quality control limit affecting samples NTC19-RB120308-01 and NTC19-SB120308-01.

Other Factors Affecting Data Quality: The ICP interfering analytes calcium and/or iron were present in several samples. The soil sample matrix spike / matrix spike duplicate percent recoveries for antimony were < 30% quality control limit. The soil sample matrix spike percent recovery for lead was > 125% quality control limit. The ICP serial dilution percent differences for calcium were > 10% quality control limit. Field duplicate imprecision (RPD > 50%) was noted for sample pair NTC19SB16-SO-0103 / NTC19-FD120308-02 for barium, lead and manganese. Field duplicate imprecision (RPD > 50%) was noted for sample pair NTC19SB17-SO-0002 / NTC19-FD120308-03 for chromium, lead, manganese, nickel and zinc.

The data for these analyses were reviewed with reference to the "National Functional Guidelines for Inorganic Review", October 2004, and the DOD document entitled "Quality System Manual (QSM) for Environmental Laboratories" (Jan 2006).

The text of this report has been formulated to address only those problem areas affecting data quality.

Terri L. Solomon

Tetra Tech NUS
Terri L. Solomon
Environmental Scientist

Edward Fedlyn / for

Tetra Tech NUS
Joseph A. Samchuck
Quality Assurance Officer

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as reported by the Laboratory
3. Appendix C - Support Documentation

APPENDIX A
QUALIFIED ANALYTICAL RESULTS

Data Validation Qualifier Codes:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration Noncompliance (e.g. % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01 = GC/MS Tuning Noncompliance
D = MS/MSD Recovery Noncompliance
E = LCS/LCSD Recovery Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = GFAA PDS-GFAA MSA's r < 0.995 / ICP PDS Recovery Noncompliance
K = ICP Interference - includes ICS % R Noncompliance
L = Instrument Calibration Range Exceedance
M = Sample Preservation Noncompliance
N = Internal Standard Noncompliance
N01 = Internal Standard Recovery Noncompliance Dioxins
N02 = Recovery Standard Noncompliance Dioxins
N03 = Clean-up Standard Noncompliance Dioxins
O - Poor Instrument Performance (e.g. base-line drifting)
P = Uncertainty near detection limit (< 2 x IDL for inorganics and <CRQL for organics)
Q = Other problems (can encompass a number of issues; e.g. chromatography,interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DOT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient r < 0.995
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is greater than sample activity

PROJ_NO: 00936

SDG: GL002 MEDIA: WATER DATA FRACTION: M

nsample	NTC19-RB120308-01
samp_date	12/3/2008
lab_id	0812060-04
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	50.000000	U	
ANTIMONY	5.000000	U	
ARSENIC	3.000000	U	
BARIUM	5.000000	U	
BERYLLIUM	1.000000	U	
CADMIUM	1.000000	U	
CALCIUM	00.000000	UJ	C
CHROMIUM	2.000000	U	
COBALT	5.000000	U	
COPPER	5.000000	U	
IRON	30.000000	U	
LEAD	1.500000	U	
MAGNESIUM	00.000000	U	
MANGANESE	3.000000	U	
MERCURY	0.080000	UJ	H
NICKEL	5.000000	U	
POTASSIUM	00.000000	U	
SELENIUM	3.000000	U	
SILVER	1.000000	U	
SODIUM	00.000000	U	
THALLIUM	3.000000	U	
VANADIUM	5.000000	U	
ZINC	5.7		

nsample	NTC19-SB120308-01
samp_date	12/3/2008
lab_id	0812060-05
qc_type	NM
units	UG/L
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	50.000000	U	
ANTIMONY	5.000000	U	
ARSENIC	3.000000	U	
BARIUM	5.000000	U	
BERYLLIUM	1.000000	U	
CADMIUM	1.000000	U	
CALCIUM	00.000000	UJ	C
CHROMIUM	2.000000	U	
COBALT	5.000000	U	
COPPER	5.000000	U	
IRON	30.000000	U	
LEAD	1.500000	U	
MAGNESIUM	00.000000	U	
MANGANESE	3.000000	U	
MERCURY	0.080000	UJ	H
NICKEL	5.000000	U	
POTASSIUM	00.000000	U	
SELENIUM	3.000000	U	
SILVER	1.000000	U	
SODIUM	00.000000	U	
THALLIUM	3.000000	U	
VANADIUM	5.000000	U	
ZINC	5.000000	U	

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19-FD120308-01
samp_date	12/3/2008
lab_id	0812060-01
qc_type	NM
units	MG/KG
Pct_Solids	87.0
DUP_OF:	NTC19SB15-SO-0406

Parameter	Result	Val Qual	Qual Code
ALUMINUM	10400		
ANTIMONY	1.100000	UR	D
ARSENIC	4.9		
BARIUM	40.8		
BERYLLIUM	0.67		
CADMIUM	0.230000	U	
CALCIUM	77900	J	I
CHROMIUM	18.2		
COBALT	9.3		
COPPER	20.7		
IRON	19700		
LEAD	9.9	J	D
MAGNESIUM	39300		
MANGANESE	534		
MERCURY	0.015000	U	
NICKEL	25.6		
POTASSIUM	2920		
SELENIUM	0.920000	UJ	K
SILVER	0.230000	U	
SODIUM	25.000000	U	
THALLIUM	0.680000	UJ	K
VANADIUM	20.7		
ZINC	43.3		

nsample	NTC19-FD120308-02
samp_date	12/3/2008
lab_id	0812060-02
qc_type	NM
units	MG/KG
Pct_Solids	87.0
DUP_OF:	NTC19SB16-SO-0103

Parameter	Result	Val Qual	Qual Code
ALUMINUM	8170		
ANTIMONY	1.100000	UR	D
ARSENIC	8.1		
BARIUM	44.1	J	G
BERYLLIUM	0.53		
CADMIUM	0.34	J	K
CALCIUM	66200	J	I
CHROMIUM	14.5		
COBALT	7.1		
COPPER	22.6		
IRON	19400		
LEAD	34.2	J	DG
MAGNESIUM	36100		
MANGANESE	768	J	G
MERCURY	0.022		
NICKEL	19.6		
POTASSIUM	1740		
SELENIUM	0.920000	UJ	K
SILVER	0.230000	U	
SODIUM	30.000000	U	
THALLIUM	0.690000	UJ	K
VANADIUM	20.5		
ZINC	66.2		

nsample	NTC19-FD120308-03
samp_date	12/3/2008
lab_id	0812060-03
qc_type	NM
units	MG/KG
Pct_Solids	88.0
DUP_OF:	NTC19SB17-SO-0002

Parameter	Result	Val Qual	Qual Code
ALUMINUM	7140		
ANTIMONY	1.100000	UR	D
ARSENIC	13.9		
BARIUM	61.8		
BERYLLIUM	0.87		
CADMIUM	0.44	J	K
CALCIUM	94900	J	I
CHROMIUM	32.6	J	G
COBALT	8.7		
COPPER	40.5		
IRON	26800		
LEAD	86.4	J	DG
MAGNESIUM	38200		
MANGANESE	1290	J	G
MERCURY	0.031		
NICKEL	47.9	J	G
POTASSIUM	1200		
SELENIUM	1.100000	UJ	K
SILVER	0.220000	U	
SODIUM	278		
THALLIUM	1.100000	UJ	K
VANADIUM	16.4		
ZINC	204	J	G

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB12-SO-0002
samp_date	12/3/2008
lab_id	0812060-07
qc_type	NM
units	MG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	11900		
ANTIMONY	1.2	UR	D
ARSENIC	6.4		
BARIUM	50.5		
BERYLLIUM	0.71		
CADMIUM	0.240000	U	
CALCIUM	58000	J	I
CHROMIUM	20.8		
COBALT	8.9		
COPPER	21.5		
IRON	20800		
LEAD	147	J	D
MAGNESIUM	32900		
MANGANESE	561		
MERCURY	0.029		
NICKEL	26.5		
POTASSIUM	2270		
SELENIUM	0.710000	U	
SILVER	0.240000	U	
SODIUM	239		
THALLIUM	0.710000	U	
VANADIUM	21.6		
ZINC	76.7		

nsample	NTC19SB12-SO-0507
samp_date	12/3/2008
lab_id	0812060-08
qc_type	NM
units	MG/KG
Pct_Solids	83.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	11000		
ANTIMONY	1.2	UR	D
ARSENIC	4.8		
BARIUM	45.5		
BERYLLIUM	0.67		
CADMIUM	0.240000	U	
CALCIUM	119000	J	I
CHROMIUM	20		
COBALT	9.3		
COPPER	17.1		
IRON	18300		
LEAD	10.3	J	D
MAGNESIUM	32800		
MANGANESE	421		
MERCURY	0.02		
NICKEL	23.3		
POTASSIUM	2560		
SELENIUM	0.720000	UJ	K
SILVER	0.240000	U	
SODIUM	39.000000	U	
THALLIUM	0.720000	UJ	K
VANADIUM	20		
ZINC	38.6		

nsample	NTC19SB13-SO-0103
samp_date	12/3/2008
lab_id	0812060-09
qc_type	NM
units	MG/KG
Pct_Solids	82.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	14700		
ANTIMONY	1.2	UR	D
ARSENIC	13.7		
BARIUM	53.5		
BERYLLIUM	0.86		
CADMIUM	0.38	J	K
CALCIUM	48000	J	I
CHROMIUM	23.8		
COBALT	10.9		
COPPER	30.2		
IRON	33000		
LEAD	21.9	J	D
MAGNESIUM	31100		
MANGANESE	725		
MERCURY	0.018		
NICKEL	34.1		
POTASSIUM	2350		
SELENIUM	1.200000	UJ	K
SILVER	0.240000	U	
SODIUM	41.000000	U	
THALLIUM	0.720000	UJ	K
VANADIUM	29.4		
ZINC	95		

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB14-SO-0204
samp_date	12/3/2008
lab_id	0812060-10
qc_type	NM
units	MG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	5820		
ANTIMONY	1.2	UR	D
ARSENIC	19.1		
BARIUM	29.2		
BERYLLIUM	0.43		
CADMIUM	0.39	J	K
CALCIUM	108000	J	I
CHROMIUM	11.1		
COBALT	9.5		
COPPER	25.2		
IRON	22800		
LEAD	19.2	J	D
MAGNESIUM	56300		
MANGANESE	1220		
MERCURY	0.043		
NICKEL	22.7		
POTASSIUM	1510		
SELENIUM	1.200000	UJ	K
SILVER	0.230000	U	
SODIUM	30.000000	U	
THALLIUM	0.690000	UJ	K
VANADIUM	15.3		
ZINC	57.7		

nsample	NTC19SB14-SO-0507
samp_date	12/3/2008
lab_id	0812060-11
qc_type	NM
units	MG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	10000		
ANTIMONY	1.1	UR	D
ARSENIC	7.7		
BARIUM	44.7		
BERYLLIUM	0.66		
CADMIUM	0.29	J	K
CALCIUM	85100	J	I
CHROMIUM	17.6		
COBALT	11.5		
COPPER	20.5		
IRON	20300		
LEAD	10.2	J	D
MAGNESIUM	41300		
MANGANESE	841		
MERCURY	0.018		
NICKEL	33.6		
POTASSIUM	2610		
SELENIUM	0.680000	UJ	K
SILVER	0.230000	U	
SODIUM	28.000000	U	
THALLIUM	0.680000	UJ	K
VANADIUM	19.9		
ZINC	48.3		

nsample	NTC19SB15-SO-0103
samp_date	12/3/2008
lab_id	0812060-12
qc_type	NM
units	MG/KG
Pct_Solids	88.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	8440		
ANTIMONY	1.1	UR	D
ARSENIC	5.2		
BARIUM	31.5		
BERYLLIUM	0.55		
CADMIUM	0.220000	U	
CALCIUM	63900	J	I
CHROMIUM	15		
COBALT	7.3		
COPPER	17.5		
IRON	16300		
LEAD	9.5	J	D
MAGNESIUM	28800		
MANGANESE	336		
MERCURY	0.015000	U	
NICKEL	21.4		
POTASSIUM	2160		
SELENIUM	0.670000	UJ	K
SILVER	0.220000	U	
SODIUM	23.000000	U	
THALLIUM	0.880000	UJ	K
VANADIUM	17.8		
ZINC	40		

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB15-SO-0406
samp_date	12/3/2008
lab_id	0812060-13
qc_type	NM
units	MG/KG
Pct_Solids	87.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	8610		
ANTIMONY	1.1	UR	D
ARSENIC	5.4		
BARIUM	33.6		
BERYLLIUM	0.57		
CADMIUM	0.23	J	K
CALCIUM	80300	J	I
CHROMIUM	15.5		
COBALT	8.6		
COPPER	18.7		
IRON	17400		
LEAD	9.5	J	D
MAGNESIUM	40400		
MANGANESE	566		
MERCURY	0.016000	U	
NICKEL	22.6		
POTASSIUM	2380		
SELENIUM	0.690000	UJ	K
SILVER	0.230000	U	
SODIUM	0.000000	U	
THALLIUM	0.690000	UJ	K
VANADIUM	17.6		
ZINC	48.9		

nsample	NTC19SB16-SO-0103
samp_date	12/3/2008
lab_id	0812060-14
qc_type	NM
units	MG/KG
Pct_Solids	80.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	10500		
ANTIMONY	1.2	U	
ARSENIC	9.9		
BARIUM	93.4		
BERYLLIUM	0.72		
CADMIUM	0.81		
CALCIUM	41000		
CHROMIUM	16.3		
COBALT	8.7		
COPPER	28.9		
IRON	29000		
LEAD	62.7		
MAGNESIUM	23400		
MANGANESE	1820		
MERCURY	0.031		
NICKEL	28.9		
POTASSIUM	1810		
SELENIUM	0.960000	U	
SILVER	0.240000	U	
SODIUM	0.000000	U	
THALLIUM	0.720000	U	
VANADIUM	25		
ZINC	97.6		

nsample	NTC19SB16-SO-0507
samp_date	12/3/2008
lab_id	0812060-15
qc_type	NM
units	MG/KG
Pct_Solids	88.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	5050		
ANTIMONY	1.1	U	
ARSENIC	6.6		
BARIUM	20.9		
BERYLLIUM	0.39		
CADMIUM	0.28		
CALCIUM	73600		
CHROMIUM	10		
COBALT	5.8		
COPPER	21.3		
IRON	16400		
LEAD	12		
MAGNESIUM	38800		
MANGANESE	675		
MERCURY	0.015000	U	
NICKEL	17.6		
POTASSIUM	1340		
SELENIUM	0.880000	U	
SILVER	0.220000	U	
SODIUM	1.000000	U	
THALLIUM	0.660000	U	
VANADIUM	14.2		
ZINC	54.1		

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB17-SO-0002
samp_date	12/3/2008
lab_id	0812060-16
qc_type	NM
units	MG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	6640		
ANTIMONY	1.2		
ARSENIC	14.1		
BARIUM	36.3		
BERYLLIUM	0.49		
CADMIUM	0.43		
CALCIUM	78800		
CHROMIUM	13		
COBALT	7.3		
COPPER	53.6		
IRON	22300		
LEAD	236		
MAGNESIUM	39700		
MANGANESE	711		
MERCURY	0.034		
NICKEL	19.8		
POTASSIUM	1390		
SELENIUM	0.660000	U	
SILVER	0.220000	U	
SODIUM	20.000000	U	
THALLIUM	0.880000	U	
VANADIUM	18.6		
ZINC	109		

nsample	NTC19SB17-SO-0406
samp_date	12/3/2008
lab_id	0812060-17
qc_type	NM
units	MG/KG
Pct_Solids	89.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	5780		
ANTIMONY	1.1	U	
ARSENIC	7.4		
BARIUM	18.8		
BERYLLIUM	0.41		
CADMIUM	0.220000	U	
CALCIUM	67000		
CHROMIUM	10		
COBALT	6		
COPPER	23.6		
IRON	15300		
LEAD	9.6		
MAGNESIUM	32600		
MANGANESE	481		
MERCURY	0.013		
NICKEL	17.2		
POTASSIUM	1410		
SELENIUM	0.660000	U	
SILVER	0.220000	U	
SODIUM	249		
THALLIUM	0.880000	U	
VANADIUM	15.3		
ZINC	41.3		

nsample	NTC19SB18-SO-0204
samp_date	12/3/2008
lab_id	0812060-18
qc_type	NM
units	MG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	10300		
ANTIMONY	1.1	U	
ARSENIC	7.3		
BARIUM	39.9		
BERYLLIUM	0.67		
CADMIUM	0.3		
CALCIUM	76800		
CHROMIUM	17.6		
COBALT	9.2		
COPPER	21.7		
IRON	20400		
LEAD	25		
MAGNESIUM	39100		
MANGANESE	569		
MERCURY	0.029		
NICKEL	24.5		
POTASSIUM	2640		
SELENIUM	0.680000	U	
SILVER	0.230000	U	
SODIUM	26.000000	U	
THALLIUM	0.920000	U	
VANADIUM	20.9		
ZINC	53.6		

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB18-SO-0406
samp_date	12/3/2008
lab_id	0812060-19
qc_type	NM
units	MG/KG
Pct_Solids	86.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	10600		
ANTIMONY	1.1	U	
ARSENIC	6.7		
BARIUM	42.1		
BERYLLIUM	0.71		
CADMIUM	0.24		
CALCIUM	80700		
CHROMIUM	18.6		
COBALT	10.5		
COPPER	21.2		
IRON	20400		
LEAD	11.1		
MAGNESIUM	39800		
MANGANESE	604		
MERCURY	0.018		
NICKEL	27.5		
POTASSIUM	2700		
SELENIUM	0.680000	U	
SILVER	0.230000	U	
SODIUM	8.000000	U	
THALLIUM	0.680000	U	
VANADIUM	20.7		
ZINC	50		

nsample	NTC19SB19-SO-0002
samp_date	12/3/2008
lab_id	0812060-20
qc_type	NM
units	MG/KG
Pct_Solids	81.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	16800		
ANTIMONY	1.2	U	
ARSENIC	7.1		
BARIUM	101		
BERYLLIUM	1.1		
CADMIUM	0.25		
CALCIUM	23300		
CHROMIUM	24.3		
COBALT	10.5		
COPPER	25.9		
IRON	25300		
LEAD	25.7		
MAGNESIUM	12900		
MANGANESE	613		
MERCURY	0.055		
NICKEL	26.2		
POTASSIUM	2280		
SELENIUM	0.730000	U	
SILVER	0.240000	U	
SODIUM	2.000000	U	
THALLIUM	0.730000	U	
VANADIUM	31.8		
ZINC	72.8		

nsample	NTC19SB19-SO-0406
samp_date	12/3/2008
lab_id	0812060-21
qc_type	NM
units	MG/KG
Pct_Solids	85.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	10400		
ANTIMONY	1.2	U	
ARSENIC	7.4		
BARIUM	45.4		
BERYLLIUM	0.7		
CADMIUM	0.230000	U	
CALCIUM	81400		
CHROMIUM	18		
COBALT	14.7		
COPPER	21.6		
IRON	20300		
LEAD	11.7		
MAGNESIUM	38600		
MANGANESE	718		
MERCURY	0.021		
NICKEL	31.8		
POTASSIUM	2620		
SELENIUM	1.200000	U	
SILVER	0.230000	U	
SODIUM	5.000000	U	
THALLIUM	1.200000	U	
VANADIUM	20.6		
ZINC	52.7		

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB20-SO-0002
samp_date	12/3/2008
lab_id	0812060-22
qc_type	NM
units	MG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	10900		
ANTIMONY	1.2	U	
ARSENIC	8.9		
BARIUM	66.7		
BERYLLIUM	0.69		
CADMIUM	0.49		
CALCIUM	19800		
CHROMIUM	19.2		
COBALT	10.3		
COPPER	31.8		
IRON	23700		
LEAD	74.9		
MAGNESIUM	11500		
MANGANESE	648		
MERCURY	0.087		
NICKEL	22.4		
POTASSIUM	1370		
SELENIUM	0.700000	U	
SILVER	0.44		
SODIUM	3.000000	U	
THALLIUM	0.700000	U	
VANADIUM	28.5		
ZINC	127		

nsample	NTC19SB20-SO-0406
samp_date	12/3/2008
lab_id	0812060-23
qc_type	NM
units	MG/KG
Pct_Solids	84.0
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	9250		
ANTIMONY	1.2	U	
ARSENIC	7.6		
BARIUM	34.3		
BERYLLIUM	0.59		
CADMIUM	0.240000	U	
CALCIUM	76600		
CHROMIUM	16.3		
COBALT	8.4		
COPPER	19.6		
IRON	19100		
LEAD	10.6		
MAGNESIUM	38700		
MANGANESE	592		
MERCURY	0.014000	U	
NICKEL	23.5		
POTASSIUM	2150		
SELENIUM	0.960000	U	
SILVER	0.240000	U	
SODIUM	8.000000	U	
THALLIUM	0.710000	U	
VANADIUM	19.2		
ZINC	39		

PROJ_NO: 00936

SDG: GL002 MEDIA: SOIL DATA FRACTION: MISC

nsample	NTC19SB12-SO-0507	nsample	NTC19SB18-SO-0406
samp_date	12/3/2008	samp_date	12/3/2008
lab_id	0812060-08	lab_id	0812060-19
qc_type	NM	qc_type	NM
Pct_Solids		Pct_Solids	
DUP_OF:		DUP_OF:	

Parameter	units	Result	Val Qual	Qual Code
HYDROMETER-0.0019MM	%	12		
HYDROMETER-0.0043MM	%	22		
HYDROMETER-0.0052MM	%	22		
HYDROMETER-0.0074MM	%	28		
HYDROMETER-0.01MM	%	32		
HYDROMETER-0.026MM	%	44		

Parameter	units	Result	Val Qual	Qual Code
HYDROMETER-0.0019MM	%	4		
HYDROMETER-0.0043MM	%	4		
HYDROMETER-0.0052MM	%	6		
HYDROMETER-0.0074MM	%	8		
HYDROMETER-0.01MM	%	10		
HYDROMETER-0.026MM	%	14		

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**B. DAVIS**	**DATE:**	**FEBRUARY 9, 2009**
FROM:	**MATTHEW D. KRAUS**	**COPIES:**	**DV FILE**

SUBJECT: **INORGANIC DATA VALIDATION – TAL METALS/MISCELLANEOUS**
NTC GREAT LAKES – CTO 468
SAMPLE DELIVERY GROUP (SDG) – GL003

SAMPLES: 4/Soil/

NTC19SB01-SO-0002 NTC19SB03-SO-0001 NTC19SB06-SO-0001
NTC19SB07-SO-0001

3/Aqueous/

NTC19-MW01-1208 NTC19-MW02-1208 NTC19FD120808-01

Overview

The sample set for NTC Great Lakes, CTO 468, SDG GL003, consists of four soil and three aqueous environmental samples. One field duplicate pair was included in this SDG (NTC19-FD120808-01 / NTC19-MW01-1208).

All samples were analyzed for target analyte list (TAL) metals. Samples were collected by Tetra Tech NUS on December 2nd and 8th, 2008. Empirical Laboratories analyzed all samples under Naval Facilities Engineering Service Center (NFESC) Quality Assurance / Quality Control (QA/QC) criteria.

Metals and mercury analyses were conducted using SW-846 Methods 6010B and 7471A, respectively, and Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES) and Cold Vapor Atomic Absorption (CVAA) instrumentation and methodologies, respectively.

Data were evaluated based on the following parameters:

* • Data Completeness
* • Holding Times
• Calibration Recoveries
• Laboratory Method/Preparation Blank Analyses
• ICP Interference Check Sample Results
• Matrix Spike/Matrix Spike Duplicate Recoveries
• Laboratory Duplicate Precision
* • Laboratory Control Sample Recoveries
• Serial Dilution Results
* • Field Duplicate Precision
* • Detection Limits
* • Analyte Quantitation

* - All quality control criteria were met for this parameter.

Calibration Recoveries

The fourth continuing calibration verification (CCV) analyzed on 12/17/09 yielded a percent recovery (%R) greater than 110% for cadmium affecting all of the filtered metals results. The non-detected dissolved cadmium results were reported as estimated, "UJ".

Laboratory Blank Analyses

The following contaminants were detected in the laboratory method/preparation blanks at the following maximum concentrations:

Analyte	Maximum Concentration	Action Level
Thallium [1]	3.30 µg/L	16.5 µg/L
Thallium [2]	3.10 µg/L	15.5 µg/L

[1] Maximum blank concentration applies to aqueous total thallium results.

[2] Maximum preparation blank concentration applies to aqueous dissolved thallium results.

An action level of 5X the maximum concentration was used to evaluate the sample data for blank contamination. Sample aliquot, percent solids, and dilution factors, if applicable, were taken into consideration when evaluating for blank contamination. The dissolved thallium result reported for sample NTC19-MW01-1208 was qualified as non-detected, "U", due to laboratory blank contamination.

ICP Interference Check Sample Results

The interfering analyte iron was present in samples NTC19SB01-SO-0002 and NTC19SB06-SO-0001 at concentrations greater than 50% of those found in the Interference Check Sample (ICS) solution. Several analytes, namely, antimony, arsenic, cadmium, selenium, thallium, and zinc were present in the ICS solution at a concentration greater than absolute value of the Method Detection Limit (MDL). Interference effects exist for cadmium, selenium, and thallium in the aforementioned samples. The positive results reported for cadmium in the affected samples were qualified as estimated, "J". The non-detected results reported for selenium and thallium were qualified as estimated, "UJ".

Matrix Spike/Matrix Spike Duplicate Recoveries

The matrix spike (MS) and matrix spike duplicate (MSD) analyses of sample NTC19SB07-SO-0001 yielded %Rs for antimony less than 30%. The post-digestion matrix spike of that sample yielded an antimony %R within quality control limits. Non-detected antimony results reported for soil samples were qualified as estimated, "UJ".

The MS and MSD analyses of sample NTC19SB07-SO-0001 yielded %Rs for manganese that were greater than the upper quality control limit (125%). The positive manganese results reported for soil samples were qualified as estimated, "J".

Laboratory Duplicate Precision

Laboratory duplicate imprecision (samples results greater than 5X the Reporting Limit (RL) and Relative Percent Difference (RPD) between sample results greater than 35% was noted for lead for the laboratory duplicate analyses of sample NTC19SB07-SO-0001. The positive lead results reported for soil samples were qualified as estimated, "J".

Serial Dilution Results

The ICP serial dilution of sample NTC19SB07-SO-0001 yielded percent differences (%Ds) for calcium and zinc greater than the upper quality control limit (10%) and the initial sample results for those analytes were greater than 50 times the MDL. The positive calcium and zinc results reported for soil samples were qualified as estimated, "J".

The total and dissolved metal ICP serial dilutions of sample NTC19-MW01-1208 yielded %Ds for calcium greater than the upper quality control limit (10%) and the initial sample results were greater than 50 times the MDL. The positive calcium results reported for aqueous samples were qualified as estimated, "J".

Notes

The MS analysis of sample NTC19SB07-SO-0001 yielded a %R for zinc greater than the upper quality control limit (175%); however, the MSD of that sample yielded a compliant %R for zinc therefore no validation action was taken.

The MSD analysis of sample NTC19SB07-SO-0001 yielded noncompliant %Rs for lead and potassium; however, the MS of that sample yielded a compliant %Rs for lead and zinc therefore no validation action was taken.

The MS and/or MSD total and dissolved analyses of sample NTC19SB07-SO-0001 yielded noncompliant %Rs for aluminum, iron, and magnesium however, the original sample results for those analytes were greater than 4X the amount of corresponding spikes added therefore no validation action was taken.

The MS and/or MSD total and dissolved analyses of sample NTC19-MW01-1208 yielded noncompliant %Rs for aluminum, calcium, and sodium; however, the original sample results for those analytes were greater than 4X the amount of corresponding spikes added therefore no validation action was taken.

Executive Summary

Laboratory Performance: Cadmium was qualified due to calibration noncompliance. Thallium was qualified due to laboratory blank contamination. Lead was qualified due to laboratory duplicate imprecision.

Other Factors Affecting Data Quality: Cadmium, selenium, and thallium were qualified due to ICP interference. Antimony and manganese were qualified due matrix spike noncompliance. Calcium and zinc were qualified due to serial dilution noncompliance.

The data for these analyses were reviewed with reference to the "National Functional Guidelines for Inorganic Data Review", October 2004 and the Department of Defense (DoD) document entitled "Quality Systems Manual (QSM) for Environmental Laboratories" (January 2006).

The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the DoD QSM Guidelines."

Tetra Tech NUS
Matthew D. Kraus
Environmental Chemist

Tetra Tech NUS
Joseph A. Samchuck
Quality Assurance Officer

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as reported by the Laboratory
3. Appendix C – Support Documentation

APPENDIX A

QUALIFIED ANALYTICAL RESULTS

Validation Qualifier Codes:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration Noncompliance (e.g. % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01 = GC/MS Tuning Noncompliance
D = MS/MSD Recovery Noncompliance
E = LCS/LCSD Recovery Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = GFAA PDS - GFAA MSA's $r < 0.995$ / ICP PDS Recovery Noncompliance
K = ICP Interference - includes ICS % R Noncompliance
L = Instrument Calibration Range Exceedance
M = Sample Preservation Noncompliance
N = Internal Standard Noncompliance
N01 = Internal Standard Recovery Noncompliance Dioxins
N02 = Recovery Standard Noncompliance Dioxins
N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (e.g. base-line drifting)
P = Uncertainty near detection limit (< 2 x IDL for inorganics and <CRQL for organics)
Q = Other problems (can encompass a number of issues; e.g. chromatography,interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient $r < 0.995$
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is greater than sample activity

Data Qualifier Codes:

J = Estimated detected result
R = Rejected detected result
U = Non-detected result
UJ = Estimated non-detected result
UR = Rejected non-detected result

PROJ_NO: 00936

SDG: GL003 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB01-SO-0002
samp_date	12/2/2008
lab_id	0812073-01
qc_type	NM
units	MG/KG
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	14100		
ANTIMONY	1.2	UJ	D
ARSENIC	12.9		
BARIUM	103		
BERYLLIUM	0.95		
CADMIUM	0.43	J	K
CALCIUM	12900	J	I
CHROMIUM	23.1		
COBALT	9.7		
COPPER	23.1		
IRON	31600		
LEAD	80.9	J	F
MAGNESIUM	9330		
MANGANESE	954	J	D
MERCURY	0.084		
NICKEL	27.3		
POTASSIUM	2190		
SELENIUM	0.73	UJ	K
SILVER	0.24	U	
SODIUM	443		
THALLIUM	0.73	UJ	K
VANADIUM	34		
ZINC	128	J	I

nsample	NTC19SB03-SO-0001
samp_date	12/2/2008
lab_id	0812073-02
qc_type	NM
units	MG/KG
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	15300		
ANTIMONY	3.8	UJ	D
ARSENIC	8.5		
BARIUM	100		
BERYLLIUM	0.96		
CADMIUM	0.54		
CALCIUM	21500	J	I
CHROMIUM	24.3		
COBALT	10.4		
COPPER	28.2		
IRON	24900		
LEAD	480	J	F
MAGNESIUM	12000		
MANGANESE	746	J	D
MERCURY	0.32		
NICKEL	25.1		
POTASSIUM	2330		
SELENIUM	0.77	U	
SILVER	0.48		
SODIUM	256	U	
THALLIUM	0.77	U	
VANADIUM	32.4		
ZINC	190	J	I

nsample	NTC19SB06-SO-0001
samp_date	12/2/2008
lab_id	0812073-03
qc_type	NM
units	MG/KG
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	19300		
ANTIMONY	3.7	UJ	D
ARSENIC	8.1		
BARIUM	188		
BERYLLIUM	1.3		
CADMIUM	0.92	J	K
CALCIUM	7900	J	I
CHROMIUM	27.6		
COBALT	10.9		
COPPER	36.2		
IRON	31700		
LEAD	133	J	F
MAGNESIUM	6430		
MANGANESE	1280	J	D
MERCURY	0.47		
NICKEL	28.3		
POTASSIUM	2180		
SELENIUM	0.74	UJ	K
SILVER	1.0		
SODIUM	248	U	
THALLIUM	0.74	UJ	K
VANADIUM	37.1		
ZINC	250	J	I

PROJ_NO: 00936

SDG: GL003 MEDIA: SOIL DATA FRACTION: M

nsample	NTC19SB07-SO-0001
samp_date	12/2/2008
lab_id	0812073-04
qc_type	NM
units	MG/KG
Pct_Solids	
DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	8640		
ANTIMONY	3.5	UJ	D
ARSENIC	5.7		
BARIUM	52.2		
BERYLLIUM	0.66		
CADMIUM	0.33		
CALCIUM	111000	J	I
CHROMIUM	13.5		
COBALT	5		
COPPER	17.6		
IRON	14600		
LEAD	89.1	J	F
MAGNESIUM	62100		
MANGANESE	466	J	D
MERCURY	0.12		
NICKEL	14.0		
POTASSIUM	1650		
SELENIUM	0.69	U	
SILVER	0.23	U	
SODIUM	231	U	
THALLIUM	0.92	U	
VANADIUM	18.5		
ZINC	119	J	I

PROJ_NO: 00936

SDG: GL003 MEDIA: WATER DATA FRACTION: M

nsample	NTC19FD120808-01	nsample	NTC19-MW01-1208	nsample	NTC19-MW02-1208
samp_date	12/8/2008	samp_date	12/8/2008	samp_date	12/8/2008
lab_id	0812147-04	lab_id	0812147-01	lab_id	0812147-02
qc_type	NM	qc_type	NM	qc_type	NM
units	UG/L	units	UG/L	units	UG/L
Pct_Solids		Pct_Solids		Pct_Solids	
DUP_OF:	NTC19-MW01-1208	DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	134		
ANTIMONY	5.0	U	
ARSENIC	3.3		
BARIUM	51.8		
BERYLLIUM	1.0	U	
CADMIUM	1.0	U	
CALCIUM	116000	J	I
CHROMIUM	2.0	U	
COBALT	5.0	U	
COPPER	5.0	U	
IRON	204		
LEAD	1.5	U	
MAGNESIUM	48900		
MANGANESE	35.8		
MERCURY	0.080	U	
NICKEL	5.0	U	
POTASSIUM	9120		
SELENIUM	3.0	U	
SILVER	1.0	U	
SODIUM	70300		
THALLIUM	3.0	U	
VANADIUM	5.0	U	
ZINC	5.0	U	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	138		
ANTIMONY	5.0	U	
ARSENIC	3.0	U	
BARIUM	52.9		
BERYLLIUM	1.0	U	
CADMIUM	1.0	U	
CALCIUM	114000	J	I
CHROMIUM	2.0	U	
COBALT	5.0	U	
COPPER	5.0	U	
IRON	182		
LEAD	1.5	U	
MAGNESIUM	48200		
MANGANESE	37.6		
MERCURY	0.080	U	
NICKEL	5.0	U	
POTASSIUM	9000		
SELENIUM	3.0	U	
SILVER	1.0	U	
SODIUM	68800		
THALLIUM	3.0	U	
VANADIUM	5.0	U	
ZINC	5.0	U	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	272		
ANTIMONY	5.0	U	
ARSENIC	3.0	U	
BARIUM	167		
BERYLLIUM	1.0	U	
CADMIUM	1.0	U	
CALCIUM	88100	J	I
CHROMIUM	2.0	U	
COBALT	5.0	U	
COPPER	5.0	U	
IRON	489		
LEAD	1.5	U	
MAGNESIUM	46200		
MANGANESE	39.6		
MERCURY	0.080	U	
NICKEL	5.0	U	
POTASSIUM	7860		
SELENIUM	3.0	U	
SILVER	1.0	U	
SODIUM	36900		
THALLIUM	3.0	U	
VANADIUM	5.0	U	
ZINC	9.4		

PROJ_NO: 00936

SDG: GL003 MEDIA: WATER DATA FRACTION: MF

nsample	NTC19FD120808-01SOLUBL	nsample	NTC19-MW01-1208SOLUBLE	nsample	NTC19-MW02-1208SOLUBLE
samp_date	12/8/2008	samp_date	12/8/2008	samp_date	12/8/2008
lab_id	0812147-04SOLUBLE	lab_id	0812147-01SOLUBLE	lab_id	0812147-02SOLUBLE
qc_type	NM	qc_type	NM	qc_type	NM
units	UG/L	units	UG/L	units	UG/L
Pct_Solids		Pct_Solids		Pct_Solids	
DUP_OF:	NTC19-MW01-1208SOLUBLE	DUP_OF:		DUP_OF:	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	50.0	U	
ANTIMONY	5.0	U	
ARSENIC	3.0	U	
BARIUM	48.9		
BERYLLIUM	1.0	U	
CADMIUM	1.0	UJ	C
CALCIUM	117000	J	I
CHROMIUM	2.0	U	
COBALT	5.0	U	
COPPER	5.0	U	
IRON	30.0	U	
LEAD	1.50	U	
MAGNESIUM	46300		
MANGANESE	30.9		
MERCURY	0.080	U	
NICKEL	5.0	U	
POTASSIUM	8040		
SELENIUM	3.0	U	
SILVER	1.000000	U	
SODIUM	62300		
THALLIUM	3.0	U	
VANADIUM	5.0	U	
ZINC	5.0	U	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	50.0	U	
ANTIMONY	5.0	U	
ARSENIC	3.0	U	
BARIUM	52.4		
BERYLLIUM	1.0	U	
CADMIUM	1.0	UJ	C
CALCIUM	123000	J	I
CHROMIUM	2.0	U	
COBALT	5.0	U	
COPPER	5.0	U	
IRON	30.0	U	
LEAD	1.5	U	
MAGNESIUM	48800		
MANGANESE	34.5		
MERCURY	0.080	U	
NICKEL	5.0	U	
POTASSIUM	8570		
SELENIUM	3.0	U	
SILVER	1.0	U	
SODIUM	65000		
THALLIUM	3.8	U	A
VANADIUM	5.0	U	
ZINC	5.0	U	

Parameter	Result	Val Qual	Qual Code
ALUMINUM	50.0	U	
ANTIMONY	5.0	U	
ARSENIC	3.0	U	
BARIUM	161		
BERYLLIUM	1.0	U	
CADMIUM	1.0	UJ	C
CALCIUM	93400	J	I
CHROMIUM	2.0	U	
COBALT	5.0	U	
COPPER	5.0	U	
IRON	30.0	U	
LEAD	1.5	U	
MAGNESIUM	45900		
MANGANESE	31.8		
MERCURY	0.080	U	
NICKEL	5.0	U	
POTASSIUM	7240		
SELENIUM	3.0	U	
SILVER	1.0	U	
SODIUM	33600		
THALLIUM	3.0	U	
VANADIUM	5.0	U	
ZINC	5.0	U	

APPENDIX C

LABORATORY ANALYTICAL SUMMARY SHEETS

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
1-SO-0608

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-01

Sample wt/vol: 6.9 (g/mL) G Lab File ID: 1203601A

Level: (low/med) LOW Date Sampled: 12/02/08 08:20

% Moisture: not dec. 17 Date Analyzed: 12/09/08 14:33

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.7	4.4	2.4	J
71-43-2	Benzene	0.41	4.4		U
75-27-4	Bromodichloromethane	0.26	4.4		U
75-25-2	Bromoform	0.87	8.7		U
74-83-9	Bromomethane	0.63	8.7		U
78-93-3	2-Butanone	1.2	4.4		U
75-15-0	Carbon disulfide	1.1	4.4		U
56-23-5	Carbon tetrachloride	0.77	4.4		U
108-90-7	Chlorobenzene	0.30	4.4		U
75-00-3	Chloroethane	0.96	8.7		U
67-66-3	Chloroform	0.48	8.7		U
74-87-3	Chloromethane	0.45	8.7		U
110-82-7	Cyclohexane	0.47	4.4		U
124-48-1	Dibromochloromethane	0.30	4.4		U
96-12-8	1,2-Dibromo-3-chloropropane	1.0	4.4		U
106-93-4	1,2-Dibromoethane	0.38	4.4		U
95-50-1	1,2-Dichlorobenzene	0.32	4.4		U
541-73-1	1,3-Dichlorobenzene	0.73	4.4		U
106-46-7	1,4-Dichlorobenzene	0.48	4.4		U
75-71-8	Dichlorodifluoromethane	0.96	4.4		U
75-34-3	1,1-Dichloroethane	0.47	4.4		U
107-06-2	1,2-Dichloroethane	0.40	4.4		U
75-35-4	1,1-Dichloroethene	1.0	8.7		U
156-59-2	cis-1,2-Dichloroethene	1.0	8.7		U
156-60-5	trans-1,2-Dichloroethene	0.96	4.4		U
78-87-5	1,2-Dichloropropane	0.40	4.4		U
10061-01-5	cis-1,3-Dichloropropene	0.44	4.4		U
10061-02-6	trans-1,3-Dichloropropene	0.28	4.4		U
100-41-4	Ethylbenzene	0.66	4.4		U
591-78-6	2-Hexanone	2.0	4.4		U
98-82-8	Isopropylbenzene	0.77	4.4		U
79-20-9	Methyl acetate	1.4	8.7		U
75-09-2	Methylene chloride	0.54	8.7	4.0	JB
108-87-2	Methyl cyclohexane	0.26	8.7		U
1634-04-4	Methyl-tert-butyl ether	0.28	8.7		U
108-10-1	4-Methyl-2-pentanone	0.51	4.4		U
100-42-5	Styrene	0.30	4.4		U
79-34-5	1,1,2,2-Tetrachloroethane	0.38	4.4		U
127-18-4	Tetrachloroethene	0.85	8.7		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
1-SO-0608

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-01

Sample wt/vol: 6.9 (g/mL) G Lab File ID: 1203601A

Level: (low/med) LOW Date Sampled: 12/02/08 08:20

% Moisture: not dec. 17 Date Analyzed: 12/09/08 14:33

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.75	4.4		U
120-82-1	1,2,4-Trichlorobenzene	0.16	8.7		U
71-55-6	1,1,1-Trichloroethane	0.79	4.4		U
79-00-5	1,1,2-Trichloroethane	0.30	4.4		U
79-01-6	Trichloroethene	0.74	4.4		U
76-13-1	Trichlorotrifluoroethane	0.48	4.4		U
75-69-4	Trichlorofluoromethane	0.83	4.4		U
75-01-4	Vinyl chloride	0.96	4.4		U
1330-20-7	Xylene(total)	0.61	4.4		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
2-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-02

Sample wt/vol: 5.5 (g/mL) G Lab File ID: 1203602A

Level: (low/med) LOW Date Sampled: 12/02/08 08:52

% Moisture: not dec. 19 Date Analyzed: 12/09/08 15:12

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.2	5.6		U
71-43-2	Benzene	0.53	5.6		U
75-27-4	Bromodichloromethane	0.34	5.6		U
75-25-2	Bromoform	1.1	11		U
74-83-9	Bromomethane	0.81	11		U
78-93-3	2-Butanone	1.6	5.6		U
75-15-0	Carbon disulfide	1.5	5.6		U
56-23-5	Carbon tetrachloride	0.99	5.6		U
108-90-7	Chlorobenzene	0.38	5.6		U
75-00-3	Chloroethane	1.2	11		U
67-66-3	Chloroform	0.62	11		U
74-87-3	Chloromethane	0.58	11		U
110-82-7	Cyclohexane	0.61	5.6		U
124-48-1	Dibromochloromethane	0.38	5.6		U
96-12-8	1,2-Dibromo-3-chloropropane	1.4	5.6		U
106-93-4	1,2-Dibromoethane	0.48	5.6		U
95-50-1	1,2-Dichlorobenzene	0.42	5.6		U
541-73-1	1,3-Dichlorobenzene	0.95	5.6		U
106-46-7	1,4-Dichlorobenzene	0.62	5.6		U
75-71-8	Dichlorodifluoromethane	1.2	5.6		U
75-34-3	1,1-Dichloroethane	0.61	5.6		U
107-06-2	1,2-Dichloroethane	0.52	5.6		U
75-35-4	1,1-Dichloroethene	1.4	11		U
156-59-2	cis-1,2-Dichloroethene	1.4	11		U
156-60-5	trans-1,2-Dichloroethene	1.2	5.6		U
78-87-5	1,2-Dichloropropane	0.52	5.6		U
10061-01-5	cis-1,3-Dichloropropene	0.56	5.6		U
10061-02-6	trans-1,3-Dichloropropene	0.36	5.6		U
100-41-4	Ethylbenzene	0.84	5.6		U
591-78-6	2-Hexanone	2.6	5.6		U
98-82-8	Isopropylbenzene	0.99	5.6		U
79-20-9	Methyl acetate	1.8	11		U
75-09-2	Methylene chloride	0.70	11	5.9	JB
108-87-2	Methyl cyclohexane	0.34	11		U
1634-04-4	Methyl-tert-butyl ether	0.36	11		U
108-10-1	4-Methyl-2-pentanone	0.65	5.6		U
100-42-5	Styrene	0.39	5.6		U
79-34-5	1,1,2,2-Tetrachloroethane	0.48	5.6		U
127-18-4	Tetrachloroethene	1.1	11		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
2-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-02

Sample wt/vol: 5.5 (g/mL) G Lab File ID: 1203602A

Level: (low/med) LOW Date Sampled: 12/02/08 08:52

% Moisture: not dec. 19 Date Analyzed: 12/09/08 15:12

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.97	5.6		U
120-82-1	1,2,4-Trichlorobenzene	0.20	11		U
71-55-6	1,1,1-Trichloroethane	1.0	5.6		U
79-00-5	1,1,2-Trichloroethane	0.39	5.6		U
79-01-6	Trichloroethene	0.96	5.6		U
76-13-1	Trichlorotrifluoroethane	0.62	5.6		U
75-69-4	Trichlorofluoromethane	1.1	5.6		U
75-01-4	Vinyl chloride	1.2	5.6		U
1330-20-7	Xylene(total)	0.79	5.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
3-SO-0103

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-03

Sample wt/vol: 5.5 (g/mL) G Lab File ID: 1203603A

Level: (low/med) LOW Date Sampled: 12/02/08 09:00

% Moisture: not dec. 15 Date Analyzed: 12/09/08 15:51

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.1	5.4		U
71-43-2	Benzene	0.50	5.4		U
75-27-4	Bromodichloromethane	0.32	5.4		U
75-25-2	Bromoform	1.1	11		U
74-83-9	Bromomethane	0.77	11		U
78-93-3	2-Butanone	1.5	5.4		U
75-15-0	Carbon disulfide	1.4	5.4		U
56-23-5	Carbon tetrachloride	0.94	5.4		U
108-90-7	Chlorobenzene	0.36	5.4		U
75-00-3	Chloroethane	1.2	11		U
67-66-3	Chloroform	0.59	11		U
74-87-3	Chloromethane	0.56	11		U
110-82-7	Cyclohexane	0.58	5.4		U
124-48-1	Dibromochloromethane	0.36	5.4		U
96-12-8	1,2-Dibromo-3-chloropropane	1.3	5.4		U
106-93-4	1,2-Dibromoethane	0.46	5.4		U
95-50-1	1,2-Dichlorobenzene	0.40	5.4		U
541-73-1	1,3-Dichlorobenzene	0.90	5.4		U
106-46-7	1,4-Dichlorobenzene	0.59	5.4		U
75-71-8	Dichlorodifluoromethane	1.2	5.4		U
75-34-3	1,1-Dichloroethane	0.58	5.4		U
107-06-2	1,2-Dichloroethane	0.49	5.4		U
75-35-4	1,1-Dichloroethene	1.3	11		U
156-59-2	cis-1,2-Dichloroethene	1.3	11		U
156-60-5	trans-1,2-Dichloroethene	1.2	5.4		U
78-87-5	1,2-Dichloropropane	0.49	5.4		U
10061-01-5	cis-1,3-Dichloropropene	0.54	5.4		U
10061-02-6	trans-1,3-Dichloropropene	0.34	5.4		U
100-41-4	Ethylbenzene	0.80	5.4		U
591-78-6	2-Hexanone	2.5	5.4		U
98-82-8	Isopropylbenzene	0.94	5.4		U
79-20-9	Methyl acetate	1.7	11		U
75-09-2	Methylene chloride	0.66	11	5.6	JB
108-87-2	Methyl cyclohexane	0.32	11		U
1634-04-4	Methyl-tert-butyl ether	0.34	11		U
108-10-1	4-Methyl-2-pentanone	0.62	5.4		U
100-42-5	Styrene	0.37	5.4		U
79-34-5	1,1,2,2-Tetrachloroethane	0.46	5.4		U
127-18-4	Tetrachloroethene	1.0	11		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
3-SO-0103

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-03

Sample wt/vol: 5.5 (g/mL) G Lab File ID: 1203603A

Level: (low/med) LOW Date Sampled: 12/02/08 09:00

% Moisture: not dec. 15 Date Analyzed: 12/09/08 15:51

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.92	5.4		U
120-82-1	1,2,4-Trichlorobenzene	0.19	11		U
71-55-6	1,1,1-Trichloroethane	0.96	5.4		U
79-00-5	1,1,2-Trichloroethane	0.37	5.4		U
79-01-6	Trichloroethene	0.91	5.4		U
76-13-1	Trichlorotrifluoroethane	0.59	5.4		U
75-69-4	Trichlorofluoromethane	1.0	5.4		U
75-01-4	Vinyl chloride	1.2	5.4		U
1330-20-7	Xylene(total)	0.75	5.4		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
3-SO-0810

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-04

Sample wt/vol: 6.7 (g/mL) G Lab File ID: 1203604B

Level: (low/med) LOW Date Sampled: 12/02/08 09:10

% Moisture: not dec. 13 Date Analyzed: 12/11/08 17:19

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.7	4.3		U
71-43-2	Benzene	0.40	4.3		U
75-27-4	Bromodichloromethane	0.26	4.3		U
75-25-2	Bromoform	0.86	8.6		U
74-83-9	Bromomethane	0.62	8.6		U
78-93-3	2-Butanone	1.2	4.3		U
75-15-0	Carbon disulfide	1.1	4.3		U
56-23-5	Carbon tetrachloride	0.75	4.3		U
108-90-7	Chlorobenzene	0.29	4.3		U
75-00-3	Chloroethane	0.94	8.6		U
67-66-3	Chloroform	0.47	8.6		U
74-87-3	Chloromethane	0.44	8.6		U
110-82-7	Cyclohexane	0.46	4.3		U
124-48-1	Dibromochloromethane	0.29	4.3		U
96-12-8	1,2-Dibromo-3-chloropropane	1.0	4.3		U
106-93-4	1,2-Dibromoethane	0.37	4.3		U
95-50-1	1,2-Dichlorobenzene	0.32	4.3		U
541-73-1	1,3-Dichlorobenzene	0.72	4.3		U
106-46-7	1,4-Dichlorobenzene	0.47	4.3		U
75-71-8	Dichlorodifluoromethane	0.94	4.3		U
75-34-3	1,1-Dichloroethane	0.46	4.3		U
107-06-2	1,2-Dichloroethane	0.39	4.3		U
75-35-4	1,1-Dichloroethene	1.0	8.6		U
156-59-2	cis-1,2-Dichloroethene	1.0	8.6		U
156-60-5	trans-1,2-Dichloroethene	0.94	4.3		U
78-87-5	1,2-Dichloropropane	0.39	4.3		U
10061-01-5	cis-1,3-Dichloropropene	0.43	4.3		U
10061-02-6	trans-1,3-Dichloropropene	0.27	4.3		U
100-41-4	Ethylbenzene	0.64	4.3		U
591-78-6	2-Hexanone	2.0	4.3		U
98-82-8	Isopropylbenzene	0.75	4.3		U
79-20-9	Methyl acetate	1.4	8.6		U
75-09-2	Methylene chloride	0.53	8.6	3.5	JB
108-87-2	Methyl cyclohexane	0.26	8.6		U
1634-04-4	Methyl-tert-butyl ether	0.27	8.6		U
108-10-1	4-Methyl-2-pentanone	0.50	4.3		U
100-42-5	Styrene	0.30	4.3		U
79-34-5	1,1,2,2-Tetrachloroethane	0.37	4.3		U
127-18-4	Tetrachloroethene	0.83	8.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
3-SO-0810

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-04

Sample wt/vol: 6.7 (g/mL) G Lab File ID: 1203604B

Level: (low/med) LOW Date Sampled: 12/02/08 09:10

% Moisture: not dec. 13 Date Analyzed: 12/11/08 17:19

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.74	4.3		U
120-82-1	1,2,4-Trichlorobenzene	0.15	8.6		U
71-55-6	1,1,1-Trichloroethane	0.77	4.3		U
79-00-5	1,1,2-Trichloroethane	0.30	4.3		U
79-01-6	Trichloroethene	0.73	4.3		U
76-13-1	Trichlorotrifluoroethane	0.47	4.3		U
75-69-4	Trichlorofluoromethane	0.81	4.3		U
75-01-4	Vinyl chloride	0.94	4.3		U
1330-20-7	Xylene(total)	0.60	4.3		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB03
-SO-0810DL

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-04DL

Sample wt/vol: 6.8 (g/mL) G Lab File ID: 1203604D

Level: (low/med) MED Date Sampled: 12/02/08 09:10

% Moisture: not dec. 13 Date Analyzed: 12/13/08 05:18

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume: 5000(uL) Soil Aliquot Volume: 100(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	84	210		UD
71-43-2	Benzene	20	210		UD
75-27-4	Bromodichloromethane	13	210		UD
75-25-2	Bromoform	42	420		UD
74-83-9	Bromomethane	30	420		UD
78-93-3	2-Butanone	59	210		UD
75-15-0	Carbon disulfide	55	210		UD
56-23-5	Carbon tetrachloride	37	210		UD
108-90-7	Chlorobenzene	14	210		UD
75-00-3	Chloroethane	46	420		UD
67-66-3	Chloroform	23	420		UD
74-87-3	Chloromethane	22	420		UD
110-82-7	Cyclohexane	23	210		UD
124-48-1	Dibromochloromethane	14	210		UD
96-12-8	1,2-Dibromo-3-chloropropane	51	210		UD
106-93-4	1,2-Dibromoethane	18	210		UD
95-50-1	1,2-Dichlorobenzene	16	210		UD
541-73-1	1,3-Dichlorobenzene	35	210		UD
106-46-7	1,4-Dichlorobenzene	23	210		UD
75-71-8	Dichlorodifluoromethane	46	210		UD
75-34-3	1,1-Dichloroethane	23	210		UD
107-06-2	1,2-Dichloroethane	19	210		UD
75-35-4	1,1-Dichloroethene	51	420		UD
156-59-2	cis-1,2-Dichloroethene	51	420		UD
156-60-5	trans-1,2-Dichloroethene	46	210		UD
78-87-5	1,2-Dichloropropane	19	210		UD
10061-01-5	cis-1,3-Dichloropropene	21	210		UD
10061-02-6	trans-1,3-Dichloropropene	14	210		UD
100-41-4	Ethylbenzene	32	210		UD
591-78-6	2-Hexanone	97	210		UD
98-82-8	Isopropylbenzene	37	210		UD
79-20-9	Methyl acetate	68	420		UD
75-09-2	Methylene chloride	26	420	1800	BD
108-87-2	Methyl cyclohexane	13	420		UD
1634-04-4	Methyl-tert-butyl ether	14	420		UD
108-10-1	4-Methyl-2-pentanone	24	210		UD
100-42-5	Styrene	15	210		UD
79-34-5	1,1,2,2-Tetrachloroethane	18	210		UD
127-18-4	Tetrachloroethene	41	420		UD

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB03
-SO-0810DL

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-04DL

Sample wt/vol: 6.8 (g/mL) G Lab File ID: 1203604D

Level: (low/med) MED Date Sampled: 12/02/08 09:10

% Moisture: not dec. 13 Date Analyzed: 12/13/08 05:18

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume: 5000(uL) Soil Aliquot Volume: 100(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	36	210		UD
120-82-1	1,2,4-Trichlorobenzene	7.6	420		UD
71-55-6	1,1,1-Trichloroethane	38	210		UD
79-00-5	1,1,2-Trichloroethane	15	210		UD
79-01-6	Trichloroethene	36	210		UD
76-13-1	Trichlorotrifluoroethane	23	210		UD
75-69-4	Trichlorofluoromethane	40	210		UD
75-01-4	Vinyl chloride	46	210		UD
1330-20-7	Xylene(total)	30	210	37	JD

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
4-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-05

Sample wt/vol: 5.4 (g/mL) G Lab File ID: 1203605A

Level: (low/med) LOW Date Sampled: 12/02/08 09:45

% Moisture: not dec. 17 Date Analyzed: 12/09/08 17:10

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.2	5.6		U
71-43-2	Benzene	0.52	5.6		U
75-27-4	Bromodichloromethane	0.33	5.6		U
75-25-2	Bromoform	1.1	11		U
74-83-9	Bromomethane	0.80	11		U
78-93-3	2-Butanone	1.6	5.6		U
75-15-0	Carbon disulfide	1.4	5.6		U
56-23-5	Carbon tetrachloride	0.98	5.6		U
108-90-7	Chlorobenzene	0.38	5.6		U
75-00-3	Chloroethane	1.2	11		U
67-66-3	Chloroform	0.61	11		U
74-87-3	Chloromethane	0.58	11		U
110-82-7	Cyclohexane	0.60	5.6		U
124-48-1	Dibromochloromethane	0.38	5.6		U
96-12-8	1,2-Dibromo-3-chloropropane	1.3	5.6		U
106-93-4	1,2-Dibromoethane	0.48	5.6		U
95-50-1	1,2-Dichlorobenzene	0.41	5.6		U
541-73-1	1,3-Dichlorobenzene	0.93	5.6		U
106-46-7	1,4-Dichlorobenzene	0.61	5.6		U
75-71-8	Dichlorodifluoromethane	1.2	5.6		U
75-34-3	1,1-Dichloroethane	0.60	5.6		U
107-06-2	1,2-Dichloroethane	0.51	5.6		U
75-35-4	1,1-Dichloroethene	1.3	11		U
156-59-2	cis-1,2-Dichloroethene	1.3	11		U
156-60-5	trans-1,2-Dichloroethene	1.2	5.6		U
78-87-5	1,2-Dichloropropane	0.51	5.6		U
10061-01-5	cis-1,3-Dichloropropene	0.56	5.6		U
10061-02-6	trans-1,3-Dichloropropene	0.36	5.6		U
100-41-4	Ethylbenzene	0.83	5.6		U
591-78-6	2-Hexanone	2.6	5.6		U
98-82-8	Isopropylbenzene	0.98	5.6		U
79-20-9	Methyl acetate	1.8	11		U
75-09-2	Methylene chloride	0.69	11	7.7	JB
108-87-2	Methyl cyclohexane	0.33	11		U
1634-04-4	Methyl-tert-butyl ether	0.36	11		U
108-10-1	4-Methyl-2-pentanone	0.64	5.6		U
100-42-5	Styrene	0.39	5.6		U
79-34-5	1,1,2,2-Tetrachloroethane	0.48	5.6		U
127-18-4	Tetrachloroethene	1.1	11		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
4-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-05

Sample wt/vol: 5.4 (g/mL) G Lab File ID: 1203605A

Level: (low/med) LOW Date Sampled: 12/02/08 09:45

% Moisture: not dec. 17 Date Analyzed: 12/09/08 17:10

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.95	5.6		U
120-82-1	1,2,4-Trichlorobenzene	0.20	11		U
71-55-6	1,1,1-Trichloroethane	1.00	5.6		U
79-00-5	1,1,2-Trichloroethane	0.39	5.6		U
79-01-6	Trichloroethene	0.94	5.6		U
76-13-1	Trichlorotrifluoroethane	0.61	5.6		U
75-69-4	Trichlorofluoromethane	1.0	5.6		U
75-01-4	Vinyl chloride	1.2	5.6		U
1330-20-7	Xylene(total)	0.78	5.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
5-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-06

Sample wt/vol: 6.0 (g/mL) G Lab File ID: 1203606B

Level: (low/med) LOW Date Sampled: 12/02/08 10:20

% Moisture: not dec. 9 Date Analyzed: 12/11/08 17:58

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	4.6	5.8	
71-43-2	Benzene	0.43	4.6		U
75-27-4	Bromodichloromethane	0.28	4.6		U
75-25-2	Bromoform	0.92	9.2		U
74-83-9	Bromomethane	0.66	9.2		U
78-93-3	2-Butanone	1.3	4.6		U
75-15-0	Carbon disulfide	1.2	4.6		U
56-23-5	Carbon tetrachloride	0.81	4.6		U
108-90-7	Chlorobenzene	0.31	4.6		U
75-00-3	Chloroethane	1.0	9.2		U
67-66-3	Chloroform	0.50	9.2		U
74-87-3	Chloromethane	0.48	9.2		U
110-82-7	Cyclohexane	0.50	4.6		U
124-48-1	Dibromochloromethane	0.31	4.6		U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	4.6		U
106-93-4	1,2-Dibromoethane	0.40	4.6		U
95-50-1	1,2-Dichlorobenzene	0.34	4.6		U
541-73-1	1,3-Dichlorobenzene	0.77	4.6		U
106-46-7	1,4-Dichlorobenzene	0.50	4.6		U
75-71-8	Dichlorodifluoromethane	1.0	4.6		U
75-34-3	1,1-Dichloroethane	0.50	4.6		U
107-06-2	1,2-Dichloroethane	0.42	4.6		U
75-35-4	1,1-Dichloroethene	1.1	9.2		U
156-59-2	cis-1,2-Dichloroethene	1.1	9.2		U
156-60-5	trans-1,2-Dichloroethene	1.0	4.6		U
78-87-5	1,2-Dichloropropane	0.42	4.6		U
10061-01-5	cis-1,3-Dichloropropene	0.46	4.6		U
10061-02-6	trans-1,3-Dichloropropene	0.29	4.6		U
100-41-4	Ethylbenzene	0.69	4.6		U
591-78-6	2-Hexanone	2.1	4.6		U
98-82-8	Isopropylbenzene	0.81	4.6		U
79-20-9	Methyl acetate	1.5	9.2		U
75-09-2	Methylene chloride	0.57	9.2	7.2	JB
108-87-2	Methyl cyclohexane	0.28	9.2		U
1634-04-4	Methyl-tert-butyl ether	0.29	9.2		U
108-10-1	4-Methyl-2-pentanone	0.53	4.6		U
100-42-5	Styrene	0.32	4.6		U
79-34-5	1,1,2,2-Tetrachloroethane	0.40	4.6		U
127-18-4	Tetrachloroethene	0.89	9.2		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
5-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-06

Sample wt/vol: 6.0 (g/mL) G Lab File ID: 1203606B

Level: (low/med) LOW Date Sampled: 12/02/08 10:20

% Moisture: not dec. 9 Date Analyzed: 12/11/08 17:58

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.79	4.6		U
120-82-1	1,2,4-Trichlorobenzene	0.16	9.2		U
71-55-6	1,1,1-Trichloroethane	0.83	4.6		U
79-00-5	1,1,2-Trichloroethane	0.32	4.6		U
79-01-6	Trichloroethene	0.78	4.6		U
76-13-1	Trichlorotrifluoroethane	0.50	4.6		U
75-69-4	Trichlorofluoromethane	0.87	4.6		U
75-01-4	Vinyl chloride	1.0	4.6		U
1330-20-7	Xylene(total)	0.64	4.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB05
-SO-0406DL

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-06DL

Sample wt/vol: 6.3 (g/mL) G Lab File ID: 1203606D

Level: (low/med) MED Date Sampled: 12/02/08 10:20

% Moisture: not dec. 9 Date Analyzed: 12/13/08 05:57

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume: 5000(uL) Soil Aliquot Volume: 100(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	88	220		UD
71-43-2	Benzene	20	220		UD
75-27-4	Bromodichloromethane	13	220		UD
75-25-2	Bromoform	44	440		UD
74-83-9	Bromomethane	32	440		UD
78-93-3	2-Butanone	61	220		UD
75-15-0	Carbon disulfide	57	220		UD
56-23-5	Carbon tetrachloride	38	220		UD
108-90-7	Chlorobenzene	15	220		UD
75-00-3	Chloroethane	48	440		UD
67-66-3	Chloroform	24	440		UD
74-87-3	Chloromethane	23	440		UD
110-82-7	Cyclohexane	24	220		UD
124-48-1	Dibromochloromethane	15	220		UD
96-12-8	1,2-Dibromo-3-chloropropane	52	220		UD
106-93-4	1,2-Dibromoethane	19	220		UD
95-50-1	1,2-Dichlorobenzene	16	220		UD
541-73-1	1,3-Dichlorobenzene	37	220		UD
106-46-7	1,4-Dichlorobenzene	24	220		UD
75-71-8	Dichlorodifluoromethane	48	220		UD
75-34-3	1,1-Dichloroethane	24	220		UD
107-06-2	1,2-Dichloroethane	20	220		UD
75-35-4	1,1-Dichloroethene	52	440		UD
156-59-2	cis-1,2-Dichloroethene	52	440		UD
156-60-5	trans-1,2-Dichloroethene	48	220		UD
78-87-5	1,2-Dichloropropane	20	220		UD
10061-01-5	cis-1,3-Dichloropropene	22	220		UD
10061-02-6	trans-1,3-Dichloropropene	14	220		UD
100-41-4	Ethylbenzene	33	220		UD
591-78-6	2-Hexanone	100	220		UD
98-82-8	Isopropylbenzene	38	220		UD
79-20-9	Methyl acetate	70	440		UD
75-09-2	Methylene chloride	27	440	1900	BD
108-87-2	Methyl cyclohexane	13	440		UD
1634-04-4	Methyl-tert-butyl ether	14	440		UD
108-10-1	4-Methyl-2-pentanone	25	220		UD
100-42-5	Styrene	15	220		UD
79-34-5	1,1,2,2-Tetrachloroethane	19	220		UD
127-18-4	Tetrachloroethene	42	440		UD

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB05
-SO-0406DL

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-06DL

Sample wt/vol: 6.3 (g/mL) G Lab File ID: 1203606D

Level: (low/med) MED Date Sampled: 12/02/08 10:20

% Moisture: not dec. 9 Date Analyzed: 12/13/08 05:57

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume: 5000(uL) Soil Aliquot Volume: 100(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	38	220		UD
120-82-1	1,2,4-Trichlorobenzene	7.9	440		UD
71-55-6	1,1,1-Trichloroethane	39	220		UD
79-00-5	1,1,2-Trichloroethane	15	220		UD
79-01-6	Trichloroethene	37	220		UD
76-13-1	Trichlorotrifluoroethane	24	220		UD
75-69-4	Trichlorofluoromethane	42	220		UD
75-01-4	Vinyl chloride	48	220		UD
1330-20-7	Xylene(total)	31	220	110	JD

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
5-SO-0608

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-07

Sample wt/vol: 6.3 (g/mL) G Lab File ID: 1203607A

Level: (low/med) LOW Date Sampled: 12/02/08 10:30

% Moisture: not dec. 11 Date Analyzed: 12/09/08 18:28

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	4.5	2.3	J
71-43-2	Benzene	0.42	4.5		U
75-27-4	Bromodichloromethane	0.27	4.5		U
75-25-2	Bromoform	0.89	8.9		U
74-83-9	Bromomethane	0.64	8.9		U
78-93-3	2-Butanone	1.2	4.5		U
75-15-0	Carbon disulfide	1.2	4.5		U
56-23-5	Carbon tetrachloride	0.78	4.5		U
108-90-7	Chlorobenzene	0.30	4.5		U
75-00-3	Chloroethane	0.98	8.9		U
67-66-3	Chloroform	0.49	8.9		U
74-87-3	Chloromethane	0.46	8.9		U
110-82-7	Cyclohexane	0.48	4.5		U
124-48-1	Dibromochloromethane	0.30	4.5		U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	4.5		U
106-93-4	1,2-Dibromoethane	0.38	4.5		U
95-50-1	1,2-Dichlorobenzene	0.33	4.5		U
541-73-1	1,3-Dichlorobenzene	0.75	4.5		U
106-46-7	1,4-Dichlorobenzene	0.49	4.5		U
75-71-8	Dichlorodifluoromethane	0.98	4.5		U
75-34-3	1,1-Dichloroethane	0.48	4.5		U
107-06-2	1,2-Dichloroethane	0.41	4.5		U
75-35-4	1,1-Dichloroethene	1.1	8.9		U
156-59-2	cis-1,2-Dichloroethene	1.1	8.9		U
156-60-5	trans-1,2-Dichloroethene	0.98	4.5		U
78-87-5	1,2-Dichloropropane	0.41	4.5		U
10061-01-5	cis-1,3-Dichloropropene	0.45	4.5		U
10061-02-6	trans-1,3-Dichloropropene	0.28	4.5		U
100-41-4	Ethylbenzene	0.67	4.5		U
591-78-6	2-Hexanone	2.0	4.5		U
98-82-8	Isopropylbenzene	0.78	4.5		U
79-20-9	Methyl acetate	1.4	8.9		U
75-09-2	Methylene chloride	0.55	8.9	5.6	JB
108-87-2	Methyl cyclohexane	0.27	8.9		U
1634-04-4	Methyl-tert-butyl ether	0.28	8.9		U
108-10-1	4-Methyl-2-pentanone	0.52	4.5		U
100-42-5	Styrene	0.31	4.5		U
79-34-5	1,1,2,2-Tetrachloroethane	0.38	4.5		U
127-18-4	Tetrachloroethene	0.86	8.9		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
5-SO-0608

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-07

Sample wt/vol: 6.3 (g/mL) G Lab File ID: 1203607A

Level: (low/med) LOW Date Sampled: 12/02/08 10:30

% Moisture: not dec. 11 Date Analyzed: 12/09/08 18:28

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.77	4.5		U
120-82-1	1,2,4-Trichlorobenzene	0.16	8.9		U
71-55-6	1,1,1-Trichloroethane	0.80	4.5		U
79-00-5	1,1,2-Trichloroethane	0.31	4.5		U
79-01-6	Trichloroethene	0.76	4.5		U
76-13-1	Trichlorotrifluoroethane	0.49	4.5		U
75-69-4	Trichlorofluoromethane	0.85	4.5		U
75-01-4	Vinyl chloride	0.98	4.5		U
1330-20-7	Xylene(total)	0.62	4.5		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
6-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-08

Sample wt/vol: 4.2 (g/mL) G Lab File ID: 1203608A

Level: (low/med) LOW Date Sampled: 12/02/08 11:30

% Moisture: not dec. 15 Date Analyzed: 12/09/08 19:07

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.8	7.0		U
71-43-2	Benzene	0.66	7.0		U
75-27-4	Bromodichloromethane	0.42	7.0		U
75-25-2	Bromoform	1.4	14		U
74-83-9	Bromomethane	1.0	14		U
78-93-3	2-Butanone	2.0	7.0		U
75-15-0	Carbon disulfide	1.8	7.0		U
56-23-5	Carbon tetrachloride	1.2	7.0		U
108-90-7	Chlorobenzene	0.48	7.0		U
75-00-3	Chloroethane	1.5	14		U
67-66-3	Chloroform	0.77	14		U
74-87-3	Chloromethane	0.73	14		U
110-82-7	Cyclohexane	0.76	7.0		U
124-48-1	Dibromochloromethane	0.48	7.0		U
96-12-8	1,2-Dibromo-3-chloropropane	1.7	7.0		U
106-93-4	1,2-Dibromoethane	0.60	7.0		U
95-50-1	1,2-Dichlorobenzene	0.52	7.0		U
541-73-1	1,3-Dichlorobenzene	1.2	7.0		U
106-46-7	1,4-Dichlorobenzene	0.77	7.0		U
75-71-8	Dichlorodifluoromethane	1.5	7.0		U
75-34-3	1,1-Dichloroethane	0.76	7.0		U
107-06-2	1,2-Dichloroethane	0.64	7.0		U
75-35-4	1,1-Dichloroethene	1.7	14		U
156-59-2	cis-1,2-Dichloroethene	1.7	14		U
156-60-5	trans-1,2-Dichloroethene	1.5	7.0		U
78-87-5	1,2-Dichloropropane	0.64	7.0		U
10061-01-5	cis-1,3-Dichloropropene	0.70	7.0		U
10061-02-6	trans-1,3-Dichloropropene	0.45	7.0		U
100-41-4	Ethylbenzene	1.0	7.0		U
591-78-6	2-Hexanone	3.2	7.0		U
98-82-8	Isopropylbenzene	1.2	7.0		U
79-20-9	Methyl acetate	2.2	14		U
75-09-2	Methylene chloride	0.87	14	9.9	JB
108-87-2	Methyl cyclohexane	0.42	14		U
1634-04-4	Methyl-tert-butyl ether	0.45	14		U
108-10-1	4-Methyl-2-pentanone	0.81	7.0		U
100-42-5	Styrene	0.49	7.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.60	7.0		U
127-18-4	Tetrachloroethene	1.4	14		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
6-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-08

Sample wt/vol: 4.2 (g/mL) G Lab File ID: 1203608A

Level: (low/med) LOW Date Sampled: 12/02/08 11:30

% Moisture: not dec. 15 Date Analyzed: 12/09/08 19:07

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	1.2	7.0		U
120-82-1	1,2,4-Trichlorobenzene	0.25	14		U
71-55-6	1,1,1-Trichloroethane	1.3	7.0		U
79-00-5	1,1,2-Trichloroethane	0.49	7.0		U
79-01-6	Trichloroethene	1.2	7.0		U
76-13-1	Trichlorotrifluoroethane	0.77	7.0		U
75-69-4	Trichlorofluoromethane	1.3	7.0		U
75-01-4	Vinyl chloride	1.5	7.0		U
1330-20-7	Xylene(total)	0.98	7.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
6-SO-0608

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-09

Sample wt/vol: 5.8 (g/mL) G Lab File ID: 1203609A

Level: (low/med) LOW Date Sampled: 12/02/08 11:40

% Moisture: not dec. 11 Date Analyzed: 12/09/08 19:47

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.9	4.8	2.7	J
71-43-2	Benzene	0.45	4.8		U
75-27-4	Bromodichloromethane	0.29	4.8		U
75-25-2	Bromoform	0.97	9.7		U
74-83-9	Bromomethane	0.70	9.7		U
78-93-3	2-Butanone	1.4	4.8		U
75-15-0	Carbon disulfide	1.2	4.8		U
56-23-5	Carbon tetrachloride	0.85	4.8		U
108-90-7	Chlorobenzene	0.33	4.8		U
75-00-3	Chloroethane	1.1	9.7		U
67-66-3	Chloroform	0.53	9.7		U
74-87-3	Chloromethane	0.50	9.7		U
110-82-7	Cyclohexane	0.52	4.8		U
124-48-1	Dibromochloromethane	0.33	4.8		U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	4.8		U
106-93-4	1,2-Dibromoethane	0.42	4.8		U
95-50-1	1,2-Dichlorobenzene	0.36	4.8		U
541-73-1	1,3-Dichlorobenzene	0.81	4.8		U
106-46-7	1,4-Dichlorobenzene	0.53	4.8		U
75-71-8	Dichlorodifluoromethane	1.1	4.8		U
75-34-3	1,1-Dichloroethane	0.52	4.8		U
107-06-2	1,2-Dichloroethane	0.44	4.8		U
75-35-4	1,1-Dichloroethene	1.2	9.7		U
156-59-2	cis-1,2-Dichloroethene	1.2	9.7		U
156-60-5	trans-1,2-Dichloroethene	1.1	4.8		U
78-87-5	1,2-Dichloropropane	0.44	4.8		U
10061-01-5	cis-1,3-Dichloropropene	0.48	4.8		U
10061-02-6	trans-1,3-Dichloropropene	0.31	4.8		U
100-41-4	Ethylbenzene	0.72	4.8		U
591-78-6	2-Hexanone	2.2	4.8		U
98-82-8	Isopropylbenzene	0.85	4.8		U
79-20-9	Methyl acetate	1.5	9.7		U
75-09-2	Methylene chloride	0.60	9.7	6.8	JB
108-87-2	Methyl cyclohexane	0.29	9.7		U
1634-04-4	Methyl-tert-butyl ether	0.31	9.7		U
108-10-1	4-Methyl-2-pentanone	0.56	4.8		U
100-42-5	Styrene	0.34	4.8		U
79-34-5	1,1,2,2-Tetrachloroethane	0.42	4.8		U
127-18-4	Tetrachloroethene	0.94	9.7		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
6-SO-0608

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-09

Sample wt/vol: 5.8 (g/mL) G Lab File ID: 1203609A

Level: (low/med) LOW Date Sampled: 12/02/08 11:40

% Moisture: not dec. 11 Date Analyzed: 12/09/08 19:47

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.83	4.8		U
120-82-1	1,2,4-Trichlorobenzene	0.17	9.7		U
71-55-6	1,1,1-Trichloroethane	0.87	4.8		U
79-00-5	1,1,2-Trichloroethane	0.34	4.8		U
79-01-6	Trichloroethene	0.82	4.8		U
76-13-1	Trichlorotrifluoroethane	0.53	4.8		U
75-69-4	Trichlorofluoromethane	0.92	4.8		U
75-01-4	Vinyl chloride	1.1	4.8		U
1330-20-7	Xylene(total)	0.68	4.8		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
7-SO-0507

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-10

Sample wt/vol: 5.5 (g/mL) G Lab File ID: 1203610A

Level: (low/med) LOW Date Sampled: 12/02/08 13:11

% Moisture: not dec. 10 Date Analyzed: 12/09/08 20:26

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.0	5.1	3.2	J
71-43-2	Benzene	0.48	5.1		U
75-27-4	Bromodichloromethane	0.30	5.1		U
75-25-2	Bromoform	1.0	10		U
74-83-9	Bromomethane	0.73	10		U
78-93-3	2-Butanone	1.4	5.1		U
75-15-0	Carbon disulfide	1.3	5.1		U
56-23-5	Carbon tetrachloride	0.89	5.1		U
108-90-7	Chlorobenzene	0.34	5.1		U
75-00-3	Chloroethane	1.1	10		U
67-66-3	Chloroform	0.56	10		U
74-87-3	Chloromethane	0.53	10		U
110-82-7	Cyclohexane	0.55	5.1		U
124-48-1	Dibromochloromethane	0.34	5.1		U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	5.1		U
106-93-4	1,2-Dibromoethane	0.44	5.1		U
95-50-1	1,2-Dichlorobenzene	0.37	5.1		U
541-73-1	1,3-Dichlorobenzene	0.85	5.1		U
106-46-7	1,4-Dichlorobenzene	0.56	5.1		U
75-71-8	Dichlorodifluoromethane	1.1	5.1		U
75-34-3	1,1-Dichloroethane	0.55	5.1		U
107-06-2	1,2-Dichloroethane	0.46	5.1		U
75-35-4	1,1-Dichloroethene	1.2	10		U
156-59-2	cis-1,2-Dichloroethene	1.2	10		U
156-60-5	trans-1,2-Dichloroethene	1.1	5.1		U
78-87-5	1,2-Dichloropropane	0.46	5.1		U
10061-01-5	cis-1,3-Dichloropropene	0.51	5.1		U
10061-02-6	trans-1,3-Dichloropropene	0.32	5.1		U
100-41-4	Ethylbenzene	0.76	5.1		U
591-78-6	2-Hexanone	2.3	5.1		U
98-82-8	Isopropylbenzene	0.89	5.1		U
79-20-9	Methyl acetate	1.6	10		U
75-09-2	Methylene chloride	0.63	10	6.1	JB
108-87-2	Methyl cyclohexane	0.30	10		U
1634-04-4	Methyl-tert-butyl ether	0.32	10		U
108-10-1	4-Methyl-2-pentanone	0.59	5.1		U
100-42-5	Styrene	0.35	5.1		U
79-34-5	1,1,2,2-Tetrachloroethane	0.44	5.1		U
127-18-4	Tetrachloroethene	0.98	10		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
7-SO-0507

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-10

Sample wt/vol: 5.5 (g/mL) G Lab File ID: 1203610A

Level: (low/med) LOW Date Sampled: 12/02/08 13:11

% Moisture: not dec. 10 Date Analyzed: 12/09/08 20:26

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.87	5.1		U
120-82-1	1,2,4-Trichlorobenzene	0.18	10		U
71-55-6	1,1,1-Trichloroethane	0.91	5.1		U
79-00-5	1,1,2-Trichloroethane	0.35	5.1		U
79-01-6	Trichloroethene	0.86	5.1		U
76-13-1	Trichlorotrifluoroethane	0.56	5.1		U
75-69-4	Trichlorofluoromethane	0.96	5.1	3.9	J
75-01-4	Vinyl chloride	1.1	5.1		U
1330-20-7	Xylene(total)	0.71	5.1		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
8-SO-0103

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-11

Sample wt/vol: 6.0 (g/mL) G Lab File ID: 1203611A

Level: (low/med) LOW Date Sampled: 12/02/08 13:40

% Moisture: not dec. 12 Date Analyzed: 12/09/08 21:05

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.9	4.7		U
71-43-2	Benzene	0.44	4.7		U
75-27-4	Bromodichloromethane	0.28	4.7		U
75-25-2	Bromoform	0.94	9.4		U
74-83-9	Bromomethane	0.68	9.4		U
78-93-3	2-Butanone	1.3	4.7		U
75-15-0	Carbon disulfide	1.2	4.7		U
56-23-5	Carbon tetrachloride	0.83	4.7		U
108-90-7	Chlorobenzene	0.32	4.7		U
75-00-3	Chloroethane	1.0	9.4		U
67-66-3	Chloroform	0.52	9.4		U
74-87-3	Chloromethane	0.49	9.4		U
110-82-7	Cyclohexane	0.51	4.7		U
124-48-1	Dibromochloromethane	0.32	4.7		U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	4.7		U
106-93-4	1,2-Dibromoethane	0.41	4.7		U
95-50-1	1,2-Dichlorobenzene	0.35	4.7		U
541-73-1	1,3-Dichlorobenzene	0.79	4.7		U
106-46-7	1,4-Dichlorobenzene	0.52	4.7		U
75-71-8	Dichlorodifluoromethane	1.0	4.7		U
75-34-3	1,1-Dichloroethane	0.51	4.7		U
107-06-2	1,2-Dichloroethane	0.44	4.7		U
75-35-4	1,1-Dichloroethene	1.1	9.4		U
156-59-2	cis-1,2-Dichloroethene	1.1	9.4		U
156-60-5	trans-1,2-Dichloroethene	1.0	4.7		U
78-87-5	1,2-Dichloropropane	0.44	4.7		U
10061-01-5	cis-1,3-Dichloropropene	0.47	4.7		U
10061-02-6	trans-1,3-Dichloropropene	0.30	4.7		U
100-41-4	Ethylbenzene	0.71	4.7		U
591-78-6	2-Hexanone	2.2	4.7		U
98-82-8	Isopropylbenzene	0.83	4.7		U
79-20-9	Methyl acetate	1.5	9.4		U
75-09-2	Methylene chloride	0.59	9.4	6.2	JB
108-87-2	Methyl cyclohexane	0.28	9.4		U
1634-04-4	Methyl-tert-butyl ether	0.30	9.4		U
108-10-1	4-Methyl-2-pentanone	0.55	4.7		U
100-42-5	Styrene	0.33	4.7		U
79-34-5	1,1,2,2-Tetrachloroethane	0.41	4.7		U
127-18-4	Tetrachloroethene	0.92	9.4		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
8-SO-0103

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-11

Sample wt/vol: 6.0 (g/mL) G Lab File ID: 1203611A

Level: (low/med) LOW Date Sampled: 12/02/08 13:40

% Moisture: not dec. 12 Date Analyzed: 12/09/08 21:05

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.81	4.7		U
120-82-1	1,2,4-Trichlorobenzene	0.17	9.4		U
71-55-6	1,1,1-Trichloroethane	0.85	4.7		U
79-00-5	1,1,2-Trichloroethane	0.33	4.7		U
79-01-6	Trichloroethene	0.80	4.7		U
76-13-1	Trichlorotrifluoroethane	0.52	4.7		U
75-69-4	Trichlorofluoromethane	0.90	4.7		U
75-01-4	Vinyl chloride	1.0	4.7		U
1330-20-7	Xylene(total)	0.66	4.7		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
8-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-12

Sample wt/vol: 4.2 (g/mL) G Lab File ID: 1203612A

Level: (low/med) LOW Date Sampled: 12/02/08 13:45

% Moisture: not dec. 11 Date Analyzed: 12/10/08 01:29

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.7	6.7		U
71-43-2	Benzene	0.63	6.7		U
75-27-4	Bromodichloromethane	0.40	6.7		U
75-25-2	Bromoform	1.3	13		U
74-83-9	Bromomethane	0.97	13		U
78-93-3	2-Butanone	1.9	6.7		U
75-15-0	Carbon disulfide	1.7	6.7		U
56-23-5	Carbon tetrachloride	1.2	6.7		U
108-90-7	Chlorobenzene	0.46	6.7		U
75-00-3	Chloroethane	1.5	13		U
67-66-3	Chloroform	0.74	13		U
74-87-3	Chloromethane	0.70	13		U
110-82-7	Cyclohexane	0.72	6.7		U
124-48-1	Dibromochloromethane	0.46	6.7		U
96-12-8	1,2-Dibromo-3-chloropropane	1.6	6.7		U
106-93-4	1,2-Dibromoethane	0.58	6.7		U
95-50-1	1,2-Dichlorobenzene	0.50	6.7		U
541-73-1	1,3-Dichlorobenzene	1.1	6.7		U
106-46-7	1,4-Dichlorobenzene	0.74	6.7		U
75-71-8	Dichlorodifluoromethane	1.5	6.7		U
75-34-3	1,1-Dichloroethane	0.72	6.7		U
107-06-2	1,2-Dichloroethane	0.62	6.7		U
75-35-4	1,1-Dichloroethene	1.6	13		U
156-59-2	cis-1,2-Dichloroethene	1.6	13		U
156-60-5	trans-1,2-Dichloroethene	1.5	6.7		U
78-87-5	1,2-Dichloropropane	0.62	6.7		U
10061-01-5	cis-1,3-Dichloropropene	0.67	6.7		U
10061-02-6	trans-1,3-Dichloropropene	0.43	6.7		U
100-41-4	Ethylbenzene	1.0	6.7		U
591-78-6	2-Hexanone	3.1	6.7		U
98-82-8	Isopropylbenzene	1.2	6.7		U
79-20-9	Methyl acetate	2.1	13		U
75-09-2	Methylene chloride	0.83	13	8.6	JB
108-87-2	Methyl cyclohexane	0.40	13		U
1634-04-4	Methyl-tert-butyl ether	0.43	13		U
108-10-1	4-Methyl-2-pentanone	0.78	6.7		U
100-42-5	Styrene	0.47	6.7		U
79-34-5	1,1,2,2-Tetrachloroethane	0.58	6.7		U
127-18-4	Tetrachloroethene	1.3	13		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
8-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-12

Sample wt/vol: 4.2 (g/mL) G Lab File ID: 1203612A

Level: (low/med) LOW Date Sampled: 12/02/08 13:45

% Moisture: not dec. 11 Date Analyzed: 12/10/08 01:29

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	1.2	6.7		U
120-82-1	1,2,4-Trichlorobenzene	0.24	13		U
71-55-6	1,1,1-Trichloroethane	1.2	6.7		U
79-00-5	1,1,2-Trichloroethane	0.47	6.7		U
79-01-6	Trichloroethene	1.1	6.7		U
76-13-1	Trichlorotrifluoroethane	0.74	6.7		U
75-69-4	Trichlorofluoromethane	1.3	6.7		U
75-01-4	Vinyl chloride	1.5	6.7		U
1330-20-7	Xylene(total)	0.94	6.7		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
9-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-13

Sample wt/vol: 5.7 (g/mL) G Lab File ID: 1203613A

Level: (low/med) LOW Date Sampled: 12/02/08 14:10

% Moisture: not dec. 14 Date Analyzed: 12/10/08 02:08

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.0	5.1	15	
71-43-2	Benzene	0.48	5.1		U
75-27-4	Bromodichloromethane	0.30	5.1		U
75-25-2	Bromoform	1.0	10		U
74-83-9	Bromomethane	0.73	10		U
78-93-3	2-Butanone	1.4	5.1		U
75-15-0	Carbon disulfide	1.3	5.1		U
56-23-5	Carbon tetrachloride	0.89	5.1		U
108-90-7	Chlorobenzene	0.34	5.1		U
75-00-3	Chloroethane	1.1	10		U
67-66-3	Chloroform	0.56	10		U
74-87-3	Chloromethane	0.53	10		U
110-82-7	Cyclohexane	0.55	5.1		U
124-48-1	Dibromochloromethane	0.34	5.1		U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	5.1		U
106-93-4	1,2-Dibromoethane	0.44	5.1		U
95-50-1	1,2-Dichlorobenzene	0.38	5.1		U
541-73-1	1,3-Dichlorobenzene	0.85	5.1		U
106-46-7	1,4-Dichlorobenzene	0.56	5.1		U
75-71-8	Dichlorodifluoromethane	1.1	5.1		U
75-34-3	1,1-Dichloroethane	0.55	5.1		U
107-06-2	1,2-Dichloroethane	0.47	5.1		U
75-35-4	1,1-Dichloroethene	1.2	10		U
156-59-2	cis-1,2-Dichloroethene	1.2	10		U
156-60-5	trans-1,2-Dichloroethene	1.1	5.1		U
78-87-5	1,2-Dichloropropane	0.47	5.1		U
10061-01-5	cis-1,3-Dichloropropene	0.51	5.1		U
10061-02-6	trans-1,3-Dichloropropene	0.32	5.1		U
100-41-4	Ethylbenzene	0.76	5.1		U
591-78-6	2-Hexanone	2.3	5.1		U
98-82-8	Isopropylbenzene	0.89	5.1		U
79-20-9	Methyl acetate	1.6	10		U
75-09-2	Methylene chloride	0.63	10	5.6	JB
108-87-2	Methyl cyclohexane	0.30	10		U
1634-04-4	Methyl-tert-butyl ether	0.32	10		U
108-10-1	4-Methyl-2-pentanone	0.59	5.1		U
100-42-5	Styrene	0.35	5.1		U
79-34-5	1,1,2,2-Tetrachloroethane	0.44	5.1		U
127-18-4	Tetrachloroethene	0.98	10		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
9-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-13

Sample wt/vol: 5.7 (g/mL) G Lab File ID: 1203613A

Level: (low/med) LOW Date Sampled: 12/02/08 14:10

% Moisture: not dec. 14 Date Analyzed: 12/10/08 02:08

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.87	5.1		U
120-82-1	1,2,4-Trichlorobenzene	0.18	10		U
71-55-6	1,1,1-Trichloroethane	0.91	5.1		U
79-00-5	1,1,2-Trichloroethane	0.35	5.1		U
79-01-6	Trichloroethene	0.86	5.1		U
76-13-1	Trichlorotrifluoroethane	0.56	5.1		U
75-69-4	Trichlorofluoromethane	0.96	5.1		U
75-01-4	Vinyl chloride	1.1	5.1		U
1330-20-7	Xylene(total)	0.71	5.1		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
9-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-14

Sample wt/vol: 6.7 (g/mL) G Lab File ID: 1203614A

Level: (low/med) LOW Date Sampled: 12/02/08 14:20

% Moisture: not dec. 11 Date Analyzed: 12/10/08 02:47

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.7	4.2	2.6	J
71-43-2	Benzene	0.39	4.2		U
75-27-4	Bromodichloromethane	0.25	4.2		U
75-25-2	Bromoform	0.84	8.4		U
74-83-9	Bromomethane	0.60	8.4		U
78-93-3	2-Butanone	1.2	4.2		U
75-15-0	Carbon disulfide	1.1	4.2		U
56-23-5	Carbon tetrachloride	0.74	4.2		U
108-90-7	Chlorobenzene	0.28	4.2		U
75-00-3	Chloroethane	0.92	8.4		U
67-66-3	Chloroform	0.46	8.4		U
74-87-3	Chloromethane	0.43	8.4		U
110-82-7	Cyclohexane	0.45	4.2		U
124-48-1	Dibromochloromethane	0.28	4.2		U
96-12-8	1,2-Dibromo-3-chloropropane	1.0	4.2		U
106-93-4	1,2-Dibromoethane	0.36	4.2		U
95-50-1	1,2-Dichlorobenzene	0.31	4.2		U
541-73-1	1,3-Dichlorobenzene	0.70	4.2		U
106-46-7	1,4-Dichlorobenzene	0.46	4.2		U
75-71-8	Dichlorodifluoromethane	0.92	4.2		U
75-34-3	1,1-Dichloroethane	0.45	4.2		U
107-06-2	1,2-Dichloroethane	0.38	4.2		U
75-35-4	1,1-Dichloroethene	1.0	8.4		U
156-59-2	cis-1,2-Dichloroethene	1.0	8.4		U
156-60-5	trans-1,2-Dichloroethene	0.92	4.2		U
78-87-5	1,2-Dichloropropane	0.38	4.2		U
10061-01-5	cis-1,3-Dichloropropene	0.42	4.2		U
10061-02-6	trans-1,3-Dichloropropene	0.27	4.2		U
100-41-4	Ethylbenzene	0.63	4.2		U
591-78-6	2-Hexanone	1.9	4.2		U
98-82-8	Isopropylbenzene	0.74	4.2		U
79-20-9	Methyl acetate	1.3	8.4		U
75-09-2	Methylene chloride	0.52	8.4	5.5	JB
108-87-2	Methyl cyclohexane	0.25	8.4		U
1634-04-4	Methyl-tert-butyl ether	0.27	8.4		U
108-10-1	4-Methyl-2-pentanone	0.48	4.2		U
100-42-5	Styrene	0.29	4.2		U
79-34-5	1,1,2,2-Tetrachloroethane	0.36	4.2		U
127-18-4	Tetrachloroethene	0.81	8.4		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
9-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-14

Sample wt/vol: 6.7 (g/mL) G Lab File ID: 1203614A

Level: (low/med) LOW Date Sampled: 12/02/08 14:20

% Moisture: not dec. 11 Date Analyzed: 12/10/08 02:47

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.72	4.2		U
120-82-1	1,2,4-Trichlorobenzene	0.15	8.4		U
71-55-6	1,1,1-Trichloroethane	0.75	4.2		U
79-00-5	1,1,2-Trichloroethane	0.29	4.2		U
79-01-6	Trichloroethene	0.71	4.2		U
76-13-1	Trichlorotrifluoroethane	0.46	4.2		U
75-69-4	Trichlorofluoromethane	0.79	4.2		U
75-01-4	Vinyl chloride	0.92	4.2		U
1330-20-7	Xylene(total)	0.58	4.2		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
0-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-15

Sample wt/vol: 4.7 (g/mL) G Lab File ID: 1203615A

Level: (low/med) LOW Date Sampled: 12/02/08 15:02

% Moisture: not dec. 15 Date Analyzed: 12/10/08 03:26

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.5	6.3	16	
71-43-2	Benzene	0.59	6.3		U
75-27-4	Bromodichloromethane	0.38	6.3		U
75-25-2	Bromoform	1.2	12		U
74-83-9	Bromomethane	0.90	12		U
78-93-3	2-Butanone	1.8	6.3		U
75-15-0	Carbon disulfide	1.6	6.3		U
56-23-5	Carbon tetrachloride	1.1	6.3		U
108-90-7	Chlorobenzene	0.43	6.3		U
75-00-3	Chloroethane	1.4	12		U
67-66-3	Chloroform	0.69	12		U
74-87-3	Chloromethane	0.65	12		U
110-82-7	Cyclohexane	0.68	6.3		U
124-48-1	Dibromochloromethane	0.43	6.3		U
96-12-8	1,2-Dibromo-3-chloropropane	1.5	6.3		U
106-93-4	1,2-Dibromoethane	0.54	6.3		U
95-50-1	1,2-Dichlorobenzene	0.46	6.3		U
541-73-1	1,3-Dichlorobenzene	1.0	6.3		U
106-46-7	1,4-Dichlorobenzene	0.69	6.3		U
75-71-8	Dichlorodifluoromethane	1.4	6.3		U
75-34-3	1,1-Dichloroethane	0.68	6.3		U
107-06-2	1,2-Dichloroethane	0.58	6.3		U
75-35-4	1,1-Dichloroethene	1.5	12		U
156-59-2	cis-1,2-Dichloroethene	1.5	12		U
156-60-5	trans-1,2-Dichloroethene	1.4	6.3		U
78-87-5	1,2-Dichloropropane	0.58	6.3		U
10061-01-5	cis-1,3-Dichloropropene	0.63	6.3		U
10061-02-6	trans-1,3-Dichloropropene	0.40	6.3		U
100-41-4	Ethylbenzene	0.94	6.3		U
591-78-6	2-Hexanone	2.9	6.3		U
98-82-8	Isopropylbenzene	1.1	6.3		U
79-20-9	Methyl acetate	2.0	12		U
75-09-2	Methylene chloride	0.78	12	9.2	JB
108-87-2	Methyl cyclohexane	0.38	12		U
1634-04-4	Methyl-tert-butyl ether	0.40	12		U
108-10-1	4-Methyl-2-pentanone	0.73	6.3		U
100-42-5	Styrene	0.44	6.3		U
79-34-5	1,1,2,2-Tetrachloroethane	0.54	6.3		U
127-18-4	Tetrachloroethene	1.2	12		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
0-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-15

Sample wt/vol: 4.7 (g/mL) G Lab File ID: 1203615A

Level: (low/med) LOW Date Sampled: 12/02/08 15:02

% Moisture: not dec. 15 Date Analyzed: 12/10/08 03:26

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	1.1	6.3		U
120-82-1	1,2,4-Trichlorobenzene	0.23	12		U
71-55-6	1,1,1-Trichloroethane	1.1	6.3		U
79-00-5	1,1,2-Trichloroethane	0.44	6.3		U
79-01-6	Trichloroethene	1.1	6.3		U
76-13-1	Trichlorotrifluoroethane	0.69	6.3		U
75-69-4	Trichlorofluoromethane	1.2	6.3		U
75-01-4	Vinyl chloride	1.4	6.3		U
1330-20-7	Xylene(total)	0.88	6.3		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
0-SO-0507

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-16

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1203616A

Level: (low/med) LOW Date Sampled: 12/02/08 15:08

% Moisture: not dec. 14 Date Analyzed: 12/10/08 04:06

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	4.4		U
71-43-2	Benzene	0.42	4.4		U
75-27-4	Bromodichloromethane	0.26	4.4		U
75-25-2	Bromoform	0.88	8.8		U
74-83-9	Bromomethane	0.64	8.8		U
78-93-3	2-Butanone	1.2	4.4		U
75-15-0	Carbon disulfide	1.2	4.4		U
56-23-5	Carbon tetrachloride	0.78	4.4		U
108-90-7	Chlorobenzene	0.30	4.4		U
75-00-3	Chloroethane	0.97	8.8		U
67-66-3	Chloroform	0.49	8.8		U
74-87-3	Chloromethane	0.46	8.8		U
110-82-7	Cyclohexane	0.48	4.4		U
124-48-1	Dibromochloromethane	0.30	4.4		U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	4.4		U
106-93-4	1,2-Dibromoethane	0.38	4.4		U
95-50-1	1,2-Dichlorobenzene	0.33	4.4		U
541-73-1	1,3-Dichlorobenzene	0.74	4.4		U
106-46-7	1,4-Dichlorobenzene	0.49	4.4		U
75-71-8	Dichlorodifluoromethane	0.97	4.4		U
75-34-3	1,1-Dichloroethane	0.48	4.4		U
107-06-2	1,2-Dichloroethane	0.41	4.4		U
75-35-4	1,1-Dichloroethene	1.1	8.8		U
156-59-2	cis-1,2-Dichloroethene	1.1	8.8		U
156-60-5	trans-1,2-Dichloroethene	0.97	4.4		U
78-87-5	1,2-Dichloropropane	0.41	4.4		U
10061-01-5	cis-1,3-Dichloropropene	0.44	4.4		U
10061-02-6	trans-1,3-Dichloropropene	0.28	4.4		U
100-41-4	Ethylbenzene	0.66	4.4		U
591-78-6	2-Hexanone	2.0	4.4		U
98-82-8	Isopropylbenzene	0.78	4.4		U
79-20-9	Methyl acetate	1.4	8.8		U
75-09-2	Methylene chloride	0.55	8.8	4.3	JB
108-87-2	Methyl cyclohexane	0.26	8.8		U
1634-04-4	Methyl-tert-butyl ether	0.28	8.8		U
108-10-1	4-Methyl-2-pentanone	0.51	4.4		U
100-42-5	Styrene	0.31	4.4		U
79-34-5	1,1,2,2-Tetrachloroethane	0.38	4.4		U
127-18-4	Tetrachloroethene	0.86	8.8		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
0-SO-0507

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-16

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1203616A

Level: (low/med) LOW Date Sampled: 12/02/08 15:08

% Moisture: not dec. 14 Date Analyzed: 12/10/08 04:06

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.76	4.4		U
120-82-1	1,2,4-Trichlorobenzene	0.16	8.8		U
71-55-6	1,1,1-Trichloroethane	0.80	4.4		U
79-00-5	1,1,2-Trichloroethane	0.31	4.4		U
79-01-6	Trichloroethene	0.75	4.4		U
76-13-1	Trichlorotrifluoroethane	0.49	4.4		U
75-69-4	Trichlorofluoromethane	0.84	4.4		U
75-01-4	Vinyl chloride	0.97	4.4		U
1330-20-7	Xylene(total)	0.62	4.4		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
1-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-17

Sample wt/vol: 4.8 (g/mL) G Lab File ID: 1203617A

Level: (low/med) LOW Date Sampled: 12/02/08 15:47

% Moisture: not dec. 21 Date Analyzed: 12/10/08 04:45

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.6	6.6	29	
71-43-2	Benzene	0.62	6.6		U
75-27-4	Bromodichloromethane	0.40	6.6		U
75-25-2	Bromoform	1.3	13		U
74-83-9	Bromomethane	0.95	13		U
78-93-3	2-Butanone	1.8	6.6	2.5	J
75-15-0	Carbon disulfide	1.7	6.6		U
56-23-5	Carbon tetrachloride	1.2	6.6		U
108-90-7	Chlorobenzene	0.45	6.6		U
75-00-3	Chloroethane	1.4	13		U
67-66-3	Chloroform	0.72	13		U
74-87-3	Chloromethane	0.68	13		U
110-82-7	Cyclohexane	0.71	6.6		U
124-48-1	Dibromochloromethane	0.45	6.6		U
96-12-8	1,2-Dibromo-3-chloropropane	1.6	6.6		U
106-93-4	1,2-Dibromoethane	0.57	6.6		U
95-50-1	1,2-Dichlorobenzene	0.49	6.6		U
541-73-1	1,3-Dichlorobenzene	1.1	6.6		U
106-46-7	1,4-Dichlorobenzene	0.72	6.6		U
75-71-8	Dichlorodifluoromethane	1.4	6.6		U
75-34-3	1,1-Dichloroethane	0.71	6.6		U
107-06-2	1,2-Dichloroethane	0.60	6.6		U
75-35-4	1,1-Dichloroethene	1.6	13		U
156-59-2	cis-1,2-Dichloroethene	1.6	13		U
156-60-5	trans-1,2-Dichloroethene	1.4	6.6		U
78-87-5	1,2-Dichloropropane	0.60	6.6		U
10061-01-5	cis-1,3-Dichloropropene	0.66	6.6		U
10061-02-6	trans-1,3-Dichloropropene	0.42	6.6		U
100-41-4	Ethylbenzene	0.99	6.6		U
591-78-6	2-Hexanone	3.0	6.6		U
98-82-8	Isopropylbenzene	1.2	6.6		U
79-20-9	Methyl acetate	2.1	13		U
75-09-2	Methylene chloride	0.82	13	8.1	JB
108-87-2	Methyl cyclohexane	0.40	13		U
1634-04-4	Methyl-tert-butyl ether	0.42	13		U
108-10-1	4-Methyl-2-pentanone	0.76	6.6		U
100-42-5	Styrene	0.46	6.6		U
79-34-5	1,1,2,2-Tetrachloroethane	0.57	6.6		U
127-18-4	Tetrachloroethene	1.3	13		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
1-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-17

Sample wt/vol: 4.8 (g/mL) G Lab File ID: 1203617A

Level: (low/med) LOW Date Sampled: 12/02/08 15:47

% Moisture: not dec. 21 Date Analyzed: 12/10/08 04:45

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	1.1	6.6		U
120-82-1	1,2,4-Trichlorobenzene	0.24	13		U
71-55-6	1,1,1-Trichloroethane	1.2	6.6		U
79-00-5	1,1,2-Trichloroethane	0.46	6.6		U
79-01-6	Trichloroethene	1.1	6.6		U
76-13-1	Trichlorotrifluoroethane	0.72	6.6		U
75-69-4	Trichlorofluoromethane	1.2	6.6		U
75-01-4	Vinyl chloride	1.4	6.6		U
1330-20-7	Xylene(total)	0.92	6.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19TB120208

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) WATER Lab Sample ID: 0812036-18

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1203618

Level: (low/med) LOW Date Sampled: 12/02/08 08:00

% Moisture: not dec. _____ Date Analyzed: 12/15/08 18:54

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	0.84	10		U
71-43-2	Benzene	0.11	1.0		U
75-27-4	Bromodichloromethane	0.10	1.0		U
75-25-2	Bromoform	0.10	1.0		U
74-83-9	Bromomethane	0.32	1.0		U
78-93-3	2-Butanone	1.0	10		U
75-15-0	Carbon disulfide	0.13	1.0		U
56-23-5	Carbon tetrachloride	0.15	1.0		U
108-90-7	Chlorobenzene	0.10	1.0		U
75-00-3	Chloroethane	0.18	2.0		U
67-66-3	Chloroform	0.11	1.0		U
74-87-3	Chloromethane	0.29	2.0		U
110-82-7	Cyclohexane	0.20	1.0		U
124-48-1	Dibromochloromethane	0.10	1.0		U
96-12-8	1,2-Dibromo-3-chloropropane	0.11	1.0		U
106-93-4	1,2-Dibromoethane	0.10	1.0		U
95-50-1	1,2-Dichlorobenzene	0.10	1.0		U
541-73-1	1,3-Dichlorobenzene	0.13	1.0		U
106-46-7	1,4-Dichlorobenzene	0.10	1.0		U
75-71-8	Dichlorodifluoromethane	0.22	2.0		U
75-34-3	1,1-Dichloroethane	0.12	1.0		U
107-06-2	1,2-Dichloroethane	0.10	1.0		U
75-35-4	1,1-Dichloroethene	0.15	2.0		U
156-59-2	cis-1,2-Dichloroethene	0.13	1.0		U
156-60-5	trans-1,2-Dichloroethene	0.13	1.0		U
78-87-5	1,2-Dichloropropane	0.10	1.0		U
10061-01-5	cis-1,3-Dichloropropene	0.11	1.0		U
10061-02-6	trans-1,3-Dichloropropene	0.10	1.0		U
100-41-4	Ethylbenzene	0.13	1.0		U
591-78-6	2-Hexanone	0.30	5.0		U
98-82-8	Isopropylbenzene	0.15	1.0		U
79-20-9	Methyl acetate	0.30	3.0		U
75-09-2	Methylene chloride	0.14	2.0	2.1	B
108-87-2	Methyl cyclohexane	0.17	1.0		U
1634-04-4	Methyl-tert-butyl ether	0.10	1.0		U
108-10-1	4-Methyl-2-pentanone	0.29	10		U
100-42-5	Styrene	0.10	1.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.10	1.0		U
127-18-4	Tetrachloroethene	0.15	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19TB120208

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) WATER Lab Sample ID: 0812036-18

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1203618

Level: (low/med) LOW Date Sampled: 12/02/08 08:00

% Moisture: not dec. _____ Date Analyzed: 12/15/08 18:54

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.10	1.0		U
120-82-1	1,2,4-Trichlorobenzene	0.10	2.0	0.14	J
71-55-6	1,1,1-Trichloroethane	0.17	1.0		U
79-00-5	1,1,2-Trichloroethane	0.10	1.0		U
79-01-6	Trichloroethene	0.13	1.0		U
76-13-1	Trichlorotrifluoroethane	0.18	2.0		U
75-69-4	Trichlorofluoromethane	0.17	2.0		U
75-01-4	Vinyl chloride	0.18	2.0		U
1330-20-7	Xylene(total)	0.22	1.0		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
1-SO-0608

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-01

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203601

% Moisture: 17 decanted: (Y/N) N Date Sampled: 12/02/08 08:20

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 16:35

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	4.0		U
208-96-8	Acenaphthylene	1.4	4.0		U
120-12-7	Anthracene	0.96	4.0		U
56-55-3	Benzo(a)anthracene	1.7	4.0		U
205-99-2	Benzo(b)fluoranthene	1.8	4.0		U
207-08-9	Benzo(k)fluoranthene	1.5	4.0		U
191-24-2	Benzo(g,h,i)perylene	1.8	4.0	3.7	J
50-32-8	Benzo(a)pyrene	1.2	4.0		U
218-01-9	Chrysene	1.3	4.0		U
53-70-3	Dibenz(a,h)anthracene	1.8	4.0		U
206-44-0	Fluoranthene	2.0	4.0		U
86-73-7	Fluorene	1.4	4.0		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	4.0		U
91-57-6	2-Methylnaphthalene	2.0	4.0		U
91-20-3	Naphthalene	2.8	4.0		U
85-01-8	Phenanthrene	2.0	4.0	5.7	
129-00-0	Pyrene	1.8	4.0	4.5	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
2-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-02

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203602

% Moisture: 19 decanted: (Y/N) N Date Sampled: 12/02/08 08:52

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 17:04

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.5	4.1		U
208-96-8	Acenaphthylene	1.4	4.1		U
120-12-7	Anthracene	0.99	4.1		U
56-55-3	Benzo(a)anthracene	1.7	4.1		U
205-99-2	Benzo(b)fluoranthene	1.9	4.1		U
207-08-9	Benzo(k)fluoranthene	1.6	4.1		U
191-24-2	Benzo(g,h,i)perylene	1.8	4.1	2.2	J
50-32-8	Benzo(a)pyrene	1.2	4.1		U
218-01-9	Chrysene	1.3	4.1	2.4	J
53-70-3	Dibenz(a,h)anthracene	1.9	4.1		U
206-44-0	Fluoranthene	2.1	4.1		U
86-73-7	Fluorene	1.5	4.1		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.9	4.1		U
91-57-6	2-Methylnaphthalene	2.1	4.1		U
91-20-3	Naphthalene	2.9	4.1		U
85-01-8	Phenanthrene	2.1	4.1		U
129-00-0	Pyrene	1.9	4.1		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
3-SO-0103

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-03

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203603

% Moisture: 15 decanted: (Y/N) N Date Sampled: 12/02/08 09:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 17:33

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.9		U
208-96-8	Acenaphthylene	1.3	3.9	1.4	J
120-12-7	Anthracene	0.94	3.9		U
56-55-3	Benzo(a)anthracene	1.6	3.9	19	
205-99-2	Benzo(b)fluoranthene	1.8	3.9	18	
207-08-9	Benzo(k)fluoranthene	1.5	3.9	8.5	
191-24-2	Benzo(g,h,i)perylene	1.7	3.9	13	
50-32-8	Benzo(a)pyrene	1.2	3.9	21	
218-01-9	Chrysene	1.2	3.9	19	
53-70-3	Dibenz(a,h)anthracene	1.8	3.9		U
206-44-0	Fluoranthene	2.0	3.9	26	
86-73-7	Fluorene	1.4	3.9		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.9	9.5	
91-57-6	2-Methylnaphthalene	2.0	3.9		U
91-20-3	Naphthalene	2.7	3.9		U
85-01-8	Phenanthrene	2.0	3.9	7.0	
129-00-0	Pyrene	1.8	3.9	29	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
3-SO-0810

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-04

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203604

% Moisture: 13 decanted: (Y/N) N Date Sampled: 12/02/08 09:10

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 18:02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8		U
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.92	3.8		U
56-55-3	Benzo(a)anthracene	1.6	3.8		U
205-99-2	Benzo(b)fluoranthene	1.8	3.8		U
207-08-9	Benzo(k)fluoranthene	1.4	3.8		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.8	5.6	
50-32-8	Benzo(a)pyrene	1.1	3.8		U
218-01-9	Chrysene	1.2	3.8		U
53-70-3	Dibenz(a,h)anthracene	1.8	3.8		U
206-44-0	Fluoranthene	1.9	3.8		U
86-73-7	Fluorene	1.4	3.8		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.8		U
91-57-6	2-Methylnaphthalene	1.9	3.8		U
91-20-3	Naphthalene	2.7	3.8		U
85-01-8	Phenanthrene	1.9	3.8	17	
129-00-0	Pyrene	1.8	3.8		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
4-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-05

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203605

% Moisture: 17 decanted: (Y/N) N Date Sampled: 12/02/08 09:45

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/04/08

Concentrated Extract Volume: 1000.0 (uL) Date Analyzed: 12/11/08 18:31

Injection Volume: 1.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	4.0		U
208-96-8	Acenaphthylene	1.4	4.0	1.7	J
120-12-7	Anthracene	0.96	4.0		U
56-55-3	Benzo(a)anthracene	1.7	4.0	16	
205-99-2	Benzo(b)fluoranthene	1.8	4.0	15	
207-08-9	Benzo(k)fluoranthene	1.5	4.0	6.1	
191-24-2	Benzo(g,h,i)perylene	1.8	4.0	11	
50-32-8	Benzo(a)pyrene	1.2	4.0	18	
218-01-9	Chrysene	1.3	4.0	17	
53-70-3	Dibenz(a,h)anthracene	1.8	4.0		U
206-44-0	Fluoranthene	2.0	4.0	28	
86-73-7	Fluorene	1.4	4.0		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	4.0	6.5	
91-57-6	2-Methylnaphthalene	2.0	4.0		U
91-20-3	Naphthalene	2.8	4.0		U
85-01-8	Phenanthrene	2.0	4.0	16	
129-00-0	Pyrene	1.8	4.0	27	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
5-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-06

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203606

% Moisture: 9 decanted: (Y/N) N Date Sampled: 12/02/08 10:20

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 19:00

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.3	3.7		U
208-96-8	Acenaphthylene	1.2	3.7		U
120-12-7	Anthracene	0.88	3.7		U
56-55-3	Benzo(a)anthracene	1.5	3.7		U
205-99-2	Benzo(b)fluoranthene	1.7	3.7		U
207-08-9	Benzo(k)fluoranthene	1.4	3.7		U
191-24-2	Benzo(g,h,i)perylene	1.6	3.7	5.8	
50-32-8	Benzo(a)pyrene	1.1	3.7		U
218-01-9	Chrysene	1.2	3.7		U
53-70-3	Dibenz(a,h)anthracene	1.7	3.7		U
206-44-0	Fluoranthene	1.8	3.7		U
86-73-7	Fluorene	1.3	3.7		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.7		U
91-57-6	2-Methylnaphthalene	1.8	3.7		U
91-20-3	Naphthalene	2.6	3.7		U
85-01-8	Phenanthrene	1.8	3.7		U
129-00-0	Pyrene	1.7	3.7	5.8	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
5-SO-0608

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-07

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203607

% Moisture: 11 decanted: (Y/N) N Date Sampled: 12/02/08 10:30

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/04/08

Concentrated Extract Volume: 1000.0 (uL) Date Analyzed: 12/11/08 19:29

Injection Volume: 1.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.3	3.7		U
208-96-8	Acenaphthylene	1.3	3.7		U
120-12-7	Anthracene	0.90	3.7		U
56-55-3	Benzo(a)anthracene	1.6	3.7		U
205-99-2	Benzo(b)fluoranthene	1.7	3.7		U
207-08-9	Benzo(k)fluoranthene	1.4	3.7		U
191-24-2	Benzo(g,h,i)perylene	1.6	3.7	4.0	
50-32-8	Benzo(a)pyrene	1.1	3.7		U
218-01-9	Chrysene	1.2	3.7		U
53-70-3	Dibenz(a,h)anthracene	1.7	3.7		U
206-44-0	Fluoranthene	1.9	3.7		U
86-73-7	Fluorene	1.3	3.7		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.7		U
91-57-6	2-Methylnaphthalene	1.9	3.7		U
91-20-3	Naphthalene	2.6	3.7		U
85-01-8	Phenanthrene	1.9	3.7	7.8	
129-00-0	Pyrene	1.7	3.7		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
6-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-08

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203608

% Moisture: 15 decanted: (Y/N) N Date Sampled: 12/02/08 11:30

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 19:58

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.9		U
208-96-8	Acenaphthylene	1.3	3.9		U
120-12-7	Anthracene	0.94	3.9		U
56-55-3	Benzo(a)anthracene	1.6	3.9	20	
205-99-2	Benzo(b)fluoranthene	1.8	3.9	18	
207-08-9	Benzo(k)fluoranthene	1.5	3.9	8.3	
191-24-2	Benzo(g,h,i)perylene	1.7	3.9	11	
50-32-8	Benzo(a)pyrene	1.2	3.9	20	
218-01-9	Chrysene	1.2	3.9	18	
53-70-3	Dibenz(a,h)anthracene	1.8	3.9		U
206-44-0	Fluoranthene	2.0	3.9	24	
86-73-7	Fluorene	1.4	3.9		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.9	7.3	
91-57-6	2-Methylnaphthalene	2.0	3.9		U
91-20-3	Naphthalene	2.7	3.9		U
85-01-8	Phenanthrene	2.0	3.9	12	
129-00-0	Pyrene	1.8	3.9	24	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
6-SO-0608

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-09

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203609

% Moisture: 11 decanted: (Y/N) N Date Sampled: 12/02/08 11:40

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 20:27

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.3	3.7		U
208-96-8	Acenaphthylene	1.3	3.7		U
120-12-7	Anthracene	0.90	3.7		U
56-55-3	Benzo(a)anthracene	1.6	3.7		U
205-99-2	Benzo(b)fluoranthene	1.7	3.7		U
207-08-9	Benzo(k)fluoranthene	1.4	3.7		U
191-24-2	Benzo(g,h,i)perylene	1.6	3.7	3.7	J
50-32-8	Benzo(a)pyrene	1.1	3.7		U
218-01-9	Chrysene	1.2	3.7		U
53-70-3	Dibenz(a,h)anthracene	1.7	3.7		U
206-44-0	Fluoranthene	1.9	3.7		U
86-73-7	Fluorene	1.3	3.7		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.7		U
91-57-6	2-Methylnaphthalene	1.9	3.7	5.2	
91-20-3	Naphthalene	2.6	3.7		U
85-01-8	Phenanthrene	1.9	3.7	12	
129-00-0	Pyrene	1.7	3.7	5.3	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
7-SO-0507

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-10

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203610

% Moisture: 10 decanted: (Y/N) N Date Sampled: 12/02/08 13:11

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 20:56

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.3	3.7		U
208-96-8	Acenaphthylene	1.3	3.7		U
120-12-7	Anthracene	0.89	3.7		U
56-55-3	Benzo(a)anthracene	1.6	3.7		U
205-99-2	Benzo(b)fluoranthene	1.7	3.7		U
207-08-9	Benzo(k)fluoranthene	1.4	3.7		U
191-24-2	Benzo(g,h,i)perylene	1.6	3.7	5.4	
50-32-8	Benzo(a)pyrene	1.1	3.7		U
218-01-9	Chrysene	1.2	3.7		U
53-70-3	Dibenz(a,h)anthracene	1.7	3.7		U
206-44-0	Fluoranthene	1.8	3.7		U
86-73-7	Fluorene	1.3	3.7		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.7		U
91-57-6	2-Methylnaphthalene	1.8	3.7		U
91-20-3	Naphthalene	2.6	3.7		U
85-01-8	Phenanthrene	1.8	3.7	6.7	
129-00-0	Pyrene	1.7	3.7	6.8	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
8-SO-0103

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-11

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203611

% Moisture: 12 decanted: (Y/N) N Date Sampled: 12/02/08 13:40

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 21:25

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8		U
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.91	3.8		U
56-55-3	Benzo(a)anthracene	1.6	3.8	2.3	J
205-99-2	Benzo(b)fluoranthene	1.7	3.8		U
207-08-9	Benzo(k)fluoranthene	1.4	3.8		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.8		U
50-32-8	Benzo(a)pyrene	1.1	3.8	4.2	
218-01-9	Chrysene	1.2	3.8	2.4	J
53-70-3	Dibenz(a,h)anthracene	1.7	3.8		U
206-44-0	Fluoranthene	1.9	3.8	2.2	J
86-73-7	Fluorene	1.4	3.8		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.8		U
91-57-6	2-Methylnaphthalene	1.9	3.8		U
91-20-3	Naphthalene	2.6	3.8		U
85-01-8	Phenanthrene	1.9	3.8		U
129-00-0	Pyrene	1.7	3.8	2.4	J

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
8-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-12

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203612

% Moisture: 11 decanted: (Y/N) N Date Sampled: 12/02/08 13:45

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 21:54

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8		U
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.90	3.8		U
56-55-3	Benzo(a)anthracene	1.6	3.8		U
205-99-2	Benzo(b)fluoranthene	1.7	3.8		U
207-08-9	Benzo(k)fluoranthene	1.4	3.8		U
191-24-2	Benzo(g,h,i)perylene	1.6	3.8	6.0	
50-32-8	Benzo(a)pyrene	1.1	3.8		U
218-01-9	Chrysene	1.2	3.8		U
53-70-3	Dibenz(a,h)anthracene	1.7	3.8		U
206-44-0	Fluoranthene	1.9	3.8		U
86-73-7	Fluorene	1.4	3.8		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.8		U
91-57-6	2-Methylnaphthalene	1.9	3.8	2.2	J
91-20-3	Naphthalene	2.6	3.8		U
85-01-8	Phenanthrene	1.9	3.8	11	
129-00-0	Pyrene	1.7	3.8	4.6	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
9-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-13

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203613

% Moisture: 14 decanted: (Y/N) N Date Sampled: 12/02/08 14:10

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/11/08 22:23

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8	1.6	J
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.92	3.8	3.6	J
56-55-3	Benzo(a)anthracene	1.6	3.8	27	
205-99-2	Benzo(b)fluoranthene	1.8	3.8	23	
207-08-9	Benzo(k)fluoranthene	1.5	3.8	8.3	
191-24-2	Benzo(g,h,i)perylene	1.7	3.8	14	
50-32-8	Benzo(a)pyrene	1.2	3.8	26	
218-01-9	Chrysene	1.2	3.8	28	
53-70-3	Dibenz(a,h)anthracene	1.8	3.8		U
206-44-0	Fluoranthene	1.9	3.8	50	
86-73-7	Fluorene	1.4	3.8	1.8	J
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.8	8.8	
91-57-6	2-Methylnaphthalene	1.9	3.8	2.1	J
91-20-3	Naphthalene	2.7	3.8		U
85-01-8	Phenanthrene	1.9	3.8	29	
129-00-0	Pyrene	1.8	3.8	44	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB0
9-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-14

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203614

% Moisture: 11 decanted: (Y/N) N Date Sampled: 12/02/08 14:20

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/15/08 15:34

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.3	3.7		U
208-96-8	Acenaphthylene	1.3	3.7		U
120-12-7	Anthracene	0.90	3.7		U
56-55-3	Benzo(a)anthracene	1.6	3.7		U
205-99-2	Benzo(b)fluoranthene	1.7	3.7		U
207-08-9	Benzo(k)fluoranthene	1.4	3.7		U
191-24-2	Benzo(g,h,i)perylene	1.6	3.7	5.8	
50-32-8	Benzo(a)pyrene	1.1	3.7		U
218-01-9	Chrysene	1.2	3.7	6.7	
53-70-3	Dibenz(a,h)anthracene	1.7	3.7		U
206-44-0	Fluoranthene	1.9	3.7	3.5	J
86-73-7	Fluorene	1.3	3.7		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.7		U
91-57-6	2-Methylnaphthalene	1.9	3.7		U
91-20-3	Naphthalene	2.6	3.7		U
85-01-8	Phenanthrene	1.9	3.7	4.8	
129-00-0	Pyrene	1.7	3.7	4.6	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
0-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-15

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203615

% Moisture: 15 decanted: (Y/N) N Date Sampled: 12/02/08 15:02

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/15/08 16:03

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.9		U
208-96-8	Acenaphthylene	1.3	3.9		U
120-12-7	Anthracene	0.94	3.9	2.1	J
56-55-3	Benzo(a)anthracene	1.6	3.9	7.5	
205-99-2	Benzo(b)fluoranthene	1.8	3.9	6.7	
207-08-9	Benzo(k)fluoranthene	1.5	3.9	2.7	J
191-24-2	Benzo(g,h,i)perylene	1.7	3.9	7.0	
50-32-8	Benzo(a)pyrene	1.2	3.9	9.6	
218-01-9	Chrysene	1.2	3.9	6.2	
53-70-3	Dibenz(a,h)anthracene	1.8	3.9		U
206-44-0	Fluoranthene	2.0	3.9	20	
86-73-7	Fluorene	1.4	3.9		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.9	4.4	
91-57-6	2-Methylnaphthalene	2.0	3.9		U
91-20-3	Naphthalene	2.8	3.9		U
85-01-8	Phenanthrene	2.0	3.9	9.6	
129-00-0	Pyrene	1.8	3.9	15	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
0-SO-0507

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-16

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203616

% Moisture: 14 decanted: (Y/N) N Date Sampled: 12/02/08 15:08

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/15/08 16:32

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.9		U
208-96-8	Acenaphthylene	1.3	3.9		U
120-12-7	Anthracene	0.93	3.9		U
56-55-3	Benzo(a)anthracene	1.6	3.9		U
205-99-2	Benzo(b)fluoranthene	1.8	3.9		U
207-08-9	Benzo(k)fluoranthene	1.5	3.9		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.9	5.2	
50-32-8	Benzo(a)pyrene	1.2	3.9		U
218-01-9	Chrysene	1.2	3.9		U
53-70-3	Dibenz(a,h)anthracene	1.8	3.9		U
206-44-0	Fluoranthene	1.9	3.9	3.0	J
86-73-7	Fluorene	1.4	3.9		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.9		U
91-57-6	2-Methylnaphthalene	1.9	3.9		U
91-20-3	Naphthalene	2.7	3.9		U
85-01-8	Phenanthrene	1.9	3.9	3.1	J
129-00-0	Pyrene	1.8	3.9	6.3	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
1-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-17

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203617

% Moisture: 21 decanted: (Y/N) N Date Sampled: 12/02/08 15:47

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/15/08 17:01

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.5	4.2	240	
208-96-8	Acenaphthylene	1.4	4.2	74	
120-12-7	Anthracene	1.0	4.2	590	
56-55-3	Benzo(a)anthracene	1.8	4.2	1700	
205-99-2	Benzo(b)fluoranthene	1.9	4.2	1400	
207-08-9	Benzo(k)fluoranthene	1.6	4.2	360	
191-24-2	Benzo(g,h,i)perylene	1.8	4.2	670	
50-32-8	Benzo(a)pyrene	1.3	4.2	1200	
218-01-9	Chrysene	1.3	4.2	1300	E
53-70-3	Dibenz(a,h)anthracene	1.9	4.2	160	
206-44-0	Fluoranthene	2.1	4.2	3700	E
86-73-7	Fluorene	1.5	4.2	250	
193-39-5	Indeno(1,2,3-cd)pyrene	1.9	4.2	590	
91-57-6	2-Methylnaphthalene	2.1	4.2	53	
91-20-3	Naphthalene	2.9	4.2	62	
85-01-8	Phenanthrene	2.1	4.2	3200	
129-00-0	Pyrene	1.9	4.2	3500	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB11
-SO-0002DL

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL001

Matrix: (soil/water) SOIL Lab Sample ID: 0812036-17DL

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1203617D

% Moisture: 21 decanted: (Y/N) N Date Sampled: 12/02/08 15:47

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/04/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/18/08 04:30

Injection Volume: 1.0(uL) Dilution Factor: 5.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	7.6	21	280	D
208-96-8	Acenaphthylene	7.2	21	81	D
120-12-7	Anthracene	5.0	21	580	D
56-55-3	Benzo(a)anthracene	8.8	21	2500	DX
205-99-2	Benzo(b)fluoranthene	9.7	21	2400	D
207-08-9	Benzo(k)fluoranthene	8.0	21	580	D
191-24-2	Benzo(g,h,i)perylene	9.3	21	880	D
50-32-8	Benzo(a)pyrene	6.3	21	1600	D
218-01-9	Chrysene	6.7	21	1900	D
53-70-3	Dibenz(a,h)anthracene	9.7	21	200	D
206-44-0	Fluoranthene	10	21	5100	D
86-73-7	Fluorene	7.6	21	280	D
193-39-5	Indeno(1,2,3-cd)pyrene	9.7	21	760	D
91-57-6	2-Methylnaphthalene	10	21	58	D
91-20-3	Naphthalene	15	21	79	D
85-01-8	Phenanthrene	10	21	4100	D
129-00-0	Pyrene	9.7	21	4400	D

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB01-SO-0608

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-01

evel (low/med): LOW Date Received: 12/03/08

Solids: 83.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	14400			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	13.7			P
7440-39-3	Barium	66.5			P
7440-41-7	Beryllium	0.94	J		P
7440-43-9	Cadmium	0.24	J		P
7440-70-2	Calcium	3010		*E	P
7440-47-3	Chromium	25.5			P
7440-48-4	Cobalt	18.8			P
7440-50-8	Copper	31.7			P
7439-89-6	Iron	33100			P
7439-92-1	Lead	16.5		N	P
7439-95-4	Magnesium	6610		*	P
7439-96-5	Manganese	1040			P
7439-97-6	Mercury	0.026	J		AV
7440-02-0	Nickel	40.8			P
7440-09-7	Potassium	2860		N	P
7782-49-2	Selenium	0.96	U		P
7440-22-4	Silver	0.24	U		P
7440-23-5	Sodium	241	U		P
7440-28-0	Thallium	0.72	U		P
7440-62-2	Vanadium	28.2			P
7440-66-6	Zinc	78.6		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: Selenium MDL increased due to negative bias.

USEPA - CLP

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB02-SO-0204

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-02

evel (low/med): LOW Date Received: 12/03/08

Solids: 81.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	14700			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	9.3			P
7440-39-3	Barium	81.9			P
7440-41-7	Beryllium	0.94	J		P
7440-43-9	Cadmium	0.37	J		P
7440-70-2	Calcium	2850		*E	P
7440-47-3	Chromium	25.8			P
7440-48-4	Cobalt	22.1			P
7440-50-8	Copper	34.2			P
7439-89-6	Iron	31300			P
7439-92-1	Lead	17.7		N	P
7439-95-4	Magnesium	6440		*	P
7439-96-5	Manganese	1600			P
7439-97-6	Mercury	0.032	J		AV
7440-02-0	Nickel	48.8			P
7440-09-7	Potassium	2950		N	P
7782-49-2	Selenium	1.2	U		P
7440-22-4	Silver	0.25	U		P
7440-23-5	Sodium	249	U		P
7440-28-0	Thallium	0.78	J		P
7440-62-2	Vanadium	27.9			P
7440-66-6	Zinc	77.7		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Selenium MDL increased due to negative bias.**

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB03-SO-0103

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: Case No.: SAS No.: SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-03

evel (low/med): LOW Date Received: 12/03/08

Solids: 85.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	15400			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	14.2			P
7440-39-3	Barium	91.4			P
7440-41-7	Beryllium	1.0	J		P
7440-43-9	Cadmium	0.52	J		P
7440-70-2	Calcium	5210		*E	P
7440-47-3	Chromium	23.7			P
7440-48-4	Cobalt	12.7			P
7440-50-8	Copper	23.3			P
7439-89-6	Iron	34700			P
7439-92-1	Lead	33.4		N	P
7439-95-4	Magnesium	5270		*	P
7439-96-5	Manganese	896			P
7439-97-6	Mercury	0.058			AV
7440-02-0	Nickel	29.8			P
7440-09-7	Potassium	1970		N	P
7782-49-2	Selenium	0.71	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	235	U		P
7440-28-0	Thallium	0.71	U		P
7440-62-2	Vanadium	36.9			P
7440-66-6	Zinc	125		N*	P

Color Before: Clarity Before: Texture:

Color After: Clarity After: Artifacts:

Comments:

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB03-SO-0810

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-04

evel (low/med): LOW Date Received: 12/03/08

Solids: 87.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	9810			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	11.8			P
7440-39-3	Barium	45.0			P
7440-41-7	Beryllium	0.66	J		P
7440-43-9	Cadmium	0.22	U		P
7440-70-2	Calcium	85000		*E	P
7440-47-3	Chromium	17.3			P
7440-48-4	Cobalt	9.8			P
7440-50-8	Copper	21.0			P
7439-89-6	Iron	19500			P
7439-92-1	Lead	10.4		N	P
7439-95-4	Magnesium	40700		*	P
7439-96-5	Manganese	589			P
7439-97-6	Mercury	0.017	J		AV
7440-02-0	Nickel	25.6			P
7440-09-7	Potassium	2760		N	P
7782-49-2	Selenium	0.67	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	223	U		P
7440-28-0	Thallium	0.67	U		P
7440-62-2	Vanadium	19.8			P
7440-66-6	Zinc	45.3		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB04-SO-0204

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-05

evel (low/med): LOW Date Received: 12/03/08

Solids: 83.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7110			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	20.7			P
7440-39-3	Barium	65.1			P
7440-41-7	Beryllium	0.59	J		P
7440-43-9	Cadmium	0.33	J		P
7440-70-2	Calcium	12000		*E	P
7440-47-3	Chromium	15.2			P
7440-48-4	Cobalt	9.0			P
7440-50-8	Copper	22.6			P
7439-89-6	Iron	34900			P
7439-92-1	Lead	37.0		N	P
7439-95-4	Magnesium	8020		*	P
7439-96-5	Manganese	1150			P
7439-97-6	Mercury	0.049			AV
7440-02-0	Nickel	25.7			P
7440-09-7	Potassium	1370		N	P
7782-49-2	Selenium	0.73	U		P
7440-22-4	Silver	0.24	U		P
7440-23-5	Sodium	243	U		P
7440-28-0	Thallium	0.73	U		P
7440-62-2	Vanadium	26.5			P
7440-66-6	Zinc	108		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB05-SO-0406

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-06

evel (low/med): LOW Date Received: 12/03/08

Solids: 91.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4580			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	25.1			P
7440-39-3	Barium	67.4			P
7440-41-7	Beryllium	0.39	J		P
7440-43-9	Cadmium	0.22	U		P
7440-70-2	Calcium	63600		*E	P
7440-47-3	Chromium	9.0			P
7440-48-4	Cobalt	6.7			P
7440-50-8	Copper	22.3			P
7439-89-6	Iron	24300			P
7439-92-1	Lead	12.8		N	P
7439-95-4	Magnesium	33400		*	P
7439-96-5	Manganese	802			P
7439-97-6	Mercury	0.016	J		AV
7440-02-0	Nickel	17.5			P
7440-09-7	Potassium	1240		N	P
7782-49-2	Selenium	1.1	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	218	U		P
7440-28-0	Thallium	0.65	U		P
7440-62-2	Vanadium	14.0			P
7440-66-6	Zinc	57.9		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: Selenium MDL increased due to negative bias.

USEPA - CLP

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB05-SO-0608

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-07

evel (low/med): LOW Date Received: 12/03/08

Solids: 89.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4740			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	4.0			P
7440-39-3	Barium	10.9			P
7440-41-7	Beryllium	0.36	J		P
7440-43-9	Cadmium	0.22	U		P
7440-70-2	Calcium	62000		*E	P
7440-47-3	Chromium	9.9			P
7440-48-4	Cobalt	5.2			P
7440-50-8	Copper	18.7			P
7439-89-6	Iron	12200			P
7439-92-1	Lead	8.5		N	P
7439-95-4	Magnesium	31500		*	P
7439-96-5	Manganese	435			P
7439-97-6	Mercury	0.013	U		AV
7440-02-0	Nickel	14.9			P
7440-09-7	Potassium	1310		N	P
7782-49-2	Selenium	0.67	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	222	U		P
7440-28-0	Thallium	1.1	U		P
7440-62-2	Vanadium	12.7			P
7440-66-6	Zinc	39.3		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Thallium MDL increased due to negative bias.**

USEPA - CLP

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB06-SO-0204

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-08

evel (low/med): LOW Date Received: 12/03/08

Solids: 85.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8970			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	13.4			P
7440-39-3	Barium	55.0			P
7440-41-7	Beryllium	0.66	J		P
7440-43-9	Cadmium	0.43	J		P
7440-70-2	Calcium	19200		*E	P
7440-47-3	Chromium	19.1			P
7440-48-4	Cobalt	8.9			P
7440-50-8	Copper	22.0			P
7439-89-6	Iron	28900			P
7439-92-1	Lead	54.8		N	P
7439-95-4	Magnesium	12500		*	P
7439-96-5	Manganese	941			P
7439-97-6	Mercury	0.041			AV
7440-02-0	Nickel	25.0			P
7440-09-7	Potassium	1510		N	P
7782-49-2	Selenium	0.92	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	233	U		P
7440-28-0	Thallium	0.70	U		P
7440-62-2	Vanadium	29.8			P
7440-66-6	Zinc	140		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Selenium MDL increased due to negative bias.**

Form I - IN

USEPA - CLP

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB06-SO-0608

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-09

evel (low/med): LOW Date Received: 12/03/08

Solids: 89.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5670			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	9.7			P
7440-39-3	Barium	13.4			P
7440-41-7	Beryllium	0.43	J		P
7440-43-9	Cadmium	0.28	J		P
7440-70-2	Calcium	65600		*E	P
7440-47-3	Chromium	11.5			P
7440-48-4	Cobalt	6.5			P
7440-50-8	Copper	24.1			P
7439-89-6	Iron	24000			P
7439-92-1	Lead	13.6		N	P
7439-95-4	Magnesium	34400		*	P
7439-96-5	Manganese	534			P
7439-97-6	Mercury	0.014	U		AV
7440-02-0	Nickel	20.2			P
7440-09-7	Potassium	1550		N	P
7782-49-2	Selenium	0.88	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	216	U		P
7440-28-0	Thallium	0.65	U		P
7440-62-2	Vanadium	16.0			P
7440-66-6	Zinc	80.3		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: Selenium MDL increased due to negative bias.

USEPA - CLP

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB07-SO-0507

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-10

evel (low/med): LOW Date Received: 12/03/08

Solids: 90.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5500			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	7.3			P
7440-39-3	Barium	20.3			P
7440-41-7	Beryllium	0.41	J		P
7440-43-9	Cadmium	0.38	J		P
7440-70-2	Calcium	73500		*E	P
7440-47-3	Chromium	12.9			P
7440-48-4	Cobalt	6.6			P
7440-50-8	Copper	24.9			P
7439-89-6	Iron	20800			P
7439-92-1	Lead	15.0		N	P
7439-95-4	Magnesium	40500		*	P
7439-96-5	Manganese	660			P
7439-97-6	Mercury	0.013	U		AV
7440-02-0	Nickel	19.0			P
7440-09-7	Potassium	1250		N	P
7782-49-2	Selenium	0.67	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	224	U		P
7440-28-0	Thallium	0.67	U		P
7440-62-2	Vanadium	17.3			P
7440-66-6	Zinc	87.8		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB08-SO-0103

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: Case No.: SAS No.: SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-11

evel (low/med): LOW Date Received: 12/03/08

Solids: 88.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6750			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	13.1			P
7440-39-3	Barium	37.7			P
7440-41-7	Beryllium	0.50	J		P
7440-43-9	Cadmium	0.43	J		P
7440-70-2	Calcium	45300		*E	P
7440-47-3	Chromium	15.0			P
7440-48-4	Cobalt	8.4			P
7440-50-8	Copper	30.9			P
7439-89-6	Iron	26000			P
7439-92-1	Lead	20.2		N	P
7439-95-4	Magnesium	27300		*	P
7439-96-5	Manganese	946			P
7439-97-6	Mercury	0.019	J		AV
7440-02-0	Nickel	24.5			P
7440-09-7	Potassium	1520		N	P
7782-49-2	Selenium	0.67	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	223	U		P
7440-28-0	Thallium	0.67	U		P
7440-62-2	Vanadium	25.5			P
7440-66-6	Zinc	89.8		N*	P

Color Before: Clarity Before: Texture:

Color After: Clarity After: Artifacts:

Comments:

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB08-SO-0406

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: Case No.: SAS No.: SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-12

evel (low/med): LOW Date Received: 12/03/08

Solids: 89.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4910			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	4.4			P
7440-39-3	Barium	28.5			P
7440-41-7	Beryllium	0.36	J		P
7440-43-9	Cadmium	0.22	U		P
7440-70-2	Calcium	78500		*E	P
7440-47-3	Chromium	9.2			P
7440-48-4	Cobalt	6.9			P
7440-50-8	Copper	15.4			P
7439-89-6	Iron	15500			P
7439-92-1	Lead	8.1		N	P
7439-95-4	Magnesium	42100		*	P
7439-96-5	Manganese	724			P
7439-97-6	Mercury	0.015	U		AV
7440-02-0	Nickel	18.3			P
7440-09-7	Potassium	1250		N	P
7782-49-2	Selenium	0.67	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	241	J		P
7440-28-0	Thallium	0.88	U		P
7440-62-2	Vanadium	13.9			P
7440-66-6	Zinc	41.4		N*	P

Color Before: Clarity Before: Texture:

Color After: Clarity After: Artifacts:

Comments: Thallium MDL increased due to negative bias.

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB09-SO-0002

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-13

evel (low/med): LOW Date Received: 12/03/08

Solids: 86.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8120			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	16.4			P
7440-39-3	Barium	65.0			P
7440-41-7	Beryllium	0.62	J		P
7440-43-9	Cadmium	0.44	J		P
7440-70-2	Calcium	15100		*E	P
7440-47-3	Chromium	18.4			P
7440-48-4	Cobalt	11.1			P
7440-50-8	Copper	29.2			P
7439-89-6	Iron	32700			P
7439-92-1	Lead	48.3		N	P
7439-95-4	Magnesium	10000		*	P
7439-96-5	Manganese	1350			P
7439-97-6	Mercury	0.026	J		AV
7440-02-0	Nickel	28.3			P
7440-09-7	Potassium	1420		N	P
7782-49-2	Selenium	0.92	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	233	U		P
7440-28-0	Thallium	0.70	U		P
7440-62-2	Vanadium	26.2			P
7440-66-6	Zinc	113		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: Selenium MDL increased due to negative bias.

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB09-SO-0406

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-14

evel (low/med): LOW Date Received: 12/03/08

Solids: 89.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4500			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	9.5			P
7440-39-3	Barium	21.6			P
7440-41-7	Beryllium	0.37	J		P
7440-43-9	Cadmium	0.22	U		P
7440-70-2	Calcium	65100		*E	P
7440-47-3	Chromium	9.6			P
7440-48-4	Cobalt	5.4			P
7440-50-8	Copper	17.7			P
7439-89-6	Iron	17400			P
7439-92-1	Lead	10.1		N	P
7439-95-4	Magnesium	34700		*	P
7439-96-5	Manganese	520			P
7439-97-6	Mercury	0.014	U		AV
7440-02-0	Nickel	16.5			P
7440-09-7	Potassium	1210		N	P
7782-49-2	Selenium	0.88	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	220	U		P
7440-28-0	Thallium	0.88	U		P
7440-62-2	Vanadium	13.7			P
7440-66-6	Zinc	37.5		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Selenium and Thallium MDLs increased due to negative bias.**

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB10-SO-0002

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-15

evel (low/med): LOW Date Received: 12/03/08

Solids: 85.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7420			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	32.2			P
7440-39-3	Barium	90.0			P
7440-41-7	Beryllium	0.57	J		P
7440-43-9	Cadmium	0.51	J		P
7440-70-2	Calcium	7710		*E	P
7440-47-3	Chromium	14.0			P
7440-48-4	Cobalt	13.3			P
7440-50-8	Copper	29.4			P
7439-89-6	Iron	36800			P
7439-92-1	Lead	64.2		N	P
7439-95-4	Magnesium	5450		*	P
7439-96-5	Manganese	1730			P
7439-97-6	Mercury	0.048			AV
7440-02-0	Nickel	33.6			P
7440-09-7	Potassium	1030	J	N	P
7782-49-2	Selenium	0.69	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	231	U		P
7440-28-0	Thallium	0.69	U		P
7440-62-2	Vanadium	26.1			P
7440-66-6	Zinc	115		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB10-SO-0507

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-16

evel (low/med): LOW Date Received: 12/03/08

Solids: 86.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10200			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	6.2			P
7440-39-3	Barium	38.4			P
7440-41-7	Beryllium	0.66	J		P
7440-43-9	Cadmium	0.26	J		P
7440-70-2	Calcium	81900		*E	P
7440-47-3	Chromium	18.1			P
7440-48-4	Cobalt	9.2			P
7440-50-8	Copper	21.5			P
7439-89-6	Iron	20000			P
7439-92-1	Lead	11.6		N	P
7439-95-4	Magnesium	41200		*	P
7439-96-5	Manganese	524			P
7439-97-6	Mercury	0.014	U		AV
7440-02-0	Nickel	25.8			P
7440-09-7	Potassium	2660		N	P
7782-49-2	Selenium	0.67	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	224	U		P
7440-28-0	Thallium	0.67	U		P
7440-62-2	Vanadium	20.7			P
7440-66-6	Zinc	48.6		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

USEPA - CLP
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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB11-SO-0002

ab Name: Empirical Laboratories Contract: TetraTech NUS, I

ab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL001

atrix (soil/water): SOLID Lab Sample ID: 0812036-17

evel (low/med): LOW Date Received: 12/03/08

Solids: 79.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	17500			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	8.1			P
7440-39-3	Barium	138			P
7440-41-7	Beryllium	2.0			P
7440-43-9	Cadmium	0.71	J		P
7440-70-2	Calcium	14100		*E	P
7440-47-3	Chromium	23.4			P
7440-48-4	Cobalt	11.8			P
7440-50-8	Copper	32.1			P
7439-89-6	Iron	27700			P
7439-92-1	Lead	49.2		N	P
7439-95-4	Magnesium	5510		*	P
7439-96-5	Manganese	673			P
7439-97-6	Mercury	0.045			AV
7440-02-0	Nickel	26.9			P
7440-09-7	Potassium	2720		N	P
7782-49-2	Selenium	0.74	U		P
7440-22-4	Silver	0.25	U		P
7440-23-5	Sodium	565	J		P
7440-28-0	Thallium	1.2	U		P
7440-62-2	Vanadium	34.4			P
7440-66-6	Zinc	209		N*	P

Color Before: _____ Clarity Before: _____ Texture: _____

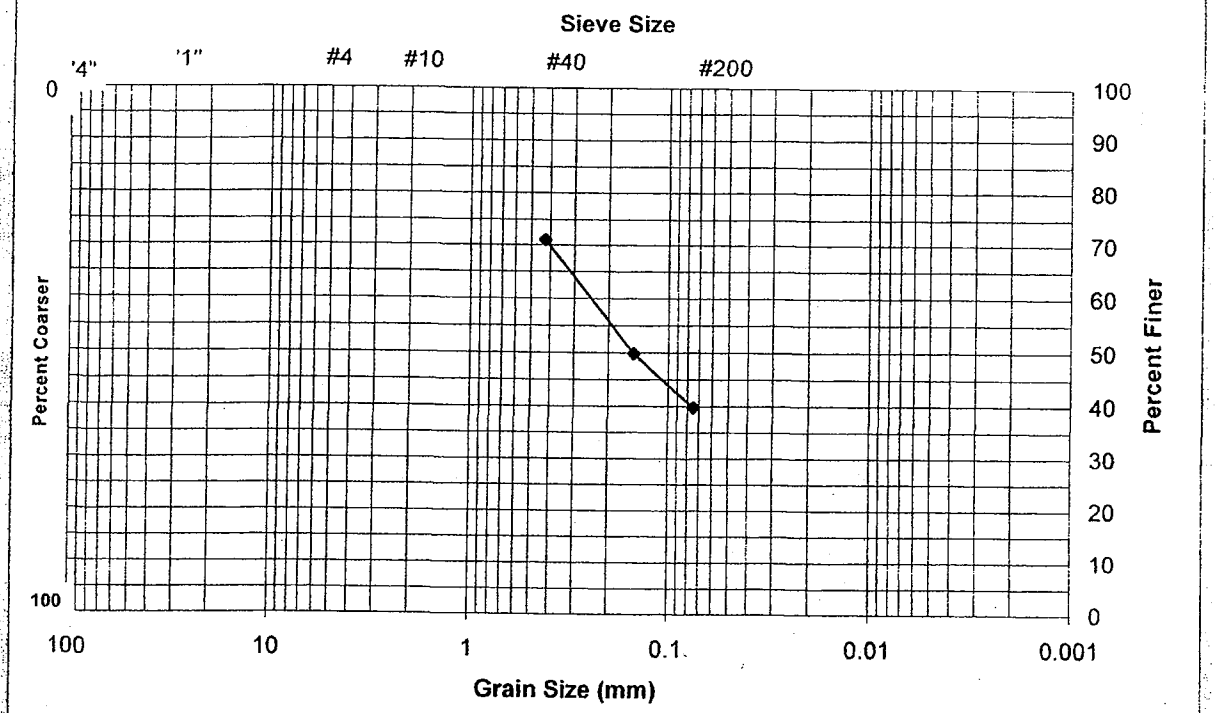
Color After: _____ Clarity After: _____ Artifacts: _____

Comments: Thallium MDL increased due to negative bias.

PARTICLE SIZE ANALYSIS

ASTM D 422

HYDROMETER ONLY



PERCENT PASSING

SAMPLE ID	Sieve Sizes for Washover Analysis													
					#40	#100	#200							
0812036-07					71	50	40							
LAB ID J 3072														

BEAVER ENGINEERING

PROJECT: EMPIRICAL LABORATORIES GREAT LAKES CTO 468

PROJECT NUMBER: 08-5852

DATE: DECEMBER 18, 2008

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-MW01-1208

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-01

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1214701

Level: (low/med) LOW Date Sampled: 12/08/08 17:59

% Moisture: not dec. _____ Date Analyzed: 12/17/08 00:51

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	10		U
71-43-2	Benzene	0.12	1.0		U
75-27-4	Bromodichloromethane	0.18	1.0		U
75-25-2	Bromoform	0.10	1.0		U
74-83-9	Bromomethane	0.27	1.0		U
78-93-3	2-Butanone	1.1	10		U
75-15-0	Carbon disulfide	0.17	1.0		U
56-23-5	Carbon tetrachloride	0.22	1.0		U
108-90-7	Chlorobenzene	0.10	1.0		U
75-00-3	Chloroethane	0.25	2.0		U
67-66-3	Chloroform	0.17	1.0		U
74-87-3	Chloromethane	0.36	2.0		U
110-82-7	Cyclohexane	0.14	1.0		U
124-48-1	Dibromochloromethane	0.10	1.0		U
96-12-8	1,2-Dibromo-3-chloropropane	0.23	1.0		U
106-93-4	1,2-Dibromoethane	0.14	1.0		U
95-50-1	1,2-Dichlorobenzene	0.16	1.0		U
541-73-1	1,3-Dichlorobenzene	0.13	1.0		U
106-46-7	1,4-Dichlorobenzene	0.10	1.0		U
75-71-8	Dichlorodifluoromethane	0.20	2.0		U
75-34-3	1,1-Dichloroethane	0.19	1.0		U
107-06-2	1,2-Dichloroethane	0.22	1.0		U
75-35-4	1,1-Dichloroethene	0.24	2.0		U
156-59-2	cis-1,2-Dichloroethene	0.16	1.0		U
156-60-5	trans-1,2-Dichloroethene	0.21	1.0		U
78-87-5	1,2-Dichloropropane	0.17	1.0		U
10061-01-5	cis-1,3-Dichloropropene	0.12	1.0		U
10061-02-6	trans-1,3-Dichloropropene	0.17	1.0		U
100-41-4	Ethylbenzene	0.10	1.0		U
591-78-6	2-Hexanone	0.42	5.0		U
98-82-8	Isopropylbenzene	0.11	1.0		U
79-20-9	Methyl acetate	0.51	3.0		U
75-09-2	Methylene chloride	0.27	2.0	0.50	JB
108-87-2	Methyl cyclohexane	0.12	1.0		U
1634-04-4	Methyl-tert-butyl ether	0.10	1.0		U
108-10-1	4-Methyl-2-pentanone	0.50	10		U
100-42-5	Styrene	0.11	1.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.23	1.0		U
127-18-4	Tetrachloroethene	0.16	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-MW01-1208

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-01

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1214701

Level: (low/med) LOW Date Sampled: 12/08/08 17:59

% Moisture: not dec. _____ Date Analyzed: 12/17/08 00:51

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.14	1.0		U
120-82-1	1,2,4-Trichlorobenzene	0.18	2.0		U
71-55-6	1,1,1-Trichloroethane	0.20	1.0		U
79-00-5	1,1,2-Trichloroethane	0.14	1.0		U
79-01-6	Trichloroethene	0.50	1.0		U
76-13-1	Trichlorotrifluoroethane	0.12	2.0		U
75-69-4	Trichlorofluoromethane	0.22	2.0		U
75-01-4	Vinyl chloride	0.19	2.0		U
1330-20-7	Xylene(total)	0.21	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-MW02-1208

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-02

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1214702

Level: (low/med) LOW Date Sampled: 12/08/08 15:45

% Moisture: not dec. _____ Date Analyzed: 12/17/08 01:20

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	10	8.5	J
71-43-2	Benzene	0.12	1.0		U
75-27-4	Bromodichloromethane	0.18	1.0		U
75-25-2	Bromoform	0.10	1.0		U
74-83-9	Bromomethane	0.27	1.0		U
78-93-3	2-Butanone	1.1	10		U
75-15-0	Carbon disulfide	0.17	1.0		U
56-23-5	Carbon tetrachloride	0.22	1.0		U
108-90-7	Chlorobenzene	0.10	1.0		U
75-00-3	Chloroethane	0.25	2.0		U
67-66-3	Chloroform	0.17	1.0		U
74-87-3	Chloromethane	0.36	2.0		U
110-82-7	Cyclohexane	0.14	1.0		U
124-48-1	Dibromochloromethane	0.10	1.0		U
96-12-8	1,2-Dibromo-3-chloropropane	0.23	1.0		U
106-93-4	1,2-Dibromoethane	0.14	1.0		U
95-50-1	1,2-Dichlorobenzene	0.16	1.0		U
541-73-1	1,3-Dichlorobenzene	0.13	1.0		U
106-46-7	1,4-Dichlorobenzene	0.10	1.0		U
75-71-8	Dichlorodifluoromethane	0.20	2.0		U
75-34-3	1,1-Dichloroethane	0.19	1.0		U
107-06-2	1,2-Dichloroethane	0.22	1.0		U
75-35-4	1,1-Dichloroethene	0.24	2.0		U
156-59-2	cis-1,2-Dichloroethene	0.16	1.0		U
156-60-5	trans-1,2-Dichloroethene	0.21	1.0		U
78-87-5	1,2-Dichloropropane	0.17	1.0		U
10061-01-5	cis-1,3-Dichloropropene	0.12	1.0		U
10061-02-6	trans-1,3-Dichloropropene	0.17	1.0		U
100-41-4	Ethylbenzene	0.10	1.0		U
591-78-6	2-Hexanone	0.42	5.0		U
98-82-8	Isopropylbenzene	0.11	1.0		U
79-20-9	Methyl acetate	0.51	3.0		U
75-09-2	Methylene chloride	0.27	2.0	0.30	JB
108-87-2	Methyl cyclohexane	0.12	1.0		U
1634-04-4	Methyl-tert-butyl ether	0.10	1.0		U
108-10-1	4-Methyl-2-pentanone	0.50	10		U
100-42-5	Styrene	0.11	1.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.23	1.0		U
127-18-4	Tetrachloroethene	0.16	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-MW02-1208

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-02

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1214702

Level: (low/med) LOW Date Sampled: 12/08/08 15:45

% Moisture: not dec. _____ Date Analyzed: 12/17/08 01:20

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.14	1.0	0.22	J
120-82-1	1,2,4-Trichlorobenzene	0.18	2.0		U
71-55-6	1,1,1-Trichloroethane	0.20	1.0		U
79-00-5	1,1,2-Trichloroethane	0.14	1.0		U
79-01-6	Trichloroethene	0.50	1.0		U
76-13-1	Trichlorotrifluoroethane	0.12	2.0		U
75-69-4	Trichlorofluoromethane	0.22	2.0		U
75-01-4	Vinyl chloride	0.19	2.0		U
1330-20-7	Xylene(total)	0.21	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-TB120809

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-03

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1214703

Level: (low/med) LOW Date Sampled: 12/08/08 08:00

% Moisture: not dec. _____ Date Analyzed: 12/17/08 00:22

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	10		U
71-43-2	Benzene	0.12	1.0		U
75-27-4	Bromodichloromethane	0.18	1.0		U
75-25-2	Bromoform	0.10	1.0		U
74-83-9	Bromomethane	0.27	1.0		U
78-93-3	2-Butanone	1.1	10		U
75-15-0	Carbon disulfide	0.17	1.0		U
56-23-5	Carbon tetrachloride	0.22	1.0		U
108-90-7	Chlorobenzene	0.10	1.0		U
75-00-3	Chloroethane	0.25	2.0		U
67-66-3	Chloroform	0.17	1.0		U
74-87-3	Chloromethane	0.36	2.0		U
110-82-7	Cyclohexane	0.14	1.0		U
124-48-1	Dibromochloromethane	0.10	1.0		U
96-12-8	1,2-Dibromo-3-chloropropane	0.23	1.0		U
106-93-4	1,2-Dibromoethane	0.14	1.0		U
95-50-1	1,2-Dichlorobenzene	0.16	1.0		U
541-73-1	1,3-Dichlorobenzene	0.13	1.0		U
106-46-7	1,4-Dichlorobenzene	0.10	1.0		U
75-71-8	Dichlorodifluoromethane	0.20	2.0		U
75-34-3	1,1-Dichloroethane	0.19	1.0		U
107-06-2	1,2-Dichloroethane	0.22	1.0		U
75-35-4	1,1-Dichloroethene	0.24	2.0		U
156-59-2	cis-1,2-Dichloroethene	0.16	1.0		U
156-60-5	trans-1,2-Dichloroethene	0.21	1.0		U
78-87-5	1,2-Dichloropropane	0.17	1.0		U
10061-01-5	cis-1,3-Dichloropropene	0.12	1.0		U
10061-02-6	trans-1,3-Dichloropropene	0.17	1.0		U
100-41-4	Ethylbenzene	0.10	1.0		U
591-78-6	2-Hexanone	0.42	5.0		U
98-82-8	Isopropylbenzene	0.11	1.0		U
79-20-9	Methyl acetate	0.51	3.0		U
75-09-2	Methylene chloride	0.27	2.0	3.0	B
108-87-2	Methyl cyclohexane	0.12	1.0		U
1634-04-4	Methyl-tert-butyl ether	0.10	1.0		U
108-10-1	4-Methyl-2-pentanone	0.50	10		U
100-42-5	Styrene	0.11	1.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.23	1.0		U
127-18-4	Tetrachloroethene	0.16	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-TB120809

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-03

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1214703

Level: (low/med) LOW Date Sampled: 12/08/08 08:00

% Moisture: not dec. _____ Date Analyzed: 12/17/08 00:22

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.14	1.0		U
120-82-1	1,2,4-Trichlorobenzene	0.18	2.0		U
71-55-6	1,1,1-Trichloroethane	0.20	1.0		U
79-00-5	1,1,2-Trichloroethane	0.14	1.0		U
79-01-6	Trichloroethene	0.50	1.0		U
76-13-1	Trichlorotrifluoroethane	0.12	2.0		U
75-69-4	Trichlorofluoromethane	0.22	2.0		U
75-01-4	Vinyl chloride	0.19	2.0		U
1330-20-7	Xylene(total)	0.21	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19FD1
20808-01

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-04

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1214704

Level: (low/med) LOW Date Sampled: 12/08/08 :

% Moisture: not dec. _____ Date Analyzed: 12/17/08 01:50

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	10		U
71-43-2	Benzene	0.12	1.0		U
75-27-4	Bromodichloromethane	0.18	1.0		U
75-25-2	Bromoform	0.10	1.0		U
74-83-9	Bromomethane	0.27	1.0		U
78-93-3	2-Butanone	1.1	10		U
75-15-0	Carbon disulfide	0.17	1.0		U
56-23-5	Carbon tetrachloride	0.22	1.0		U
108-90-7	Chlorobenzene	0.10	1.0		U
75-00-3	Chloroethane	0.25	2.0		U
67-66-3	Chloroform	0.17	1.0		U
74-87-3	Chloromethane	0.36	2.0		U
110-82-7	Cyclohexane	0.14	1.0		U
124-48-1	Dibromochloromethane	0.10	1.0		U
96-12-8	1,2-Dibromo-3-chloropropane	0.23	1.0		U
106-93-4	1,2-Dibromoethane	0.14	1.0		U
95-50-1	1,2-Dichlorobenzene	0.16	1.0		U
541-73-1	1,3-Dichlorobenzene	0.13	1.0		U
106-46-7	1,4-Dichlorobenzene	0.10	1.0		U
75-71-8	Dichlorodifluoromethane	0.20	2.0		U
75-34-3	1,1-Dichloroethane	0.19	1.0		U
107-06-2	1,2-Dichloroethane	0.22	1.0		U
75-35-4	1,1-Dichloroethene	0.24	2.0		U
156-59-2	cis-1,2-Dichloroethene	0.16	1.0		U
156-60-5	trans-1,2-Dichloroethene	0.21	1.0		U
78-87-5	1,2-Dichloropropane	0.17	1.0		U
10061-01-5	cis-1,3-Dichloropropene	0.12	1.0		U
10061-02-6	trans-1,3-Dichloropropene	0.17	1.0		U
100-41-4	Ethylbenzene	0.10	1.0		U
591-78-6	2-Hexanone	0.42	5.0		U
98-82-8	Isopropylbenzene	0.11	1.0		U
79-20-9	Methyl acetate	0.51	3.0		U
75-09-2	Methylene chloride	0.27	2.0		U
108-87-2	Methyl cyclohexane	0.12	1.0		U
1634-04-4	Methyl-tert-butyl ether	0.10	1.0		U
108-10-1	4-Methyl-2-pentanone	0.50	10		U
100-42-5	Styrene	0.11	1.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.23	1.0		U
127-18-4	Tetrachloroethene	0.16	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19FD1
20808-01

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-04

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1214704

Level: (low/med) LOW Date Sampled: 12/08/08 :

% Moisture: not dec. _____ Date Analyzed: 12/17/08 01:50

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.14	1.0		U
120-82-1	1,2,4-Trichlorobenzene	0.18	2.0		U
71-55-6	1,1,1-Trichloroethane	0.20	1.0		U
79-00-5	1,1,2-Trichloroethane	0.14	1.0		U
79-01-6	Trichloroethene	0.50	1.0		U
76-13-1	Trichlorotrifluoroethane	0.12	2.0		U
75-69-4	Trichlorofluoromethane	0.22	2.0		U
75-01-4	Vinyl chloride	0.19	2.0		U
1330-20-7	Xylene(total)	0.21	1.0		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-MW01-1208

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-01

Sample wt/vol: 1040 (g/mL) ML Lab File ID: 1214701

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/08/08 17:59

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/11/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/18/08 02:07

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	0.0058	0.048		U
208-96-8	Acenaphthylene	0.0048	0.048		U
120-12-7	Anthracene	0.0096	0.048		U
56-55-3	Benzo(a)anthracene	0.012	0.048		U
205-99-2	Benzo(b)fluoranthene	0.012	0.048		U
207-08-9	Benzo(k)fluoranthene	0.0086	0.048		U
191-24-2	Benzo(g,h,i)perylene	0.0067	0.048		U
50-32-8	Benzo(a)pyrene	0.0058	0.048		U
218-01-9	Chrysene	0.010	0.048		U
53-70-3	Dibenz(a,h)anthracene	0.0048	0.048		U
206-44-0	Fluoranthene	0.012	0.048		U
86-73-7	Fluorene	0.0067	0.048		U
193-39-5	Indeno(1,2,3-cd)pyrene	0.0038	0.048		U
91-57-6	2-Methylnaphthalene	0.0058	0.048	0.0098	J
91-20-3	Naphthalene	0.012	0.048	0.026	JB
85-01-8	Phenanthrene	0.0077	0.048	0.0091	J
129-00-0	Pyrene	0.012	0.048		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-MW02-1208

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-02

Sample wt/vol: 1020 (g/mL) ML Lab File ID: 1214702

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/08/08 15:45

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/11/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/18/08 02:36

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	0.0059	0.049	0.020	J
208-96-8	Acenaphthylene	0.0049	0.049	0.016	J
120-12-7	Anthracene	0.0098	0.049	0.026	J
56-55-3	Benzo(a)anthracene	0.013	0.049	0.036	J
205-99-2	Benzo(b)fluoranthene	0.012	0.049	0.019	J
207-08-9	Benzo(k)fluoranthene	0.0088	0.049	0.016	J
191-24-2	Benzo(g,h,i)perylene	0.0069	0.049	0.013	J
50-32-8	Benzo(a)pyrene	0.0059	0.049	0.018	J
218-01-9	Chrysene	0.011	0.049	0.035	J
53-70-3	Dibenz(a,h)anthracene	0.0049	0.049	0.013	J
206-44-0	Fluoranthene	0.013	0.049	0.030	J
86-73-7	Fluorene	0.0069	0.049	0.028	J
193-39-5	Indeno(1,2,3-cd)pyrene	0.0039	0.049	0.011	J
91-57-6	2-Methylnaphthalene	0.0059	0.049	0.017	J
91-20-3	Naphthalene	0.013	0.049		U
85-01-8	Phenanthrene	0.0078	0.049	0.038	J
129-00-0	Pyrene	0.013	0.049	0.030	J

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19FD1
20808-01

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL003

Matrix: (soil/water) WATER Lab Sample ID: 0812147-04

Sample wt/vol: 1060 (g/mL) ML Lab File ID: 1214704

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/08/08 :

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/11/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/18/08 03:04

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	0.0057	0.047		U
208-96-8	Acenaphthylene	0.0047	0.047		U
120-12-7	Anthracene	0.0094	0.047		U
56-55-3	Benzo(a)anthracene	0.012	0.047		U
205-99-2	Benzo(b)fluoranthene	0.011	0.047		U
207-08-9	Benzo(k)fluoranthene	0.0085	0.047		U
191-24-2	Benzo(g,h,i)perylene	0.0066	0.047		U
50-32-8	Benzo(a)pyrene	0.0057	0.047		U
218-01-9	Chrysene	0.010	0.047		U
53-70-3	Dibenz(a,h)anthracene	0.0047	0.047		U
206-44-0	Fluoranthene	0.012	0.047		U
86-73-7	Fluorene	0.0066	0.047		U
193-39-5	Indeno(1,2,3-cd)pyrene	0.0038	0.047		U
91-57-6	2-Methylnaphthalene	0.0057	0.047	0.0093	J
91-20-3	Naphthalene	0.012	0.047	0.021	JB
85-01-8	Phenanthrene	0.0075	0.047	0.0097	J
129-00-0	Pyrene	0.012	0.047		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-RB
120308-01

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) WATER Lab Sample ID: 0812060-04

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1206004

Level: (low/med) LOW Date Sampled: 12/03/08 17:00

% Moisture: not dec. _____ Date Analyzed: 12/08/08 16:00

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	10	2.4	J
71-43-2	Benzene	0.12	1.0		U
75-27-4	Bromodichloromethane	0.18	1.0		U
75-25-2	Bromoform	0.10	1.0		U
74-83-9	Bromomethane	0.27	1.0		U
78-93-3	2-Butanone	1.1	10		U
75-15-0	Carbon disulfide	0.17	1.0		U
56-23-5	Carbon tetrachloride	0.22	1.0		U
108-90-7	Chlorobenzene	0.10	1.0		U
75-00-3	Chloroethane	0.25	2.0		U
67-66-3	Chloroform	0.17	1.0		U
74-87-3	Chloromethane	0.36	2.0		U
110-82-7	Cyclohexane	0.14	1.0		U
124-48-1	Dibromochloromethane	0.10	1.0		U
96-12-8	1,2-Dibromo-3-chloropropane	0.23	1.0		U
106-93-4	1,2-Dibromoethane	0.14	1.0		U
95-50-1	1,2-Dichlorobenzene	0.16	1.0		U
541-73-1	1,3-Dichlorobenzene	0.13	1.0		U
106-46-7	1,4-Dichlorobenzene	0.10	1.0		U
75-71-8	Dichlorodifluoromethane	0.20	2.0		U
75-34-3	1,1-Dichloroethane	0.19	1.0		U
107-06-2	1,2-Dichloroethane	0.22	1.0		U
75-35-4	1,1-Dichloroethene	0.24	2.0		U
156-59-2	cis-1,2-Dichloroethene	0.16	1.0		U
156-60-5	trans-1,2-Dichloroethene	0.21	1.0		U
78-87-5	1,2-Dichloropropane	0.17	1.0		U
10061-01-5	cis-1,3-Dichloropropene	0.12	1.0		U
10061-02-6	trans-1,3-Dichloropropene	0.17	1.0		U
100-41-4	Ethylbenzene	0.10	1.0		U
591-78-6	2-Hexanone	0.42	5.0		U
98-82-8	Isopropylbenzene	0.11	1.0		U
79-20-9	Methyl acetate	0.51	3.0		U
75-09-2	Methylene chloride	0.27	2.0		U
108-87-2	Methyl cyclohexane	0.12	1.0		U
1634-04-4	Methyl-tert-butyl ether	0.10	1.0		U
108-10-1	4-Methyl-2-pentanone	0.50	10		U
100-42-5	Styrene	0.11	1.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.23	1.0		U
127-18-4	Tetrachloroethene	0.16	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-RB
120308-01

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) WATER Lab Sample ID: 0812060-04

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1206004

Level: (low/med) LOW Date Sampled: 12/03/08 17:00

% Moisture: not dec. _____ Date Analyzed: 12/08/08 16:00

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.14	1.0		U
120-82-1	1,2,4-Trichlorobenzene	0.18	2.0		U
71-55-6	1,1,1-Trichloroethane	0.20	1.0		U
79-00-5	1,1,2-Trichloroethane	0.14	1.0		U
79-01-6	Trichloroethene	0.50	1.0		U
76-13-1	Trichlorotrifluoroethane	0.12	2.0		U
75-69-4	Trichlorofluoromethane	0.22	2.0		U
75-01-4	Vinyl chloride	0.19	2.0		U
1330-20-7	Xylene(total)	0.21	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-SB
120308-01

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) WATER Lab Sample ID: 0812060-05

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1206005

Level: (low/med) LOW Date Sampled: 12/03/08 17:10

% Moisture: not dec. _____ Date Analyzed: 12/08/08 16:29

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	10	2.4	J
71-43-2	Benzene	0.12	1.0		U
75-27-4	Bromodichloromethane	0.18	1.0		U
75-25-2	Bromoform	0.10	1.0		U
74-83-9	Bromomethane	0.27	1.0		U
78-93-3	2-Butanone	1.1	10		U
75-15-0	Carbon disulfide	0.17	1.0		U
56-23-5	Carbon tetrachloride	0.22	1.0		U
108-90-7	Chlorobenzene	0.10	1.0		U
75-00-3	Chloroethane	0.25	2.0		U
67-66-3	Chloroform	0.17	1.0		U
74-87-3	Chloromethane	0.36	2.0		U
110-82-7	Cyclohexane	0.14	1.0		U
124-48-1	Dibromochloromethane	0.10	1.0		U
96-12-8	1,2-Dibromo-3-chloropropane	0.23	1.0		U
106-93-4	1,2-Dibromoethane	0.14	1.0		U
95-50-1	1,2-Dichlorobenzene	0.16	1.0		U
541-73-1	1,3-Dichlorobenzene	0.13	1.0		U
106-46-7	1,4-Dichlorobenzene	0.10	1.0		U
75-71-8	Dichlorodifluoromethane	0.20	2.0		U
75-34-3	1,1-Dichloroethane	0.19	1.0		U
107-06-2	1,2-Dichloroethane	0.22	1.0		U
75-35-4	1,1-Dichloroethene	0.24	2.0		U
156-59-2	cis-1,2-Dichloroethene	0.16	1.0		U
156-60-5	trans-1,2-Dichloroethene	0.21	1.0		U
78-87-5	1,2-Dichloropropane	0.17	1.0		U
10061-01-5	cis-1,3-Dichloropropene	0.12	1.0		U
10061-02-6	trans-1,3-Dichloropropene	0.17	1.0		U
100-41-4	Ethylbenzene	0.10	1.0		U
591-78-6	2-Hexanone	0.42	5.0		U
98-82-8	Isopropylbenzene	0.11	1.0		U
79-20-9	Methyl acetate	0.51	3.0		U
75-09-2	Methylene chloride	0.27	2.0		U
108-87-2	Methyl cyclohexane	0.12	1.0		U
1634-04-4	Methyl-tert-butyl ether	0.10	1.0		U
108-10-1	4-Methyl-2-pentanone	0.50	10		U
100-42-5	Styrene	0.11	1.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.23	1.0		U
127-18-4	Tetrachloroethene	0.16	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-SB
120308-01

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) WATER Lab Sample ID: 0812060-05

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1206005

Level: (low/med) LOW Date Sampled: 12/03/08 17:10

% Moisture: not dec. _____ Date Analyzed: 12/08/08 16:29

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.14	1.0		U
120-82-1	1,2,4-Trichlorobenzene	0.18	2.0		U
71-55-6	1,1,1-Trichloroethane	0.20	1.0		U
79-00-5	1,1,2-Trichloroethane	0.14	1.0		U
79-01-6	Trichloroethene	0.50	1.0		U
76-13-1	Trichlorotrifluoroethane	0.12	2.0		U
75-69-4	Trichlorofluoromethane	0.22	2.0		U
75-01-4	Vinyl chloride	0.19	2.0		U
1330-20-7	Xylene(total)	0.21	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-TB120308

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) WATER Lab Sample ID: 0812060-06

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1206006

Level: (low/med) LOW Date Sampled: 12/03/08 08:00

% Moisture: not dec. _____ Date Analyzed: 12/08/08 14:02

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	10		U
71-43-2	Benzene	0.12	1.0		U
75-27-4	Bromodichloromethane	0.18	1.0		U
75-25-2	Bromoform	0.10	1.0		U
74-83-9	Bromomethane	0.27	1.0		U
78-93-3	2-Butanone	1.1	10		U
75-15-0	Carbon disulfide	0.17	1.0		U
56-23-5	Carbon tetrachloride	0.22	1.0		U
108-90-7	Chlorobenzene	0.10	1.0		U
75-00-3	Chloroethane	0.25	2.0		U
67-66-3	Chloroform	0.17	1.0		U
74-87-3	Chloromethane	0.36	2.0		U
110-82-7	Cyclohexane	0.14	1.0		U
124-48-1	Dibromochloromethane	0.10	1.0		U
96-12-8	1,2-Dibromo-3-chloropropane	0.23	1.0		U
106-93-4	1,2-Dibromoethane	0.14	1.0		U
95-50-1	1,2-Dichlorobenzene	0.16	1.0		U
541-73-1	1,3-Dichlorobenzene	0.13	1.0		U
106-46-7	1,4-Dichlorobenzene	0.10	1.0		U
75-71-8	Dichlorodifluoromethane	0.20	2.0		U
75-34-3	1,1-Dichloroethane	0.19	1.0		U
107-06-2	1,2-Dichloroethane	0.22	1.0		U
75-35-4	1,1-Dichloroethene	0.24	2.0		U
156-59-2	cis-1,2-Dichloroethene	0.16	1.0		U
156-60-5	trans-1,2-Dichloroethene	0.21	1.0		U
78-87-5	1,2-Dichloropropane	0.17	1.0		U
10061-01-5	cis-1,3-Dichloropropene	0.12	1.0		U
10061-02-6	trans-1,3-Dichloropropene	0.17	1.0		U
100-41-4	Ethylbenzene	0.10	1.0		U
591-78-6	2-Hexanone	0.42	5.0		U
98-82-8	Isopropylbenzene	0.11	1.0		U
79-20-9	Methyl acetate	0.51	3.0		U
75-09-2	Methylene chloride	0.27	2.0	0.94	JB
108-87-2	Methyl cyclohexane	0.12	1.0		U
1634-04-4	Methyl-tert-butyl ether	0.10	1.0		U
108-10-1	4-Methyl-2-pentanone	0.50	10		U
100-42-5	Styrene	0.11	1.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.23	1.0		U
127-18-4	Tetrachloroethene	0.16	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-TB120308

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) WATER Lab Sample ID: 0812060-06

Sample wt/vol: 5.000 (g/mL) ML Lab File ID: 1206006

Level: (low/med) LOW Date Sampled: 12/03/08 08:00

% Moisture: not dec. _____ Date Analyzed: 12/08/08 14:02

GC Column: DB-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.14	1.0		U
120-82-1	1,2,4-Trichlorobenzene	0.18	2.0		U
71-55-6	1,1,1-Trichloroethane	0.20	1.0		U
79-00-5	1,1,2-Trichloroethane	0.14	1.0		U
79-01-6	Trichloroethene	0.50	1.0		U
76-13-1	Trichlorotrifluoroethane	0.12	2.0		U
75-69-4	Trichlorofluoromethane	0.22	2.0		U
75-01-4	Vinyl chloride	0.19	2.0		U
1330-20-7	Xylene(total)	0.21	1.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD
120308-01

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-01

Sample wt/vol: 4.5 (g/mL) G Lab File ID: 1206001B

Level: (low/med) LOW Date Sampled: 12/03/08 :

% Moisture: not dec. 13 Date Analyzed: 12/12/08 14:00

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.5	6.4	12	
71-43-2	Benzene	0.60	6.4		U
75-27-4	Bromodichloromethane	0.38	6.4		U
75-25-2	Bromoform	1.3	13		U
74-83-9	Bromomethane	0.92	13		U
78-93-3	2-Butanone	1.8	6.4		U
75-15-0	Carbon disulfide	1.6	6.4		U
56-23-5	Carbon tetrachloride	1.1	6.4		U
108-90-7	Chlorobenzene	0.43	6.4		U
75-00-3	Chloroethane	1.4	13		U
67-66-3	Chloroform	0.70	13		U
74-87-3	Chloromethane	0.66	13		U
110-82-7	Cyclohexane	0.69	6.4		U
124-48-1	Dibromochloromethane	0.43	6.4		U
96-12-8	1,2-Dibromo-3-chloropropane	1.5	6.4		U
106-93-4	1,2-Dibromoethane	0.55	6.4		U
95-50-1	1,2-Dichlorobenzene	0.47	6.4		U
541-73-1	1,3-Dichlorobenzene	1.1	6.4		U
106-46-7	1,4-Dichlorobenzene	0.70	6.4		U
75-71-8	Dichlorodifluoromethane	1.4	6.4		U
75-34-3	1,1-Dichloroethane	0.69	6.4		U
107-06-2	1,2-Dichloroethane	0.59	6.4		U
75-35-4	1,1-Dichloroethene	1.5	13		U
156-59-2	cis-1,2-Dichloroethene	1.5	13		U
156-60-5	trans-1,2-Dichloroethene	1.4	6.4		U
78-87-5	1,2-Dichloropropane	0.59	6.4		U
10061-01-5	cis-1,3-Dichloropropene	0.64	6.4		U
10061-02-6	trans-1,3-Dichloropropene	0.41	6.4		U
100-41-4	Ethylbenzene	0.96	6.4		U
591-78-6	2-Hexanone	2.9	6.4		U
98-82-8	Isopropylbenzene	1.1	6.4		U
79-20-9	Methyl acetate	2.0	13		U
75-09-2	Methylene chloride	0.79	13	3.4	JB
108-87-2	Methyl cyclohexane	0.38	13		U
1634-04-4	Methyl-tert-butyl ether	0.41	13		U
108-10-1	4-Methyl-2-pentanone	0.74	6.4		U
100-42-5	Styrene	0.44	6.4		U
79-34-5	1,1,2,2-Tetrachloroethane	0.55	6.4		U
127-18-4	Tetrachloroethene	1.2	13		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD
120308-01

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-01

Sample wt/vol: 4.5 (g/mL) G Lab File ID: 1206001B

Level: (low/med) LOW Date Sampled: 12/03/08 :

% Moisture: not dec. 13 Date Analyzed: 12/12/08 14:00

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	1.1	6.4		U
120-82-1	1,2,4-Trichlorobenzene	0.23	13		U
71-55-6	1,1,1-Trichloroethane	1.1	6.4		U
79-00-5	1,1,2-Trichloroethane	0.44	6.4		U
79-01-6	Trichloroethene	1.1	6.4		U
76-13-1	Trichlorotrifluoroethane	0.70	6.4		U
75-69-4	Trichlorofluoromethane	1.2	6.4		U
75-01-4	Vinyl chloride	1.4	6.4		U
1330-20-7	Xylene(total)	0.89	6.4		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD1
20308-01DL

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-01DL

Sample wt/vol: 6.1 (g/mL) G Lab File ID: 1206001D

Level: (low/med) MED Date Sampled: 12/03/08 :

% Moisture: not dec. 13 Date Analyzed: 12/16/08 08:13

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume: 5000(uL) Soil Aliquot Volume: 100(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	94	230		UD
71-43-2	Benzene	22	230		UD
75-27-4	Bromodichloromethane	14	230		UD
75-25-2	Bromoform	47	470		UD
74-83-9	Bromomethane	34	470		UD
78-93-3	2-Butanone	66	230	69	JD
75-15-0	Carbon disulfide	61	230		UD
56-23-5	Carbon tetrachloride	41	230		UD
108-90-7	Chlorobenzene	16	230		UD
75-00-3	Chloroethane	52	470		UD
67-66-3	Chloroform	26	470		UD
74-87-3	Chloromethane	24	470		UD
110-82-7	Cyclohexane	25	230		UD
124-48-1	Dibromochloromethane	16	230		UD
96-12-8	1,2-Dibromo-3-chloropropane	56	230		UD
106-93-4	1,2-Dibromoethane	20	230		UD
95-50-1	1,2-Dichlorobenzene	17	230		UD
541-73-1	1,3-Dichlorobenzene	39	230		UD
106-46-7	1,4-Dichlorobenzene	26	230		UD
75-71-8	Dichlorodifluoromethane	52	230		UD
75-34-3	1,1-Dichloroethane	25	230		UD
107-06-2	1,2-Dichloroethane	22	230		UD
75-35-4	1,1-Dichloroethene	56	470		UD
156-59-2	cis-1,2-Dichloroethene	56	470		UD
156-60-5	trans-1,2-Dichloroethene	52	230		UD
78-87-5	1,2-Dichloropropane	22	230		UD
10061-01-5	cis-1,3-Dichloropropene	23	230		UD
10061-02-6	trans-1,3-Dichloropropene	15	230		UD
100-41-4	Ethylbenzene	35	230		UD
591-78-6	2-Hexanone	110	230		UD
98-82-8	Isopropylbenzene	41	230		UD
79-20-9	Methyl acetate	75	470		UD
75-09-2	Methylene chloride	29	470	380	JBD
108-87-2	Methyl cyclohexane	14	470		UD
1634-04-4	Methyl-tert-butyl ether	15	470		UD
108-10-1	4-Methyl-2-pentanone	27	230		UD
100-42-5	Styrene	16	230		UD
79-34-5	1,1,2,2-Tetrachloroethane	20	230		UD
127-18-4	Tetrachloroethene	46	470		UD

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD1
20308-01DL

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-01DL

Sample wt/vol: 6.1 (g/mL) G Lab File ID: 1206001D

Level: (low/med) MED Date Sampled: 12/03/08 :

% Moisture: not dec. 13 Date Analyzed: 12/16/08 08:13

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume: 5000(uL) Soil Aliquot Volume: 100(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	40	230		UD
120-82-1	1,2,4-Trichlorobenzene	8.4	470		UD
71-55-6	1,1,1-Trichloroethane	42	230		UD
79-00-5	1,1,2-Trichloroethane	16	230		UD
79-01-6	Trichloroethene	40	230		UD
76-13-1	Trichlorotrifluoroethane	26	230		UD
75-69-4	Trichlorofluoromethane	45	230		UD
75-01-4	Vinyl chloride	52	230		UD
1330-20-7	Xylene(total)	33	230	120	JD

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD
120308-02

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-02

Sample wt/vol: 5.3 (g/mL) G Lab File ID: 1206002A

Level: (low/med) LOW Date Sampled: 12/03/08 :

% Moisture: not dec. 13 Date Analyzed: 12/10/08 14:01

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.2	5.4	17	
71-43-2	Benzene	0.51	5.4		U
75-27-4	Bromodichloromethane	0.32	5.4		U
75-25-2	Bromoform	1.1	11		U
74-83-9	Bromomethane	0.78	11		U
78-93-3	2-Butanone	1.5	5.4	1.6	J
75-15-0	Carbon disulfide	1.4	5.4		U
56-23-5	Carbon tetrachloride	0.95	5.4		U
108-90-7	Chlorobenzene	0.37	5.4		U
75-00-3	Chloroethane	1.2	11		U
67-66-3	Chloroform	0.60	11		U
74-87-3	Chloromethane	0.56	11		U
110-82-7	Cyclohexane	0.58	5.4		U
124-48-1	Dibromochloromethane	0.37	5.4		U
96-12-8	1,2-Dibromo-3-chloropropane	1.3	5.4		U
106-93-4	1,2-Dibromoethane	0.46	5.4		U
95-50-1	1,2-Dichlorobenzene	0.40	5.4		U
541-73-1	1,3-Dichlorobenzene	0.91	5.4		U
106-46-7	1,4-Dichlorobenzene	0.60	5.4		U
75-71-8	Dichlorodifluoromethane	1.2	5.4		U
75-34-3	1,1-Dichloroethane	0.58	5.4		U
107-06-2	1,2-Dichloroethane	0.50	5.4		U
75-35-4	1,1-Dichloroethene	1.3	11		U
156-59-2	cis-1,2-Dichloroethene	1.3	11		U
156-60-5	trans-1,2-Dichloroethene	1.2	5.4		U
78-87-5	1,2-Dichloropropane	0.50	5.4		U
10061-01-5	cis-1,3-Dichloropropene	0.54	5.4		U
10061-02-6	trans-1,3-Dichloropropene	0.35	5.4		U
100-41-4	Ethylbenzene	0.81	5.4		U
591-78-6	2-Hexanone	2.5	5.4		U
98-82-8	Isopropylbenzene	0.95	5.4		U
79-20-9	Methyl acetate	1.7	11		U
75-09-2	Methylene chloride	0.67	11	3.6	JB
108-87-2	Methyl cyclohexane	0.32	11		U
1634-04-4	Methyl-tert-butyl ether	0.35	11		U
108-10-1	4-Methyl-2-pentanone	0.63	5.4		U
100-42-5	Styrene	0.38	5.4		U
79-34-5	1,1,2,2-Tetrachloroethane	0.46	5.4		U
127-18-4	Tetrachloroethene	1.0	11		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD
120308-02

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-02

Sample wt/vol: 5.3 (g/mL) G Lab File ID: 1206002A

Level: (low/med) LOW Date Sampled: 12/03/08 :

% Moisture: not dec. 13 Date Analyzed: 12/10/08 14:01

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.93	5.4		U
120-82-1	1,2,4-Trichlorobenzene	0.19	11		U
71-55-6	1,1,1-Trichloroethane	0.97	5.4		U
79-00-5	1,1,2-Trichloroethane	0.38	5.4		U
79-01-6	Trichloroethene	0.92	5.4		U
76-13-1	Trichlorotrifluoroethane	0.60	5.4		U
75-69-4	Trichlorofluoromethane	1.0	5.4		U
75-01-4	Vinyl chloride	1.2	5.4		U
1330-20-7	Xylene(total)	0.76	5.4		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD
120308-03

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-03

Sample wt/vol: 5.1 (g/mL) G Lab File ID: 1206003A

Level: (low/med) LOW Date Sampled: 12/03/08 :

% Moisture: not dec. 12 Date Analyzed: 12/10/08 14:40

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.2	5.5		U
71-43-2	Benzene	0.52	5.5		U
75-27-4	Bromodichloromethane	0.33	5.5		U
75-25-2	Bromoform	1.1	11		U
74-83-9	Bromomethane	0.80	11		U
78-93-3	2-Butanone	1.6	5.5		U
75-15-0	Carbon disulfide	1.4	5.5		U
56-23-5	Carbon tetrachloride	0.98	5.5		U
108-90-7	Chlorobenzene	0.38	5.5		U
75-00-3	Chloroethane	1.2	11		U
67-66-3	Chloroform	0.61	11		U
74-87-3	Chloromethane	0.58	11		U
110-82-7	Cyclohexane	0.60	5.5		U
124-48-1	Dibromochloromethane	0.38	5.5		U
96-12-8	1,2-Dibromo-3-chloropropane	1.3	5.5		U
106-93-4	1,2-Dibromoethane	0.48	5.5		U
95-50-1	1,2-Dichlorobenzene	0.41	5.5		U
541-73-1	1,3-Dichlorobenzene	0.93	5.5		U
106-46-7	1,4-Dichlorobenzene	0.61	5.5		U
75-71-8	Dichlorodifluoromethane	1.2	5.5		U
75-34-3	1,1-Dichloroethane	0.60	5.5		U
107-06-2	1,2-Dichloroethane	0.51	5.5		U
75-35-4	1,1-Dichloroethene	1.3	11		U
156-59-2	cis-1,2-Dichloroethene	1.3	11		U
156-60-5	trans-1,2-Dichloroethene	1.2	5.5		U
78-87-5	1,2-Dichloropropane	0.51	5.5		U
10061-01-5	cis-1,3-Dichloropropene	0.55	5.5		U
10061-02-6	trans-1,3-Dichloropropene	0.35	5.5		U
100-41-4	Ethylbenzene	0.83	5.5		U
591-78-6	2-Hexanone	2.6	5.5		U
98-82-8	Isopropylbenzene	0.98	5.5		U
79-20-9	Methyl acetate	1.8	11		U
75-09-2	Methylene chloride	0.69	11	3.8	JB
108-87-2	Methyl cyclohexane	0.33	11		U
1634-04-4	Methyl-tert-butyl ether	0.35	11		U
108-10-1	4-Methyl-2-pentanone	0.64	5.5		U
100-42-5	Styrene	0.39	5.5		U
79-34-5	1,1,2,2-Tetrachloroethane	0.48	5.5		U
127-18-4	Tetrachloroethene	1.1	11		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD
120308-03

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-03

Sample wt/vol: 5.1 (g/mL) G Lab File ID: 1206003A

Level: (low/med) LOW Date Sampled: 12/03/08 :

% Moisture: not dec. 12 Date Analyzed: 12/10/08 14:40

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.95	5.5		U
120-82-1	1,2,4-Trichlorobenzene	0.20	11		U
71-55-6	1,1,1-Trichloroethane	1.00	5.5		U
79-00-5	1,1,2-Trichloroethane	0.39	5.5		U
79-01-6	Trichloroethene	0.94	5.5		U
76-13-1	Trichlorotrifluoroethane	0.61	5.5		U
75-69-4	Trichlorofluoromethane	1.0	5.5		U
75-01-4	Vinyl chloride	1.2	5.5		U
1330-20-7	Xylene(total)	0.78	5.5		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
2-SO-0002

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-07

Sample wt/vol: 5.9 (g/mL) G Lab File ID: 1206007A

Level: (low/med) LOW Date Sampled: 12/03/08 08:32

% Moisture: not dec. 16 Date Analyzed: 12/10/08 15:19

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.0	5.0		U
71-43-2	Benzene	0.47	5.0		U
75-27-4	Bromodichloromethane	0.30	5.0		U
75-25-2	Bromoform	1.0	10		U
74-83-9	Bromomethane	0.72	10		U
78-93-3	2-Butanone	1.4	5.0		U
75-15-0	Carbon disulfide	1.3	5.0		U
56-23-5	Carbon tetrachloride	0.89	5.0		U
108-90-7	Chlorobenzene	0.34	5.0		U
75-00-3	Chloroethane	1.1	10		U
67-66-3	Chloroform	0.55	10		U
74-87-3	Chloromethane	0.52	10		U
110-82-7	Cyclohexane	0.54	5.0		U
124-48-1	Dibromochloromethane	0.34	5.0		U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	5.0		U
106-93-4	1,2-Dibromoethane	0.43	5.0		U
95-50-1	1,2-Dichlorobenzene	0.37	5.0		U
541-73-1	1,3-Dichlorobenzene	0.85	5.0		U
106-46-7	1,4-Dichlorobenzene	0.55	5.0		U
75-71-8	Dichlorodifluoromethane	1.1	5.0		U
75-34-3	1,1-Dichloroethane	0.54	5.0		U
107-06-2	1,2-Dichloroethane	0.46	5.0		U
75-35-4	1,1-Dichloroethene	1.2	10		U
156-59-2	cis-1,2-Dichloroethene	1.2	10		U
156-60-5	trans-1,2-Dichloroethene	1.1	5.0		U
78-87-5	1,2-Dichloropropane	0.46	5.0		U
10061-01-5	cis-1,3-Dichloropropene	0.50	5.0		U
10061-02-6	trans-1,3-Dichloropropene	0.32	5.0		U
100-41-4	Ethylbenzene	0.76	5.0		U
591-78-6	2-Hexanone	2.3	5.0		U
98-82-8	Isopropylbenzene	0.89	5.0		U
79-20-9	Methyl acetate	1.6	10		U
75-09-2	Methylene chloride	0.62	10	3.0	JB
108-87-2	Methyl cyclohexane	0.30	10		U
1634-04-4	Methyl-tert-butyl ether	0.32	10		U
108-10-1	4-Methyl-2-pentanone	0.58	5.0		U
100-42-5	Styrene	0.35	5.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.43	5.0		U
127-18-4	Tetrachloroethene	0.98	10		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
2-SO-0002

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-07

Sample wt/vol: 5.9 (g/mL) G Lab File ID: 1206007A

Level: (low/med) LOW Date Sampled: 12/03/08 08:32

% Moisture: not dec. 16 Date Analyzed: 12/10/08 15:19

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.87	5.0		U
120-82-1	1,2,4-Trichlorobenzene	0.18	10		U
71-55-6	1,1,1-Trichloroethane	0.91	5.0		U
79-00-5	1,1,2-Trichloroethane	0.35	5.0		U
79-01-6	Trichloroethene	0.86	5.0		U
76-13-1	Trichlorotrifluoroethane	0.55	5.0		U
75-69-4	Trichlorofluoromethane	0.96	5.0		U
75-01-4	Vinyl chloride	1.1	5.0		U
1330-20-7	Xylene(total)	0.70	5.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
2-SO-0507

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-08

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1206008A

Level: (low/med) LOW Date Sampled: 12/03/08 08:40

% Moisture: not dec. 17 Date Analyzed: 12/10/08 15:58

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	4.6	5.5	
71-43-2	Benzene	0.43	4.6		U
75-27-4	Bromodichloromethane	0.27	4.6		U
75-25-2	Bromoform	0.91	9.1		U
74-83-9	Bromomethane	0.66	9.1		U
78-93-3	2-Butanone	1.3	4.6		U
75-15-0	Carbon disulfide	1.2	4.6		U
56-23-5	Carbon tetrachloride	0.80	4.6		U
108-90-7	Chlorobenzene	0.31	4.6		U
75-00-3	Chloroethane	1.0	9.1		U
67-66-3	Chloroform	0.50	9.1		U
74-87-3	Chloromethane	0.48	9.1		U
110-82-7	Cyclohexane	0.49	4.6		U
124-48-1	Dibromochloromethane	0.31	4.6		U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	4.6		U
106-93-4	1,2-Dibromoethane	0.39	4.6		U
95-50-1	1,2-Dichlorobenzene	0.34	4.6		U
541-73-1	1,3-Dichlorobenzene	0.77	4.6		U
106-46-7	1,4-Dichlorobenzene	0.50	4.6		U
75-71-8	Dichlorodifluoromethane	1.0	4.6		U
75-34-3	1,1-Dichloroethane	0.49	4.6		U
107-06-2	1,2-Dichloroethane	0.42	4.6		U
75-35-4	1,1-Dichloroethene	1.1	9.1		U
156-59-2	cis-1,2-Dichloroethene	1.1	9.1		U
156-60-5	trans-1,2-Dichloroethene	1.0	4.6		U
78-87-5	1,2-Dichloropropane	0.42	4.6		U
10061-01-5	cis-1,3-Dichloropropene	0.46	4.6		U
10061-02-6	trans-1,3-Dichloropropene	0.29	4.6		U
100-41-4	Ethylbenzene	0.69	4.6		U
591-78-6	2-Hexanone	2.1	4.6		U
98-82-8	Isopropylbenzene	0.80	4.6		U
79-20-9	Methyl acetate	1.5	9.1		U
75-09-2	Methylene chloride	0.57	9.1	3.1	JB
108-87-2	Methyl cyclohexane	0.27	9.1		U
1634-04-4	Methyl-tert-butyl ether	0.29	9.1		U
108-10-1	4-Methyl-2-pentanone	0.53	4.6		U
100-42-5	Styrene	0.32	4.6		U
79-34-5	1,1,2,2-Tetrachloroethane	0.39	4.6		U
127-18-4	Tetrachloroethene	0.89	9.1		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
2-SO-0507

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-08

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1206008A

Level: (low/med) LOW Date Sampled: 12/03/08 08:40

% Moisture: not dec. 17 Date Analyzed: 12/10/08 15:58

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.79	4.6		U
120-82-1	1,2,4-Trichlorobenzene	0.16	9.1		U
71-55-6	1,1,1-Trichloroethane	0.82	4.6		U
79-00-5	1,1,2-Trichloroethane	0.32	4.6		U
79-01-6	Trichloroethene	0.78	4.6		U
76-13-1	Trichlorotrifluoroethane	0.50	4.6		U
75-69-4	Trichlorofluoromethane	0.87	4.6		U
75-01-4	Vinyl chloride	1.0	4.6		U
1330-20-7	Xylene(total)	0.64	4.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
3-SO-0103

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-09

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1206009A

Level: (low/med) LOW Date Sampled: 12/03/08 09:08

% Moisture: not dec. 18 Date Analyzed: 12/10/08 16:37

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	4.6	5.2	
71-43-2	Benzene	0.43	4.6		U
75-27-4	Bromodichloromethane	0.28	4.6		U
75-25-2	Bromoform	0.92	9.2		U
74-83-9	Bromomethane	0.66	9.2		U
78-93-3	2-Butanone	1.3	4.6		U
75-15-0	Carbon disulfide	1.2	4.6		U
56-23-5	Carbon tetrachloride	0.81	4.6		U
108-90-7	Chlorobenzene	0.31	4.6		U
75-00-3	Chloroethane	1.0	9.2		U
67-66-3	Chloroform	0.51	9.2		U
74-87-3	Chloromethane	0.48	9.2		U
110-82-7	Cyclohexane	0.50	4.6		U
124-48-1	Dibromochloromethane	0.31	4.6		U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	4.6		U
106-93-4	1,2-Dibromoethane	0.40	4.6		U
95-50-1	1,2-Dichlorobenzene	0.34	4.6		U
541-73-1	1,3-Dichlorobenzene	0.78	4.6		U
106-46-7	1,4-Dichlorobenzene	0.51	4.6		U
75-71-8	Dichlorodifluoromethane	1.0	4.6		U
75-34-3	1,1-Dichloroethane	0.50	4.6		U
107-06-2	1,2-Dichloroethane	0.42	4.6		U
75-35-4	1,1-Dichloroethene	1.1	9.2		U
156-59-2	cis-1,2-Dichloroethene	1.1	9.2		U
156-60-5	trans-1,2-Dichloroethene	1.0	4.6		U
78-87-5	1,2-Dichloropropane	0.42	4.6		U
10061-01-5	cis-1,3-Dichloropropene	0.46	4.6		U
10061-02-6	trans-1,3-Dichloropropene	0.30	4.6		U
100-41-4	Ethylbenzene	0.69	4.6		U
591-78-6	2-Hexanone	2.1	4.6		U
98-82-8	Isopropylbenzene	0.81	4.6		U
79-20-9	Methyl acetate	1.5	9.2		U
75-09-2	Methylene chloride	0.57	9.2	3.2	JB
108-87-2	Methyl cyclohexane	0.28	9.2		U
1634-04-4	Methyl-tert-butyl ether	0.30	9.2		U
108-10-1	4-Methyl-2-pentanone	0.54	4.6		U
100-42-5	Styrene	0.32	4.6		U
79-34-5	1,1,2,2-Tetrachloroethane	0.40	4.6		U
127-18-4	Tetrachloroethene	0.90	9.2		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
3-SO-0103

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-09

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1206009A

Level: (low/med) LOW Date Sampled: 12/03/08 09:08

% Moisture: not dec. 18 Date Analyzed: 12/10/08 16:37

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.79	4.6		U
120-82-1	1,2,4-Trichlorobenzene	0.17	9.2		U
71-55-6	1,1,1-Trichloroethane	0.83	4.6		U
79-00-5	1,1,2-Trichloroethane	0.32	4.6		U
79-01-6	Trichloroethene	0.78	4.6		U
76-13-1	Trichlorotrifluoroethane	0.51	4.6		U
75-69-4	Trichlorofluoromethane	0.88	4.6		U
75-01-4	Vinyl chloride	1.0	4.6		U
1330-20-7	Xylene(total)	0.64	4.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
4-SO-0204

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-10

Sample wt/vol: 5.9 (g/mL) G Lab File ID: 1206010A

Level: (low/med) LOW Date Sampled: 12/03/08 10:00

% Moisture: not dec. 14 Date Analyzed: 12/10/08 17:16

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.0	4.9	6.6	
71-43-2	Benzene	0.46	4.9		U
75-27-4	Bromodichloromethane	0.30	4.9		U
75-25-2	Bromoform	0.99	9.9		U
74-83-9	Bromomethane	0.71	9.9		U
78-93-3	2-Butanone	1.4	4.9		U
75-15-0	Carbon disulfide	1.3	4.9		U
56-23-5	Carbon tetrachloride	0.87	4.9		U
108-90-7	Chlorobenzene	0.34	4.9		U
75-00-3	Chloroethane	1.1	9.9		U
67-66-3	Chloroform	0.54	9.9		U
74-87-3	Chloromethane	0.51	9.9		U
110-82-7	Cyclohexane	0.53	4.9		U
124-48-1	Dibromochloromethane	0.34	4.9		U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	4.9		U
106-93-4	1,2-Dibromoethane	0.42	4.9		U
95-50-1	1,2-Dichlorobenzene	0.36	4.9		U
541-73-1	1,3-Dichlorobenzene	0.83	4.9		U
106-46-7	1,4-Dichlorobenzene	0.54	4.9		U
75-71-8	Dichlorodifluoromethane	1.1	4.9		U
75-34-3	1,1-Dichloroethane	0.53	4.9		U
107-06-2	1,2-Dichloroethane	0.45	4.9		U
75-35-4	1,1-Dichloroethene	1.2	9.9		U
156-59-2	cis-1,2-Dichloroethene	1.2	9.9		U
156-60-5	trans-1,2-Dichloroethene	1.1	4.9		U
78-87-5	1,2-Dichloropropane	0.45	4.9		U
10061-01-5	cis-1,3-Dichloropropene	0.49	4.9		U
10061-02-6	trans-1,3-Dichloropropene	0.32	4.9		U
100-41-4	Ethylbenzene	0.74	4.9		U
591-78-6	2-Hexanone	2.3	4.9		U
98-82-8	Isopropylbenzene	0.87	4.9		U
79-20-9	Methyl acetate	1.6	9.9		U
75-09-2	Methylene chloride	0.61	9.9	3.3	JB
108-87-2	Methyl cyclohexane	0.30	9.9		U
1634-04-4	Methyl-tert-butyl ether	0.32	9.9		U
108-10-1	4-Methyl-2-pentanone	0.57	4.9		U
100-42-5	Styrene	0.34	4.9		U
79-34-5	1,1,2,2-Tetrachloroethane	0.42	4.9		U
127-18-4	Tetrachloroethene	0.96	9.9		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
4-SO-0204

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-10

Sample wt/vol: 5.9 (g/mL) G Lab File ID: 1206010A

Level: (low/med) LOW Date Sampled: 12/03/08 10:00

% Moisture: not dec. 14 Date Analyzed: 12/10/08 17:16

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.85	4.9		U
120-82-1	1,2,4-Trichlorobenzene	0.18	9.9		U
71-55-6	1,1,1-Trichloroethane	0.89	4.9		U
79-00-5	1,1,2-Trichloroethane	0.34	4.9		U
79-01-6	Trichloroethene	0.84	4.9		U
76-13-1	Trichlorotrifluoroethane	0.54	4.9		U
75-69-4	Trichlorofluoromethane	0.94	4.9		U
75-01-4	Vinyl chloride	1.1	4.9		U
1330-20-7	Xylene(total)	0.69	4.9		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
4-SO-0507

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-11

Sample wt/vol: 6.3 (g/mL) G Lab File ID: 1206011A

Level: (low/med) LOW Date Sampled: 12/03/08 10:05

% Moisture: not dec. 14 Date Analyzed: 12/10/08 17:55

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	4.6	5.1	
71-43-2	Benzene	0.44	4.6		U
75-27-4	Bromodichloromethane	0.28	4.6		U
75-25-2	Bromoform	0.93	9.3		U
74-83-9	Bromomethane	0.67	9.3		U
78-93-3	2-Butanone	1.3	4.6		U
75-15-0	Carbon disulfide	1.2	4.6		U
56-23-5	Carbon tetrachloride	0.81	4.6		U
108-90-7	Chlorobenzene	0.31	4.6		U
75-00-3	Chloroethane	1.0	9.3		U
67-66-3	Chloroform	0.51	9.3		U
74-87-3	Chloromethane	0.48	9.3		U
110-82-7	Cyclohexane	0.50	4.6		U
124-48-1	Dibromochloromethane	0.31	4.6		U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	4.6		U
106-93-4	1,2-Dibromoethane	0.40	4.6		U
95-50-1	1,2-Dichlorobenzene	0.34	4.6		U
541-73-1	1,3-Dichlorobenzene	0.78	4.6		U
106-46-7	1,4-Dichlorobenzene	0.51	4.6		U
75-71-8	Dichlorodifluoromethane	1.0	4.6		U
75-34-3	1,1-Dichloroethane	0.50	4.6		U
107-06-2	1,2-Dichloroethane	0.42	4.6		U
75-35-4	1,1-Dichloroethene	1.1	9.3		U
156-59-2	cis-1,2-Dichloroethene	1.1	9.3		U
156-60-5	trans-1,2-Dichloroethene	1.0	4.6		U
78-87-5	1,2-Dichloropropane	0.42	4.6		U
10061-01-5	cis-1,3-Dichloropropene	0.46	4.6		U
10061-02-6	trans-1,3-Dichloropropene	0.30	4.6		U
100-41-4	Ethylbenzene	0.69	4.6		U
591-78-6	2-Hexanone	2.1	4.6		U
98-82-8	Isopropylbenzene	0.81	4.6		U
79-20-9	Methyl acetate	1.5	9.3		U
75-09-2	Methylene chloride	0.57	9.3	3.1	JB
108-87-2	Methyl cyclohexane	0.28	9.3		U
1634-04-4	Methyl-tert-butyl ether	0.30	9.3		U
108-10-1	4-Methyl-2-pentanone	0.54	4.6		U
100-42-5	Styrene	0.32	4.6		U
79-34-5	1,1,2,2-Tetrachloroethane	0.40	4.6		U
127-18-4	Tetrachloroethene	0.90	9.3		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
4-SO-0507

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-11

Sample wt/vol: 6.3 (g/mL) G Lab File ID: 1206011A

Level: (low/med) LOW Date Sampled: 12/03/08 10:05

% Moisture: not dec. 14 Date Analyzed: 12/10/08 17:55

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.80	4.6		U
120-82-1	1,2,4-Trichlorobenzene	0.17	9.3		U
71-55-6	1,1,1-Trichloroethane	0.83	4.6		U
79-00-5	1,1,2-Trichloroethane	0.32	4.6		U
79-01-6	Trichloroethene	0.79	4.6		U
76-13-1	Trichlorotrifluoroethane	0.51	4.6		U
75-69-4	Trichlorofluoromethane	0.88	4.6		U
75-01-4	Vinyl chloride	1.0	4.6		U
1330-20-7	Xylene(total)	0.65	4.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
5-SO-0103

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-12

Sample wt/vol: 6.7 (g/mL) G Lab File ID: 1206012A

Level: (low/med) LOW Date Sampled: 12/03/08 10:23

% Moisture: not dec. 12 Date Analyzed: 12/10/08 18:34

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.7	4.2	4.3	
71-43-2	Benzene	0.40	4.2		U
75-27-4	Bromodichloromethane	0.25	4.2		U
75-25-2	Bromoform	0.84	8.4		U
74-83-9	Bromomethane	0.61	8.4		U
78-93-3	2-Butanone	1.2	4.2		U
75-15-0	Carbon disulfide	1.1	4.2		U
56-23-5	Carbon tetrachloride	0.74	4.2		U
108-90-7	Chlorobenzene	0.29	4.2		U
75-00-3	Chloroethane	0.93	8.4		U
67-66-3	Chloroform	0.46	8.4		U
74-87-3	Chloromethane	0.44	8.4		U
110-82-7	Cyclohexane	0.46	4.2		U
124-48-1	Dibromochloromethane	0.29	4.2		U
96-12-8	1,2-Dibromo-3-chloropropane	1.0	4.2		U
106-93-4	1,2-Dibromoethane	0.36	4.2		U
95-50-1	1,2-Dichlorobenzene	0.31	4.2		U
541-73-1	1,3-Dichlorobenzene	0.71	4.2		U
106-46-7	1,4-Dichlorobenzene	0.46	4.2		U
75-71-8	Dichlorodifluoromethane	0.93	4.2		U
75-34-3	1,1-Dichloroethane	0.46	4.2		U
107-06-2	1,2-Dichloroethane	0.39	4.2		U
75-35-4	1,1-Dichloroethene	1.0	8.4		U
156-59-2	cis-1,2-Dichloroethene	1.0	8.4		U
156-60-5	trans-1,2-Dichloroethene	0.93	4.2		U
78-87-5	1,2-Dichloropropane	0.39	4.2		U
10061-01-5	cis-1,3-Dichloropropene	0.42	4.2		U
10061-02-6	trans-1,3-Dichloropropene	0.27	4.2		U
100-41-4	Ethylbenzene	0.63	4.2		U
591-78-6	2-Hexanone	1.9	4.2		U
98-82-8	Isopropylbenzene	0.74	4.2		U
79-20-9	Methyl acetate	1.3	8.4		U
75-09-2	Methylene chloride	0.52	8.4	3.1	JB
108-87-2	Methyl cyclohexane	0.25	8.4		U
1634-04-4	Methyl-tert-butyl ether	0.27	8.4		U
108-10-1	4-Methyl-2-pentanone	0.49	4.2		U
100-42-5	Styrene	0.30	4.2		U
79-34-5	1,1,2,2-Tetrachloroethane	0.36	4.2		U
127-18-4	Tetrachloroethene	0.82	8.4		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
5-SO-0103

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-12

Sample wt/vol: 6.7 (g/mL) G Lab File ID: 1206012A

Level: (low/med) LOW Date Sampled: 12/03/08 10:23

% Moisture: not dec. 12 Date Analyzed: 12/10/08 18:34

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.72	4.2		U
120-82-1	1,2,4-Trichlorobenzene	0.15	8.4		U
71-55-6	1,1,1-Trichloroethane	0.76	4.2		U
79-00-5	1,1,2-Trichloroethane	0.30	4.2		U
79-01-6	Trichloroethene	0.72	4.2		U
76-13-1	Trichlorotrifluoroethane	0.46	4.2		U
75-69-4	Trichlorofluoromethane	0.80	4.2		U
75-01-4	Vinyl chloride	0.93	4.2		U
1330-20-7	Xylene(total)	0.59	4.2		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
5-SO-0406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-13

Sample wt/vol: 5.7 (g/mL) G Lab File ID: 1206013A

Level: (low/med) LOW Date Sampled: 12/03/08 10:27

% Moisture: not dec. 13 Date Analyzed: 12/10/08 19:14

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.0	5.0	8.0	
71-43-2	Benzene	0.47	5.0		U
75-27-4	Bromodichloromethane	0.30	5.0		U
75-25-2	Bromoform	1.0	10		U
74-83-9	Bromomethane	0.72	10		U
78-93-3	2-Butanone	1.4	5.0		U
75-15-0	Carbon disulfide	1.3	5.0		U
56-23-5	Carbon tetrachloride	0.88	5.0		U
108-90-7	Chlorobenzene	0.34	5.0		U
75-00-3	Chloroethane	1.1	10		U
67-66-3	Chloroform	0.55	10		U
74-87-3	Chloromethane	0.52	10		U
110-82-7	Cyclohexane	0.54	5.0		U
124-48-1	Dibromochloromethane	0.34	5.0		U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	5.0		U
106-93-4	1,2-Dibromoethane	0.43	5.0		U
95-50-1	1,2-Dichlorobenzene	0.37	5.0		U
541-73-1	1,3-Dichlorobenzene	0.84	5.0		U
106-46-7	1,4-Dichlorobenzene	0.55	5.0		U
75-71-8	Dichlorodifluoromethane	1.1	5.0		U
75-34-3	1,1-Dichloroethane	0.54	5.0		U
107-06-2	1,2-Dichloroethane	0.46	5.0		U
75-35-4	1,1-Dichloroethene	1.2	10		U
156-59-2	cis-1,2-Dichloroethene	1.2	10		U
156-60-5	trans-1,2-Dichloroethene	1.1	5.0		U
78-87-5	1,2-Dichloropropane	0.46	5.0		U
10061-01-5	cis-1,3-Dichloropropene	0.50	5.0		U
10061-02-6	trans-1,3-Dichloropropene	0.32	5.0		U
100-41-4	Ethylbenzene	0.75	5.0		U
591-78-6	2-Hexanone	2.3	5.0		U
98-82-8	Isopropylbenzene	0.88	5.0		U
79-20-9	Methyl acetate	1.6	10		U
75-09-2	Methylene chloride	0.62	10	3.0	JB
108-87-2	Methyl cyclohexane	0.30	10		U
1634-04-4	Methyl-tert-butyl ether	0.32	10		U
108-10-1	4-Methyl-2-pentanone	0.58	5.0		U
100-42-5	Styrene	0.35	5.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.43	5.0		U
127-18-4	Tetrachloroethene	0.97	10		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
5-SO-0406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-13

Sample wt/vol: 5.7 (g/mL) G Lab File ID: 1206013A

Level: (low/med) LOW Date Sampled: 12/03/08 10:27

% Moisture: not dec. 13 Date Analyzed: 12/10/08 19:14

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.86	5.0		U
120-82-1	1,2,4-Trichlorobenzene	0.18	10		U
71-55-6	1,1,1-Trichloroethane	0.90	5.0		U
79-00-5	1,1,2-Trichloroethane	0.35	5.0		U
79-01-6	Trichloroethene	0.85	5.0		U
76-13-1	Trichlorotrifluoroethane	0.55	5.0		U
75-69-4	Trichlorofluoromethane	0.95	5.0		U
75-01-4	Vinyl chloride	1.1	5.0		U
1330-20-7	Xylene(total)	0.70	5.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
6-SO-0103

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-14

Sample wt/vol: 5.6 (g/mL) G Lab File ID: 1206014A

Level: (low/med) LOW Date Sampled: 12/03/08 11:01

% Moisture: not dec. 20 Date Analyzed: 12/10/08 19:53

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.2	5.6	12	
71-43-2	Benzene	0.52	5.6		U
75-27-4	Bromodichloromethane	0.33	5.6		U
75-25-2	Bromoform	1.1	11		U
74-83-9	Bromomethane	0.80	11		U
78-93-3	2-Butanone	1.6	5.6		U
75-15-0	Carbon disulfide	1.4	5.6		U
56-23-5	Carbon tetrachloride	0.98	5.6		U
108-90-7	Chlorobenzene	0.38	5.6		U
75-00-3	Chloroethane	1.2	11		U
67-66-3	Chloroform	0.61	11		U
74-87-3	Chloromethane	0.58	11		U
110-82-7	Cyclohexane	0.60	5.6		U
124-48-1	Dibromochloromethane	0.38	5.6		U
96-12-8	1,2-Dibromo-3-chloropropane	1.3	5.6		U
106-93-4	1,2-Dibromoethane	0.48	5.6		U
95-50-1	1,2-Dichlorobenzene	0.41	5.6		U
541-73-1	1,3-Dichlorobenzene	0.94	5.6		U
106-46-7	1,4-Dichlorobenzene	0.61	5.6		U
75-71-8	Dichlorodifluoromethane	1.2	5.6		U
75-34-3	1,1-Dichloroethane	0.60	5.6		U
107-06-2	1,2-Dichloroethane	0.51	5.6		U
75-35-4	1,1-Dichloroethene	1.3	11		U
156-59-2	cis-1,2-Dichloroethene	1.3	11		U
156-60-5	trans-1,2-Dichloroethene	1.2	5.6		U
78-87-5	1,2-Dichloropropane	0.51	5.6		U
10061-01-5	cis-1,3-Dichloropropene	0.56	5.6		U
10061-02-6	trans-1,3-Dichloropropene	0.36	5.6		U
100-41-4	Ethylbenzene	0.84	5.6		U
591-78-6	2-Hexanone	2.6	5.6		U
98-82-8	Isopropylbenzene	0.98	5.6		U
79-20-9	Methyl acetate	1.8	11		U
75-09-2	Methylene chloride	0.69	11	3.9	JB
108-87-2	Methyl cyclohexane	0.33	11		U
1634-04-4	Methyl-tert-butyl ether	0.36	11		U
108-10-1	4-Methyl-2-pentanone	0.65	5.6		U
100-42-5	Styrene	0.39	5.6		U
79-34-5	1,1,2,2-Tetrachloroethane	0.48	5.6		U
127-18-4	Tetrachloroethene	1.1	11		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
6-SO-0103

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-14

Sample wt/vol: 5.6 (g/mL) G Lab File ID: 1206014A

Level: (low/med) LOW Date Sampled: 12/03/08 11:01

% Moisture: not dec. 20 Date Analyzed: 12/10/08 19:53

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.96	5.6		U
120-82-1	1,2,4-Trichlorobenzene	0.20	11		U
71-55-6	1,1,1-Trichloroethane	1.0	5.6		U
79-00-5	1,1,2-Trichloroethane	0.39	5.6		U
79-01-6	Trichloroethene	0.95	5.6		U
76-13-1	Trichlorotrifluoroethane	0.61	5.6		U
75-69-4	Trichlorofluoromethane	1.1	5.6		U
75-01-4	Vinyl chloride	1.2	5.6		U
1330-20-7	Xylene(total)	0.78	5.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
6-SO-0507

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-15

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1206015A

Level: (low/med) LOW Date Sampled: 12/03/08 11:06

% Moisture: not dec. 12 Date Analyzed: 12/10/08 20:32

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.7	4.3		U
71-43-2	Benzene	0.40	4.3		U
75-27-4	Bromodichloromethane	0.26	4.3		U
75-25-2	Bromoform	0.86	8.6		U
74-83-9	Bromomethane	0.62	8.6		U
78-93-3	2-Butanone	1.2	4.3		U
75-15-0	Carbon disulfide	1.1	4.3		U
56-23-5	Carbon tetrachloride	0.76	4.3		U
108-90-7	Chlorobenzene	0.29	4.3		U
75-00-3	Chloroethane	0.94	8.6		U
67-66-3	Chloroform	0.47	8.6		U
74-87-3	Chloromethane	0.45	8.6		U
110-82-7	Cyclohexane	0.46	4.3		U
124-48-1	Dibromochloromethane	0.29	4.3		U
96-12-8	1,2-Dibromo-3-chloropropane	1.0	4.3		U
106-93-4	1,2-Dibromoethane	0.37	4.3		U
95-50-1	1,2-Dichlorobenzene	0.32	4.3		U
541-73-1	1,3-Dichlorobenzene	0.72	4.3		U
106-46-7	1,4-Dichlorobenzene	0.47	4.3		U
75-71-8	Dichlorodifluoromethane	0.94	4.3		U
75-34-3	1,1-Dichloroethane	0.46	4.3		U
107-06-2	1,2-Dichloroethane	0.39	4.3		U
75-35-4	1,1-Dichloroethene	1.0	8.6		U
156-59-2	cis-1,2-Dichloroethene	1.0	8.6		U
156-60-5	trans-1,2-Dichloroethene	0.94	4.3		U
78-87-5	1,2-Dichloropropane	0.39	4.3		U
10061-01-5	cis-1,3-Dichloropropene	0.43	4.3		U
10061-02-6	trans-1,3-Dichloropropene	0.27	4.3		U
100-41-4	Ethylbenzene	0.64	4.3		U
591-78-6	2-Hexanone	2.0	4.3		U
98-82-8	Isopropylbenzene	0.76	4.3		U
79-20-9	Methyl acetate	1.4	8.6		U
75-09-2	Methylene chloride	0.53	8.6	3.5	JB
108-87-2	Methyl cyclohexane	0.26	8.6		U
1634-04-4	Methyl-tert-butyl ether	0.27	8.6		U
108-10-1	4-Methyl-2-pentanone	0.50	4.3		U
100-42-5	Styrene	0.30	4.3		U
79-34-5	1,1,2,2-Tetrachloroethane	0.37	4.3		U
127-18-4	Tetrachloroethene	0.83	8.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
6-SO-0507

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-15

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1206015A

Level: (low/med) LOW Date Sampled: 12/03/08 11:06

% Moisture: not dec. 12 Date Analyzed: 12/10/08 20:32

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.74	4.3		U
120-82-1	1,2,4-Trichlorobenzene	0.15	8.6		U
71-55-6	1,1,1-Trichloroethane	0.77	4.3		U
79-00-5	1,1,2-Trichloroethane	0.30	4.3		U
79-01-6	Trichloroethene	0.73	4.3		U
76-13-1	Trichlorotrifluoroethane	0.47	4.3		U
75-69-4	Trichlorofluoromethane	0.82	4.3		U
75-01-4	Vinyl chloride	0.94	4.3		U
1330-20-7	Xylene(total)	0.60	4.3		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
7-SO-0002

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-16

Sample wt/vol: 6.3 (g/mL) G Lab File ID: 1206016A

Level: (low/med) LOW Date Sampled: 12/03/08 11:39

% Moisture: not dec. 15 Date Analyzed: 12/11/08 04:50

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.9	4.6		U
71-43-2	Benzene	0.44	4.6		U
75-27-4	Bromodichloromethane	0.28	4.6		U
75-25-2	Bromoform	0.93	9.3		U
74-83-9	Bromomethane	0.67	9.3		U
78-93-3	2-Butanone	1.3	4.6		U
75-15-0	Carbon disulfide	1.2	4.6		U
56-23-5	Carbon tetrachloride	0.82	4.6		U
108-90-7	Chlorobenzene	0.32	4.6		U
75-00-3	Chloroethane	1.0	9.3		U
67-66-3	Chloroform	0.51	9.3		U
74-87-3	Chloromethane	0.48	9.3		U
110-82-7	Cyclohexane	0.50	4.6		U
124-48-1	Dibromochloromethane	0.32	4.6		U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	4.6		U
106-93-4	1,2-Dibromoethane	0.40	4.6		U
95-50-1	1,2-Dichlorobenzene	0.34	4.6		U
541-73-1	1,3-Dichlorobenzene	0.78	4.6		U
106-46-7	1,4-Dichlorobenzene	0.51	4.6		U
75-71-8	Dichlorodifluoromethane	1.0	4.6		U
75-34-3	1,1-Dichloroethane	0.50	4.6		U
107-06-2	1,2-Dichloroethane	0.43	4.6		U
75-35-4	1,1-Dichloroethene	1.1	9.3		U
156-59-2	cis-1,2-Dichloroethene	1.1	9.3		U
156-60-5	trans-1,2-Dichloroethene	1.0	4.6		U
78-87-5	1,2-Dichloropropane	0.43	4.6		U
10061-01-5	cis-1,3-Dichloropropene	0.46	4.6		U
10061-02-6	trans-1,3-Dichloropropene	0.30	4.6		U
100-41-4	Ethylbenzene	0.70	4.6		U
591-78-6	2-Hexanone	2.1	4.6		U
98-82-8	Isopropylbenzene	0.82	4.6		U
79-20-9	Methyl acetate	1.5	9.3		U
75-09-2	Methylene chloride	0.58	9.3	3.1	JB
108-87-2	Methyl cyclohexane	0.28	9.3		U
1634-04-4	Methyl-tert-butyl ether	0.30	9.3		U
108-10-1	4-Methyl-2-pentanone	0.54	4.6		U
100-42-5	Styrene	0.32	4.6		U
79-34-5	1,1,2,2-Tetrachloroethane	0.40	4.6		U
127-18-4	Tetrachloroethene	0.90	9.3		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
7-SO-0002

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-16

Sample wt/vol: 6.3 (g/mL) G Lab File ID: 1206016A

Level: (low/med) LOW Date Sampled: 12/03/08 11:39

% Moisture: not dec. 15 Date Analyzed: 12/11/08 04:50

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.80	4.6		U
120-82-1	1,2,4-Trichlorobenzene	0.17	9.3		U
71-55-6	1,1,1-Trichloroethane	0.84	4.6		U
79-00-5	1,1,2-Trichloroethane	0.32	4.6		U
79-01-6	Trichloroethene	0.79	4.6		U
76-13-1	Trichlorotrifluoroethane	0.51	4.6		U
75-69-4	Trichlorofluoromethane	0.88	4.6		U
75-01-4	Vinyl chloride	1.0	4.6		U
1330-20-7	Xylene(total)	0.65	4.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
7-SO-0406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-17

Sample wt/vol: 6.8 (g/mL) G Lab File ID: 1206017A

Level: (low/med) LOW Date Sampled: 12/03/08 11:44

% Moisture: not dec. 11 Date Analyzed: 12/11/08 05:30

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.6	4.1	9.1	
71-43-2	Benzene	0.39	4.1		U
75-27-4	Bromodichloromethane	0.25	4.1		U
75-25-2	Bromoform	0.83	8.3		U
74-83-9	Bromomethane	0.60	8.3		U
78-93-3	2-Butanone	1.2	4.1		U
75-15-0	Carbon disulfide	1.1	4.1		U
56-23-5	Carbon tetrachloride	0.73	4.1		U
108-90-7	Chlorobenzene	0.28	4.1		U
75-00-3	Chloroethane	0.91	8.3		U
67-66-3	Chloroform	0.45	8.3		U
74-87-3	Chloromethane	0.43	8.3		U
110-82-7	Cyclohexane	0.45	4.1		U
124-48-1	Dibromochloromethane	0.28	4.1		U
96-12-8	1,2-Dibromo-3-chloropropane	0.99	4.1		U
106-93-4	1,2-Dibromoethane	0.36	4.1		U
95-50-1	1,2-Dichlorobenzene	0.31	4.1		U
541-73-1	1,3-Dichlorobenzene	0.69	4.1		U
106-46-7	1,4-Dichlorobenzene	0.45	4.1		U
75-71-8	Dichlorodifluoromethane	0.91	4.1		U
75-34-3	1,1-Dichloroethane	0.45	4.1		U
107-06-2	1,2-Dichloroethane	0.38	4.1		U
75-35-4	1,1-Dichloroethene	0.99	8.3		U
156-59-2	cis-1,2-Dichloroethene	0.99	8.3		U
156-60-5	trans-1,2-Dichloroethene	0.91	4.1		U
78-87-5	1,2-Dichloropropane	0.38	4.1		U
10061-01-5	cis-1,3-Dichloropropene	0.41	4.1		U
10061-02-6	trans-1,3-Dichloropropene	0.26	4.1		U
100-41-4	Ethylbenzene	0.62	4.1		U
591-78-6	2-Hexanone	1.9	4.1		U
98-82-8	Isopropylbenzene	0.73	4.1		U
79-20-9	Methyl acetate	1.3	8.3		U
75-09-2	Methylene chloride	0.51	8.3	3.8	JB
108-87-2	Methyl cyclohexane	0.25	8.3		U
1634-04-4	Methyl-tert-butyl ether	0.26	8.3		U
108-10-1	4-Methyl-2-pentanone	0.48	4.1	0.65	J
100-42-5	Styrene	0.29	4.1		U
79-34-5	1,1,2,2-Tetrachloroethane	0.36	4.1		U
127-18-4	Tetrachloroethene	0.80	8.3		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
7-SO-0406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-17

Sample wt/vol: 6.8 (g/mL) G Lab File ID: 1206017A

Level: (low/med) LOW Date Sampled: 12/03/08 11:44

% Moisture: not dec. 11 Date Analyzed: 12/11/08 05:30

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.71	4.1		U
120-82-1	1,2,4-Trichlorobenzene	0.15	8.3		U
71-55-6	1,1,1-Trichloroethane	0.74	4.1		U
79-00-5	1,1,2-Trichloroethane	0.29	4.1		U
79-01-6	Trichloroethene	0.70	4.1		U
76-13-1	Trichlorotrifluoroethane	0.45	4.1		U
75-69-4	Trichlorofluoromethane	0.78	4.1		U
75-01-4	Vinyl chloride	0.91	4.1		U
1330-20-7	Xylene(total)	0.58	4.1		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB18SO0204

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-18

Sample wt/vol: 5.8 (g/mL) G Lab File ID: 1206018A

Level: (low/med) LOW Date Sampled: 12/03/08 13:16

% Moisture: not dec. 14 Date Analyzed: 12/10/08 21:11

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.0	5.0	10	
71-43-2	Benzene	0.47	5.0		U
75-27-4	Bromodichloromethane	0.30	5.0		U
75-25-2	Bromoform	1.00	10		U
74-83-9	Bromomethane	0.72	10		U
78-93-3	2-Butanone	1.4	5.0		U
75-15-0	Carbon disulfide	1.3	5.0		U
56-23-5	Carbon tetrachloride	0.88	5.0		U
108-90-7	Chlorobenzene	0.34	5.0		U
75-00-3	Chloroethane	1.1	10		U
67-66-3	Chloroform	0.55	10		U
74-87-3	Chloromethane	0.52	10		U
110-82-7	Cyclohexane	0.54	5.0		U
124-48-1	Dibromochloromethane	0.34	5.0		U
96-12-8	1,2-Dibromo-3-chloropropane	1.2	5.0		U
106-93-4	1,2-Dibromoethane	0.43	5.0		U
95-50-1	1,2-Dichlorobenzene	0.37	5.0		U
541-73-1	1,3-Dichlorobenzene	0.84	5.0		U
106-46-7	1,4-Dichlorobenzene	0.55	5.0		U
75-71-8	Dichlorodifluoromethane	1.1	5.0		U
75-34-3	1,1-Dichloroethane	0.54	5.0		U
107-06-2	1,2-Dichloroethane	0.46	5.0		U
75-35-4	1,1-Dichloroethene	1.2	10		U
156-59-2	cis-1,2-Dichloroethene	1.2	10		U
156-60-5	trans-1,2-Dichloroethene	1.1	5.0		U
78-87-5	1,2-Dichloropropane	0.46	5.0		U
10061-01-5	cis-1,3-Dichloropropene	0.50	5.0		U
10061-02-6	trans-1,3-Dichloropropene	0.32	5.0		U
100-41-4	Ethylbenzene	0.75	5.0		U
591-78-6	2-Hexanone	2.3	5.0		U
98-82-8	Isopropylbenzene	0.88	5.0		U
79-20-9	Methyl acetate	1.6	10		U
75-09-2	Methylene chloride	0.62	10	3.6	JB
108-87-2	Methyl cyclohexane	0.30	10		U
1634-04-4	Methyl-tert-butyl ether	0.32	10		U
108-10-1	4-Methyl-2-pentanone	0.58	5.0		U
100-42-5	Styrene	0.35	5.0		U
79-34-5	1,1,2,2-Tetrachloroethane	0.43	5.0		U
127-18-4	Tetrachloroethene	0.97	10		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB18SO0204

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-18

Sample wt/vol: 5.8 (g/mL) G Lab File ID: 1206018A

Level: (low/med) LOW Date Sampled: 12/03/08 13:16

% Moisture: not dec. 14 Date Analyzed: 12/10/08 21:11

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.86	5.0		U
120-82-1	1,2,4-Trichlorobenzene	0.18	10		U
71-55-6	1,1,1-Trichloroethane	0.90	5.0		U
79-00-5	1,1,2-Trichloroethane	0.35	5.0		U
79-01-6	Trichloroethene	0.85	5.0		U
76-13-1	Trichlorotrifluoroethane	0.55	5.0		U
75-69-4	Trichlorofluoromethane	0.95	5.0		U
75-01-4	Vinyl chloride	1.1	5.0		U
1330-20-7	Xylene(total)	0.70	5.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
8-SO-0406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-19

Sample wt/vol: 6.7 (g/mL) G Lab File ID: 1206019A

Level: (low/med) LOW Date Sampled: 12/03/08 13:20

% Moisture: not dec. 14 Date Analyzed: 12/11/08 06:09

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.7	4.3		U
71-43-2	Benzene	0.41	4.3		U
75-27-4	Bromodichloromethane	0.26	4.3		U
75-25-2	Bromoform	0.86	8.6		U
74-83-9	Bromomethane	0.62	8.6		U
78-93-3	2-Butanone	1.2	4.3		U
75-15-0	Carbon disulfide	1.1	4.3		U
56-23-5	Carbon tetrachloride	0.76	4.3		U
108-90-7	Chlorobenzene	0.29	4.3		U
75-00-3	Chloroethane	0.95	8.6		U
67-66-3	Chloroform	0.48	8.6		U
74-87-3	Chloromethane	0.45	8.6		U
110-82-7	Cyclohexane	0.47	4.3		U
124-48-1	Dibromochloromethane	0.29	4.3		U
96-12-8	1,2-Dibromo-3-chloropropane	1.0	4.3		U
106-93-4	1,2-Dibromoethane	0.37	4.3		U
95-50-1	1,2-Dichlorobenzene	0.32	4.3		U
541-73-1	1,3-Dichlorobenzene	0.73	4.3		U
106-46-7	1,4-Dichlorobenzene	0.48	4.3		U
75-71-8	Dichlorodifluoromethane	0.95	4.3		U
75-34-3	1,1-Dichloroethane	0.47	4.3		U
107-06-2	1,2-Dichloroethane	0.40	4.3		U
75-35-4	1,1-Dichloroethene	1.0	8.6		U
156-59-2	cis-1,2-Dichloroethene	1.0	8.6		U
156-60-5	trans-1,2-Dichloroethene	0.95	4.3		U
78-87-5	1,2-Dichloropropane	0.40	4.3		U
10061-01-5	cis-1,3-Dichloropropene	0.43	4.3		U
10061-02-6	trans-1,3-Dichloropropene	0.28	4.3		U
100-41-4	Ethylbenzene	0.65	4.3		U
591-78-6	2-Hexanone	2.0	4.3		U
98-82-8	Isopropylbenzene	0.76	4.3		U
79-20-9	Methyl acetate	1.4	8.6		U
75-09-2	Methylene chloride	0.54	8.6	3.1	JB
108-87-2	Methyl cyclohexane	0.26	8.6		U
1634-04-4	Methyl-tert-butyl ether	0.28	8.6		U
108-10-1	4-Methyl-2-pentanone	0.50	4.3		U
100-42-5	Styrene	0.30	4.3		U
79-34-5	1,1,2,2-Tetrachloroethane	0.37	4.3		U
127-18-4	Tetrachloroethene	0.84	8.6		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
8-SO-0406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-19

Sample wt/vol: 6.7 (g/mL) G Lab File ID: 1206019A

Level: (low/med) LOW Date Sampled: 12/03/08 13:20

% Moisture: not dec. 14 Date Analyzed: 12/11/08 06:09

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.74	4.3		U
120-82-1	1,2,4-Trichlorobenzene	0.16	8.6		U
71-55-6	1,1,1-Trichloroethane	0.78	4.3		U
79-00-5	1,1,2-Trichloroethane	0.30	4.3		U
79-01-6	Trichloroethene	0.74	4.3		U
76-13-1	Trichlorotrifluoroethane	0.48	4.3		U
75-69-4	Trichlorofluoromethane	0.82	4.3		U
75-01-4	Vinyl chloride	0.95	4.3		U
1330-20-7	Xylene(total)	0.61	4.3		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
9-SO-0002

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-20

Sample wt/vol: 5.0 (g/mL) G Lab File ID: 1206020A

Level: (low/med) LOW Date Sampled: 12/03/08 13:50

% Moisture: not dec. 19 Date Analyzed: 12/11/08 06:48

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.5	6.2		U
71-43-2	Benzene	0.58	6.2		U
75-27-4	Bromodichloromethane	0.37	6.2		U
75-25-2	Bromoform	1.2	12		U
74-83-9	Bromomethane	0.88	12		U
78-93-3	2-Butanone	1.7	6.2		U
75-15-0	Carbon disulfide	1.6	6.2		U
56-23-5	Carbon tetrachloride	1.1	6.2		U
108-90-7	Chlorobenzene	0.42	6.2		U
75-00-3	Chloroethane	1.4	12		U
67-66-3	Chloroform	0.68	12		U
74-87-3	Chloromethane	0.64	12		U
110-82-7	Cyclohexane	0.66	6.2		U
124-48-1	Dibromochloromethane	0.42	6.2		U
96-12-8	1,2-Dibromo-3-chloropropane	1.5	6.2		U
106-93-4	1,2-Dibromoethane	0.53	6.2		U
95-50-1	1,2-Dichlorobenzene	0.46	6.2		U
541-73-1	1,3-Dichlorobenzene	1.0	6.2		U
106-46-7	1,4-Dichlorobenzene	0.68	6.2		U
75-71-8	Dichlorodifluoromethane	1.4	6.2		U
75-34-3	1,1-Dichloroethane	0.66	6.2		U
107-06-2	1,2-Dichloroethane	0.56	6.2		U
75-35-4	1,1-Dichloroethene	1.5	12		U
156-59-2	cis-1,2-Dichloroethene	1.5	12		U
156-60-5	trans-1,2-Dichloroethene	1.4	6.2		U
78-87-5	1,2-Dichloropropane	0.56	6.2		U
10061-01-5	cis-1,3-Dichloropropene	0.62	6.2		U
10061-02-6	trans-1,3-Dichloropropene	0.39	6.2		U
100-41-4	Ethylbenzene	0.92	6.2		U
591-78-6	2-Hexanone	2.8	6.2		U
98-82-8	Isopropylbenzene	1.1	6.2		U
79-20-9	Methyl acetate	2.0	12		U
75-09-2	Methylene chloride	0.76	12	5.5	JB
108-87-2	Methyl cyclohexane	0.37	12		U
1634-04-4	Methyl-tert-butyl ether	0.39	12		U
108-10-1	4-Methyl-2-pentanone	0.71	6.2		U
100-42-5	Styrene	0.43	6.2		U
79-34-5	1,1,2,2-Tetrachloroethane	0.53	6.2		U
127-18-4	Tetrachloroethene	1.2	12		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
9-SO-0002

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-20

Sample wt/vol: 5.0 (g/mL) G Lab File ID: 1206020A

Level: (low/med) LOW Date Sampled: 12/03/08 13:50

% Moisture: not dec. 19 Date Analyzed: 12/11/08 06:48

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	1.0	6.2		U
120-82-1	1,2,4-Trichlorobenzene	0.22	12		U
71-55-6	1,1,1-Trichloroethane	1.1	6.2		U
79-00-5	1,1,2-Trichloroethane	0.43	6.2		U
79-01-6	Trichloroethene	1.0	6.2		U
76-13-1	Trichlorotrifluoroethane	0.68	6.2		U
75-69-4	Trichlorofluoromethane	1.2	6.2		U
75-01-4	Vinyl chloride	1.4	6.2		U
1330-20-7	Xylene(total)	0.86	6.2		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB19SO0406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-21

Sample wt/vol: 6.9 (g/mL) G Lab File ID: 1206021A

Level: (low/med) LOW Date Sampled: 12/03/08 13:53

% Moisture: not dec. 15 Date Analyzed: 12/10/08 21:50

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.7	4.2	3.0	J
71-43-2	Benzene	0.40	4.2		U
75-27-4	Bromodichloromethane	0.25	4.2		U
75-25-2	Bromoform	0.85	8.5		U
74-83-9	Bromomethane	0.61	8.5		U
78-93-3	2-Butanone	1.2	4.2		U
75-15-0	Carbon disulfide	1.1	4.2		U
56-23-5	Carbon tetrachloride	0.75	4.2		U
108-90-7	Chlorobenzene	0.29	4.2		U
75-00-3	Chloroethane	0.93	8.5		U
67-66-3	Chloroform	0.47	8.5		U
74-87-3	Chloromethane	0.44	8.5		U
110-82-7	Cyclohexane	0.46	4.2		U
124-48-1	Dibromochloromethane	0.29	4.2		U
96-12-8	1,2-Dibromo-3-chloropropane	1.0	4.2		U
106-93-4	1,2-Dibromoethane	0.36	4.2		U
95-50-1	1,2-Dichlorobenzene	0.31	4.2		U
541-73-1	1,3-Dichlorobenzene	0.71	4.2		U
106-46-7	1,4-Dichlorobenzene	0.47	4.2		U
75-71-8	Dichlorodifluoromethane	0.93	4.2		U
75-34-3	1,1-Dichloroethane	0.46	4.2		U
107-06-2	1,2-Dichloroethane	0.39	4.2		U
75-35-4	1,1-Dichloroethene	1.0	8.5		U
156-59-2	cis-1,2-Dichloroethene	1.0	8.5		U
156-60-5	trans-1,2-Dichloroethene	0.93	4.2		U
78-87-5	1,2-Dichloropropane	0.39	4.2		U
10061-01-5	cis-1,3-Dichloropropene	0.42	4.2		U
10061-02-6	trans-1,3-Dichloropropene	0.27	4.2		U
100-41-4	Ethylbenzene	0.64	4.2		U
591-78-6	2-Hexanone	2.0	4.2		U
98-82-8	Isopropylbenzene	0.75	4.2		U
79-20-9	Methyl acetate	1.4	8.5		U
75-09-2	Methylene chloride	0.53	8.5	2.9	JB
108-87-2	Methyl cyclohexane	0.25	8.5		U
1634-04-4	Methyl-tert-butyl ether	0.27	8.5		U
108-10-1	4-Methyl-2-pentanone	0.49	4.2		U
100-42-5	Styrene	0.30	4.2		U
79-34-5	1,1,2,2-Tetrachloroethane	0.36	4.2		U
127-18-4	Tetrachloroethene	0.82	8.5		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB19S00406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-21

Sample wt/vol: 6.9 (g/mL) G Lab File ID: 1206021A

Level: (low/med) LOW Date Sampled: 12/03/08 13:53

% Moisture: not dec. 15 Date Analyzed: 12/10/08 21:50

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.73	4.2		U
120-82-1	1,2,4-Trichlorobenzene	0.15	8.5		U
71-55-6	1,1,1-Trichloroethane	0.76	4.2		U
79-00-5	1,1,2-Trichloroethane	0.30	4.2		U
79-01-6	Trichloroethene	0.72	4.2		U
76-13-1	Trichlorotrifluoroethane	0.47	4.2		U
75-69-4	Trichlorofluoromethane	0.81	4.2		U
75-01-4	Vinyl chloride	0.93	4.2		U
1330-20-7	Xylene(total)	0.59	4.2		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB2
0-SO-0002

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-22

Sample wt/vol: 5.4 (g/mL) G Lab File ID: 1206022A

Level: (low/med) LOW Date Sampled: 12/03/08 14:30

% Moisture: not dec. 16 Date Analyzed: 12/11/08 07:27

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	2.2	5.5		U
71-43-2	Benzene	0.52	5.5		U
75-27-4	Bromodichloromethane	0.33	5.5		U
75-25-2	Bromoform	1.1	11		U
74-83-9	Bromomethane	0.79	11		U
78-93-3	2-Butanone	1.5	5.5		U
75-15-0	Carbon disulfide	1.4	5.5		U
56-23-5	Carbon tetrachloride	0.96	5.5		U
108-90-7	Chlorobenzene	0.37	5.5		U
75-00-3	Chloroethane	1.2	11		U
67-66-3	Chloroform	0.60	11		U
74-87-3	Chloromethane	0.57	11		U
110-82-7	Cyclohexane	0.59	5.5		U
124-48-1	Dibromochloromethane	0.37	5.5		U
96-12-8	1,2-Dibromo-3-chloropropane	1.3	5.5		U
106-93-4	1,2-Dibromoethane	0.47	5.5		U
95-50-1	1,2-Dichlorobenzene	0.40	5.5		U
541-73-1	1,3-Dichlorobenzene	0.92	5.5		U
106-46-7	1,4-Dichlorobenzene	0.60	5.5		U
75-71-8	Dichlorodifluoromethane	1.2	5.5		U
75-34-3	1,1-Dichloroethane	0.59	5.5		U
107-06-2	1,2-Dichloroethane	0.50	5.5		U
75-35-4	1,1-Dichloroethene	1.3	11		U
156-59-2	cis-1,2-Dichloroethene	1.3	11		U
156-60-5	trans-1,2-Dichloroethene	1.2	5.5		U
78-87-5	1,2-Dichloropropane	0.50	5.5		U
10061-01-5	cis-1,3-Dichloropropene	0.55	5.5		U
10061-02-6	trans-1,3-Dichloropropene	0.35	5.5		U
100-41-4	Ethylbenzene	0.82	5.5		U
591-78-6	2-Hexanone	2.5	5.5		U
98-82-8	Isopropylbenzene	0.96	5.5		U
79-20-9	Methyl acetate	1.8	11		U
75-09-2	Methylene chloride	0.68	11	3.7	JB
108-87-2	Methyl cyclohexane	0.33	11		U
1634-04-4	Methyl-tert-butyl ether	0.35	11		U
108-10-1	4-Methyl-2-pentanone	0.64	5.5		U
100-42-5	Styrene	0.38	5.5		U
79-34-5	1,1,2,2-Tetrachloroethane	0.47	5.5		U
127-18-4	Tetrachloroethene	1.1	11		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB2
0-SO-0002

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-22

Sample wt/vol: 5.4 (g/mL) G Lab File ID: 1206022A

Level: (low/med) LOW Date Sampled: 12/03/08 14:30

% Moisture: not dec. 16 Date Analyzed: 12/11/08 07:27

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.94	5.5		U
120-82-1	1,2,4-Trichlorobenzene	0.20	11		U
71-55-6	1,1,1-Trichloroethane	0.99	5.5		U
79-00-5	1,1,2-Trichloroethane	0.38	5.5		U
79-01-6	Trichloroethene	0.93	5.5		U
76-13-1	Trichlorotrifluoroethane	0.60	5.5		U
75-69-4	Trichlorofluoromethane	1.0	5.5		U
75-01-4	Vinyl chloride	1.2	5.5		U
1330-20-7	Xylene(total)	0.77	5.5		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB2
0-SO-0406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-23

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1206023A

Level: (low/med) LOW Date Sampled: 12/03/08 14:40

% Moisture: not dec. 16 Date Analyzed: 12/11/08 08:06

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
67-64-1	Acetone	1.8	4.5		U
71-43-2	Benzene	0.42	4.5		U
75-27-4	Bromodichloromethane	0.27	4.5		U
75-25-2	Bromoform	0.90	9.0		U
74-83-9	Bromomethane	0.65	9.0		U
78-93-3	2-Butanone	1.2	4.5		U
75-15-0	Carbon disulfide	1.2	4.5		U
56-23-5	Carbon tetrachloride	0.79	4.5		U
108-90-7	Chlorobenzene	0.30	4.5		U
75-00-3	Chloroethane	0.99	9.0		U
67-66-3	Chloroform	0.49	9.0		U
74-87-3	Chloromethane	0.47	9.0		U
110-82-7	Cyclohexane	0.48	4.5		U
124-48-1	Dibromochloromethane	0.30	4.5		U
96-12-8	1,2-Dibromo-3-chloropropane	1.1	4.5		U
106-93-4	1,2-Dibromoethane	0.39	4.5		U
95-50-1	1,2-Dichlorobenzene	0.33	4.5		U
541-73-1	1,3-Dichlorobenzene	0.75	4.5		U
106-46-7	1,4-Dichlorobenzene	0.49	4.5		U
75-71-8	Dichlorodifluoromethane	0.99	4.5		U
75-34-3	1,1-Dichloroethane	0.48	4.5		U
107-06-2	1,2-Dichloroethane	0.41	4.5		U
75-35-4	1,1-Dichloroethene	1.1	9.0		U
156-59-2	cis-1,2-Dichloroethene	1.1	9.0		U
156-60-5	trans-1,2-Dichloroethene	0.99	4.5		U
78-87-5	1,2-Dichloropropane	0.41	4.5		U
10061-01-5	cis-1,3-Dichloropropene	0.45	4.5		U
10061-02-6	trans-1,3-Dichloropropene	0.29	4.5		U
100-41-4	Ethylbenzene	0.67	4.5		U
591-78-6	2-Hexanone	2.1	4.5		U
98-82-8	Isopropylbenzene	0.79	4.5		U
79-20-9	Methyl acetate	1.4	9.0		U
75-09-2	Methylene chloride	0.56	9.0	4.0	JB
108-87-2	Methyl cyclohexane	0.27	9.0		U
1634-04-4	Methyl-tert-butyl ether	0.29	9.0		U
108-10-1	4-Methyl-2-pentanone	0.52	4.5		U
100-42-5	Styrene	0.31	4.5		U
79-34-5	1,1,2,2-Tetrachloroethane	0.39	4.5		U
127-18-4	Tetrachloroethene	0.87	9.0		U

FORM 1
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB2
0-SO-0406

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-23

Sample wt/vol: 6.6 (g/mL) G Lab File ID: 1206023A

Level: (low/med) LOW Date Sampled: 12/03/08 14:40

% Moisture: not dec. 16 Date Analyzed: 12/11/08 08:06

GC Column: RTX-VRX ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_____(uL) Soil Aliquot Volume: _____(uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
108-88-3	Toluene	0.77	4.5		U
120-82-1	1,2,4-Trichlorobenzene	0.16	9.0		U
71-55-6	1,1,1-Trichloroethane	0.81	4.5		U
79-00-5	1,1,2-Trichloroethane	0.31	4.5		U
79-01-6	Trichloroethene	0.76	4.5		U
76-13-1	Trichlorotrifluoroethane	0.49	4.5		U
75-69-4	Trichlorofluoromethane	0.85	4.5		U
75-01-4	Vinyl chloride	0.99	4.5		U
1330-20-7	Xylene(total)	0.63	4.5		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-RB
120308-01

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) WATER Lab Sample ID: 0812060-04

Sample wt/vol: 1060 (g/mL) ML Lab File ID: 1206004

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/03/08 17:00

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/10/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/18/08 13:11

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	0.0057	0.047		U
208-96-8	Acenaphthylene	0.0047	0.047		U
120-12-7	Anthracene	0.0094	0.047	0.012	J
56-55-3	Benzo(a)anthracene	0.012	0.047		U
205-99-2	Benzo(b)fluoranthene	0.011	0.047		U
207-08-9	Benzo(k)fluoranthene	0.0085	0.047		U
191-24-2	Benzo(g,h,i)perylene	0.0066	0.047	0.014	J
50-32-8	Benzo(a)pyrene	0.0057	0.047		U
218-01-9	Chrysene	0.010	0.047		U
53-70-3	Dibenz(a,h)anthracene	0.0047	0.047	0.0056	J
206-44-0	Fluoranthene	0.012	0.047		U
86-73-7	Fluorene	0.0066	0.047		U
193-39-5	Indeno(1,2,3-cd)pyrene	0.0038	0.047	0.0072	J
91-57-6	2-Methylnaphthalene	0.0057	0.047	0.0098	J
91-20-3	Naphthalene	0.012	0.047	0.034	JB
85-01-8	Phenanthrene	0.0075	0.047	0.016	J
129-00-0	Pyrene	0.012	0.047		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-SB
120308-01

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) WATER Lab Sample ID: 0812060-05

Sample wt/vol: 1070 (g/mL) ML Lab File ID: 1206005

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/03/08 17:10

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/10/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/18/08 13:40

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	0.0056	0.047		U
208-96-8	Acenaphthylene	0.0047	0.047		U
120-12-7	Anthracene	0.0093	0.047		U
56-55-3	Benzo(a)anthracene	0.012	0.047		U
205-99-2	Benzo(b)fluoranthene	0.011	0.047		U
207-08-9	Benzo(k)fluoranthene	0.0084	0.047		U
191-24-2	Benzo(g,h,i)perylene	0.0065	0.047		U
50-32-8	Benzo(a)pyrene	0.0056	0.047		U
218-01-9	Chrysene	0.010	0.047		U
53-70-3	Dibenz(a,h)anthracene	0.0047	0.047		U
206-44-0	Fluoranthene	0.012	0.047		U
86-73-7	Fluorene	0.0065	0.047		U
193-39-5	Indeno(1,2,3-cd)pyrene	0.0037	0.047		U
91-57-6	2-Methylnaphthalene	0.0056	0.047	0.011	J
91-20-3	Naphthalene	0.012	0.047	0.031	JB
85-01-8	Phenanthrene	0.0075	0.047	0.012	J
129-00-0	Pyrene	0.012	0.047		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD
120308-01

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-01

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206001

% Moisture: 13 decanted: (Y/N) N Date Sampled: 12/03/08 :

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/05/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/16/08 08:29

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8		U
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.92	3.8		U
56-55-3	Benzo(a)anthracene	1.6	3.8		U
205-99-2	Benzo(b)fluoranthene	1.8	3.8		UY
207-08-9	Benzo(k)fluoranthene	1.4	3.8		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.8	4.8	Y
50-32-8	Benzo(a)pyrene	1.1	3.8		U
218-01-9	Chrysene	1.2	3.8		U
53-70-3	Dibenz(a,h)anthracene	1.8	3.8		U
206-44-0	Fluoranthene	1.9	3.8		U
86-73-7	Fluorene	1.4	3.8		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.8		U
91-57-6	2-Methylnaphthalene	1.9	3.8	6.5	
91-20-3	Naphthalene	2.7	3.8		U
85-01-8	Phenanthrene	1.9	3.8	7.9	
129-00-0	Pyrene	1.8	3.8		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD
120308-02

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-02

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206002R

% Moisture: 13 decanted: (Y/N) N Date Sampled: 12/03/08 :

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/05/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 11:25

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8	14	
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.92	3.8	42	
56-55-3	Benzo(a)anthracene	1.6	3.8	130	
205-99-2	Benzo(b)fluoranthene	1.8	3.8	140	
207-08-9	Benzo(k)fluoranthene	1.4	3.8	39	
191-24-2	Benzo(g,h,i)perylene	1.7	3.8	60	
50-32-8	Benzo(a)pyrene	1.1	3.8	100	
218-01-9	Chrysene	1.2	3.8	110	
53-70-3	Dibenz(a,h)anthracene	1.8	3.8	15	
206-44-0	Fluoranthene	1.9	3.8	320	
86-73-7	Fluorene	1.4	3.8	16	
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.8	53	
91-57-6	2-Methylnaphthalene	1.9	3.8	2.0	J
91-20-3	Naphthalene	2.7	3.8		U
85-01-8	Phenanthrene	1.9	3.8	220	
129-00-0	Pyrene	1.8	3.8	250	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19-FD
120308-03

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-03

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206003

% Moisture: 12 decanted: (Y/N) N Date Sampled: 12/03/08 :

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/05/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/16/08 09:26

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8	13	
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.90	3.8	33	
56-55-3	Benzo(a)anthracene	1.6	3.8	110	X
205-99-2	Benzo(b)fluoranthene	1.7	3.8	64	Y
207-08-9	Benzo(k)fluoranthene	1.4	3.8	29	
191-24-2	Benzo(g,h,i)perylene	1.6	3.8	36	Y
50-32-8	Benzo(a)pyrene	1.1	3.8	68	
218-01-9	Chrysene	1.2	3.8	85	
53-70-3	Dibenz(a,h)anthracene	1.7	3.8		U
206-44-0	Fluoranthene	1.9	3.8	140	
86-73-7	Fluorene	1.4	3.8	13	
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.8	33	
91-57-6	2-Methylnaphthalene	1.9	3.8	5.9	
91-20-3	Naphthalene	2.6	3.8	4.9	
85-01-8	Phenanthrene	1.9	3.8	120	
129-00-0	Pyrene	1.7	3.8	120	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
2-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-07

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206007

% Moisture: 16 decanted: (Y/N) N Date Sampled: 12/03/08 08:32

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/05/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/16/08 09:55

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	4.0	78	
208-96-8	Acenaphthylene	1.3	4.0	12	
120-12-7	Anthracene	0.95	4.0	250	
56-55-3	Benzo(a)anthracene	1.7	4.0	940	X
205-99-2	Benzo(b)fluoranthene	1.8	4.0	510	Y
207-08-9	Benzo(k)fluoranthene	1.5	4.0	240	
191-24-2	Benzo(g,h,i)perylene	1.7	4.0	250	Y
50-32-8	Benzo(a)pyrene	1.2	4.0	480	
218-01-9	Chrysene	1.3	4.0	740	
53-70-3	Dibenz(a,h)anthracene	1.8	4.0		U
206-44-0	Fluoranthene	2.0	4.0	1300	
86-73-7	Fluorene	1.4	4.0	93	
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	4.0	230	
91-57-6	2-Methylnaphthalene	2.0	4.0	5.8	
91-20-3	Naphthalene	2.8	4.0	7.0	
85-01-8	Phenanthrene	2.0	4.0	1200	
129-00-0	Pyrene	1.8	4.0	1100	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
2-SO-0507

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-08

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206008

% Moisture: 17 decanted: (Y/N) N Date Sampled: 12/03/08 08:40

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/05/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/16/08 10:24

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	4.0		U
208-96-8	Acenaphthylene	1.4	4.0		U
120-12-7	Anthracene	0.97	4.0		U
56-55-3	Benzo(a)anthracene	1.7	4.0		U
205-99-2	Benzo(b)fluoranthene	1.8	4.0		UY
207-08-9	Benzo(k)fluoranthene	1.5	4.0		U
191-24-2	Benzo(g,h,i)perylene	1.8	4.0		UY
50-32-8	Benzo(a)pyrene	1.2	4.0		U
218-01-9	Chrysene	1.3	4.0		U
53-70-3	Dibenz(a,h)anthracene	1.8	4.0		U
206-44-0	Fluoranthene	2.0	4.0		U
86-73-7	Fluorene	1.4	4.0		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	4.0		U
91-57-6	2-Methylnaphthalene	2.0	4.0		U
91-20-3	Naphthalene	2.8	4.0		U
85-01-8	Phenanthrene	2.0	4.0		U
129-00-0	Pyrene	1.8	4.0		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
3-SO-0103

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-09

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206009

% Moisture: 18 decanted: (Y/N) N Date Sampled: 12/03/08 09:08

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/05/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/16/08 10:52

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.5	4.1		U
208-96-8	Acenaphthylene	1.4	4.1		U
120-12-7	Anthracene	0.97	4.1		U
56-55-3	Benzo(a)anthracene	1.7	4.1		U
205-99-2	Benzo(b)fluoranthene	1.9	4.1		UY
207-08-9	Benzo(k)fluoranthene	1.5	4.1		U
191-24-2	Benzo(g,h,i)perylene	1.8	4.1		UY
50-32-8	Benzo(a)pyrene	1.2	4.1		U
218-01-9	Chrysene	1.3	4.1		U
53-70-3	Dibenz(a,h)anthracene	1.9	4.1		U
206-44-0	Fluoranthene	2.0	4.1		U
86-73-7	Fluorene	1.5	4.1		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.9	4.1		U
91-57-6	2-Methylnaphthalene	2.0	4.1		U
91-20-3	Naphthalene	2.8	4.1		U
85-01-8	Phenanthrene	2.0	4.1		U
129-00-0	Pyrene	1.9	4.1		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
4-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-10

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206010

% Moisture: 14 decanted: (Y/N) N Date Sampled: 12/03/08 10:00

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/05/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/16/08 11:21

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.9		U
208-96-8	Acenaphthylene	1.3	3.9		U
120-12-7	Anthracene	0.93	3.9		U
56-55-3	Benzo(a)anthracene	1.6	3.9		U
205-99-2	Benzo(b)fluoranthene	1.8	3.9		UY
207-08-9	Benzo(k)fluoranthene	1.5	3.9		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.9	2.5	JY
50-32-8	Benzo(a)pyrene	1.2	3.9		U
218-01-9	Chrysene	1.2	3.9		U
53-70-3	Dibenz(a,h)anthracene	1.8	3.9		U
206-44-0	Fluoranthene	1.9	3.9		U
86-73-7	Fluorene	1.4	3.9		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.9		U
91-57-6	2-Methylnaphthalene	1.9	3.9		U
91-20-3	Naphthalene	2.7	3.9		U
85-01-8	Phenanthrene	1.9	3.9	2.4	J
129-00-0	Pyrene	1.8	3.9	2.0	J

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
4-SO-0507

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-11

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206011

% Moisture: 14 decanted: (Y/N) N Date Sampled: 12/03/08 10:05

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/05/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/16/08 11:50

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.9		U
208-96-8	Acenaphthylene	1.3	3.9		U
120-12-7	Anthracene	0.93	3.9		U
56-55-3	Benzo(a)anthracene	1.6	3.9		U
205-99-2	Benzo(b)fluoranthene	1.8	3.9		UY
207-08-9	Benzo(k)fluoranthene	1.5	3.9		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.9	2.6	JY
50-32-8	Benzo(a)pyrene	1.2	3.9		U
218-01-9	Chrysene	1.2	3.9		U
53-70-3	Dibenz(a,h)anthracene	1.8	3.9		U
206-44-0	Fluoranthene	1.9	3.9		U
86-73-7	Fluorene	1.4	3.9		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.9		U
91-57-6	2-Methylnaphthalene	1.9	3.9		U
91-20-3	Naphthalene	2.7	3.9		U
85-01-8	Phenanthrene	1.9	3.9	6.7	
129-00-0	Pyrene	1.8	3.9		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
5-SO-0103

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-12

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206012

% Moisture: 12 decanted: (Y/N) N Date Sampled: 12/03/08 10:23

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 11:54

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8		U
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.90	3.8		U
56-55-3	Benzo(a)anthracene	1.6	3.8		U
205-99-2	Benzo(b)fluoranthene	1.7	3.8		U
207-08-9	Benzo(k)fluoranthene	1.4	3.8		U
191-24-2	Benzo(g,h,i)perylene	1.6	3.8	3.4	J
50-32-8	Benzo(a)pyrene	1.1	3.8		U
218-01-9	Chrysene	1.2	3.8	7.1	
53-70-3	Dibenz(a,h)anthracene	1.7	3.8		U
206-44-0	Fluoranthene	1.9	3.8		U
86-73-7	Fluorene	1.4	3.8		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.8		U
91-57-6	2-Methylnaphthalene	1.9	3.8		U
91-20-3	Naphthalene	2.6	3.8		U
85-01-8	Phenanthrene	1.9	3.8	4.2	
129-00-0	Pyrene	1.7	3.8	4.0	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
5-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-13

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206013

% Moisture: 13 decanted: (Y/N) N Date Sampled: 12/03/08 10:27

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 12:23

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8		U
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.92	3.8		U
56-55-3	Benzo(a)anthracene	1.6	3.8		U
205-99-2	Benzo(b)fluoranthene	1.8	3.8		U
207-08-9	Benzo(k)fluoranthene	1.4	3.8		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.8	8.6	
50-32-8	Benzo(a)pyrene	1.1	3.8		U
218-01-9	Chrysene	1.2	3.8		U
53-70-3	Dibenz(a,h)anthracene	1.8	3.8		U
206-44-0	Fluoranthene	1.9	3.8		U
86-73-7	Fluorene	1.4	3.8		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.8		U
91-57-6	2-Methylnaphthalene	1.9	3.8	2.4	J
91-20-3	Naphthalene	2.7	3.8		U
85-01-8	Phenanthrene	1.9	3.8	12	
129-00-0	Pyrene	1.8	3.8		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
6-SO-0103

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-14

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206014

% Moisture: 20 decanted: (Y/N) N Date Sampled: 12/03/08 11:01

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 12:51

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.5	4.2	3.2	J
208-96-8	Acenaphthylene	1.4	4.2	1.8	J
120-12-7	Anthracene	1.0	4.2	9.2	
56-55-3	Benzo(a)anthracene	1.8	4.2	36	
205-99-2	Benzo(b)fluoranthene	1.9	4.2	41	
207-08-9	Benzo(k)fluoranthene	1.6	4.2	11	
191-24-2	Benzo(g,h,i)perylene	1.8	4.2	20	
50-32-8	Benzo(a)pyrene	1.2	4.2	38	
218-01-9	Chrysene	1.3	4.2	29	
53-70-3	Dibenz(a,h)anthracene	1.9	4.2	4.8	
206-44-0	Fluoranthene	2.1	4.2	72	
86-73-7	Fluorene	1.5	4.2	3.2	J
193-39-5	Indeno(1,2,3-cd)pyrene	1.9	4.2	18	
91-57-6	2-Methylnaphthalene	2.1	4.2		U
91-20-3	Naphthalene	2.9	4.2		U
85-01-8	Phenanthrene	2.1	4.2	40	
129-00-0	Pyrene	1.9	4.2	61	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
6-SO-0507

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-15

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206015

% Moisture: 12 decanted: (Y/N) N Date Sampled: 12/03/08 11:06

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 13:21

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8		U
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.91	3.8		U
56-55-3	Benzo(a)anthracene	1.6	3.8		U
205-99-2	Benzo(b)fluoranthene	1.7	3.8		U
207-08-9	Benzo(k)fluoranthene	1.4	3.8		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.8	5.4	
50-32-8	Benzo(a)pyrene	1.1	3.8		U
218-01-9	Chrysene	1.2	3.8		U
53-70-3	Dibenz(a,h)anthracene	1.7	3.8		U
206-44-0	Fluoranthene	1.9	3.8		U
86-73-7	Fluorene	1.4	3.8		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.8		U
91-57-6	2-Methylnaphthalene	1.9	3.8		U
91-20-3	Naphthalene	2.6	3.8		U
85-01-8	Phenanthrene	1.9	3.8	8.9	
129-00-0	Pyrene	1.7	3.8		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
7-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-16

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206016

% Moisture: 15 decanted: (Y/N) N Date Sampled: 12/03/08 11:39

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/18/08 06:54

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.9	9.1	
208-96-8	Acenaphthylene	1.3	3.9	5.0	
120-12-7	Anthracene	0.94	3.9	29	
56-55-3	Benzo(a)anthracene	1.6	3.9	120	X
205-99-2	Benzo(b)fluoranthene	1.8	3.9	89	
207-08-9	Benzo(k)fluoranthene	1.5	3.9	33	
191-24-2	Benzo(g,h,i)perylene	1.7	3.9	50	
50-32-8	Benzo(a)pyrene	1.2	3.9	94	
218-01-9	Chrysene	1.2	3.9	91	
53-70-3	Dibenz(a,h)anthracene	1.8	3.9	12	
206-44-0	Fluoranthene	2.0	3.9	200	
86-73-7	Fluorene	1.4	3.9	10	
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.9	48	
91-57-6	2-Methylnaphthalene	2.0	3.9	6.7	
91-20-3	Naphthalene	2.7	3.9	5.2	
85-01-8	Phenanthrene	2.0	3.9	130	
129-00-0	Pyrene	1.8	3.9	160	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
7-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-17

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206017

% Moisture: 11 decanted: (Y/N) N Date Sampled: 12/03/08 11:44

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 13:50

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.3	3.7		U
208-96-8	Acenaphthylene	1.3	3.7		U
120-12-7	Anthracene	0.90	3.7		U
56-55-3	Benzo(a)anthracene	1.6	3.7		U
205-99-2	Benzo(b)fluoranthene	1.7	3.7		U
207-08-9	Benzo(k)fluoranthene	1.4	3.7		U
191-24-2	Benzo(g,h,i)perylene	1.6	3.7	4.8	
50-32-8	Benzo(a)pyrene	1.1	3.7		U
218-01-9	Chrysene	1.2	3.7		U
53-70-3	Dibenz(a,h)anthracene	1.7	3.7		U
206-44-0	Fluoranthene	1.9	3.7		U
86-73-7	Fluorene	1.3	3.7		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.7	3.7		U
91-57-6	2-Methylnaphthalene	1.9	3.7	2.8	J
91-20-3	Naphthalene	2.6	3.7		U
85-01-8	Phenanthrene	1.9	3.7	8.2	
129-00-0	Pyrene	1.7	3.7		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
8-SO-0204

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-18

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206018

% Moisture: 14 decanted: (Y/N) N Date Sampled: 12/03/08 13:16

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 14:19

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.8		U
208-96-8	Acenaphthylene	1.3	3.8		U
120-12-7	Anthracene	0.92	3.8	4.2	
56-55-3	Benzo(a)anthracene	1.6	3.8	15	
205-99-2	Benzo(b)fluoranthene	1.8	3.8	15	
207-08-9	Benzo(k)fluoranthene	1.5	3.8	4.5	
191-24-2	Benzo(g,h,i)perylene	1.7	3.8	9.0	
50-32-8	Benzo(a)pyrene	1.2	3.8	22	
218-01-9	Chrysene	1.2	3.8	12	
53-70-3	Dibenz(a,h)anthracene	1.8	3.8		U
206-44-0	Fluoranthene	1.9	3.8	24	
86-73-7	Fluorene	1.4	3.8		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.8	7.4	
91-57-6	2-Methylnaphthalene	1.9	3.8		U
91-20-3	Naphthalene	2.7	3.8		U
85-01-8	Phenanthrene	1.9	3.8	17	
129-00-0	Pyrene	1.8	3.8	21	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
8-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-19

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206019

% Moisture: 14 decanted: (Y/N) N Date Sampled: 12/03/08 13:20

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 14:48

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.9		U
208-96-8	Acenaphthylene	1.3	3.9		U
120-12-7	Anthracene	0.93	3.9		U
56-55-3	Benzo(a)anthracene	1.6	3.9		U
205-99-2	Benzo(b)fluoranthene	1.8	3.9		U
207-08-9	Benzo(k)fluoranthene	1.5	3.9		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.9	2.9	J
50-32-8	Benzo(a)pyrene	1.2	3.9	7.6	
218-01-9	Chrysene	1.2	3.9	7.2	
53-70-3	Dibenz(a,h)anthracene	1.8	3.9		U
206-44-0	Fluoranthene	1.9	3.9		U
86-73-7	Fluorene	1.4	3.9		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.9		U
91-57-6	2-Methylnaphthalene	1.9	3.9		U
91-20-3	Naphthalene	2.7	3.9		U
85-01-8	Phenanthrene	1.9	3.9	3.0	J
129-00-0	Pyrene	1.8	3.9	2.3	J

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
9-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-20

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206020

% Moisture: 19 decanted: (Y/N) N Date Sampled: 12/03/08 13:50

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 15:17

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.5	4.1	2.8	J
208-96-8	Acenaphthylene	1.4	4.1	1.6	J
120-12-7	Anthracene	0.98	4.1	8.4	
56-55-3	Benzo(a)anthracene	1.7	4.1	47	
205-99-2	Benzo(b)fluoranthene	1.9	4.1	37	
207-08-9	Benzo(k)fluoranthene	1.6	4.1	13	
191-24-2	Benzo(g,h,i)perylene	1.8	4.1	24	
50-32-8	Benzo(a)pyrene	1.2	4.1	50	
218-01-9	Chrysene	1.3	4.1	37	
53-70-3	Dibenz(a,h)anthracene	1.9	4.1	5.0	
206-44-0	Fluoranthene	2.0	4.1	74	
86-73-7	Fluorene	1.5	4.1	2.6	J
193-39-5	Indeno(1,2,3-cd)pyrene	1.9	4.1	20	
91-57-6	2-Methylnaphthalene	2.0	4.1		U
91-20-3	Naphthalene	2.9	4.1		U
85-01-8	Phenanthrene	2.0	4.1	41	
129-00-0	Pyrene	1.9	4.1	65	

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB1
9-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-21

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206021

% Moisture: 15 decanted: (Y/N) N Date Sampled: 12/03/08 13:53

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted: 12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 15:45

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	3.9		U
208-96-8	Acenaphthylene	1.3	3.9		U
120-12-7	Anthracene	0.94	3.9		U
56-55-3	Benzo(a)anthracene	1.6	3.9		U
205-99-2	Benzo(b)fluoranthene	1.8	3.9		U
207-08-9	Benzo(k)fluoranthene	1.5	3.9		U
191-24-2	Benzo(g,h,i)perylene	1.7	3.9		U
50-32-8	Benzo(a)pyrene	1.2	3.9	7.1	
218-01-9	Chrysene	1.2	3.9		U
53-70-3	Dibenz(a,h)anthracene	1.8	3.9		U
206-44-0	Fluoranthene	2.0	3.9		U
86-73-7	Fluorene	1.4	3.9		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	3.9		U
91-57-6	2-Methylnaphthalene	2.0	3.9		U
91-20-3	Naphthalene	2.7	3.9		U
85-01-8	Phenanthrene	2.0	3.9		U
129-00-0	Pyrene	1.8	3.9		U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB2
0-SO-0002

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-22

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206022D

% Moisture: 16 decanted: (Y/N) N Date Sampled: 12/03/08 14:30

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/18/08 05:28

Injection Volume: 1.0(uL) Dilution Factor: 10.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	14	39	180	D
208-96-8	Acenaphthylene	13	39	46	D
120-12-7	Anthracene	9.5	39	560	D
56-55-3	Benzo(a)anthracene	16	39	1500	DX
205-99-2	Benzo(b)fluoranthene	18	39	1700	D
207-08-9	Benzo(k)fluoranthene	15	39	460	D
191-24-2	Benzo(g,h,i)perylene	17	39	940	D
50-32-8	Benzo(a)pyrene	12	39	1200	D
218-01-9	Chrysene	13	39	1200	D
53-70-3	Dibenz(a,h)anthracene	18	39	160	D
206-44-0	Fluoranthene	20	39	3900	D
86-73-7	Fluorene	14	39	200	D
193-39-5	Indeno(1,2,3-cd)pyrene	18	39	730	D
91-57-6	2-Methylnaphthalene	20	39	25	JD
91-20-3	Naphthalene	28	39		UD
85-01-8	Phenanthrene	20	39	2900	D
129-00-0	Pyrene	18	39	3300	D

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC19SB2
0-SO-0406

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: GL002

Matrix: (soil/water) SOIL Lab Sample ID: 0812060-23

Sample wt/vol: 15.0 (g/mL) G Lab File ID: 1206023

% Moisture: 16 decanted: (Y/N) N Date Sampled: 12/03/08 14:40

Extraction: (SepF/Cont/Sonc/Soxh) SOXH Date Extracted:12/09/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 12/17/08 16:14

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
83-32-9	Acenaphthene	1.4	4.0		U
208-96-8	Acenaphthylene	1.3	4.0		U
120-12-7	Anthracene	0.95	4.0		U
56-55-3	Benzo(a)anthracene	1.7	4.0		U
205-99-2	Benzo(b)fluoranthene	1.8	4.0		U
207-08-9	Benzo(k)fluoranthene	1.5	4.0		U
191-24-2	Benzo(g,h,i)perylene	1.7	4.0		U
50-32-8	Benzo(a)pyrene	1.2	4.0	12	
218-01-9	Chrysene	1.3	4.0		U
53-70-3	Dibenz(a,h)anthracene	1.8	4.0		U
206-44-0	Fluoranthene	2.0	4.0		U
86-73-7	Fluorene	1.4	4.0		U
193-39-5	Indeno(1,2,3-cd)pyrene	1.8	4.0		U
91-57-6	2-Methylnaphthalene	2.0	4.0		U
91-20-3	Naphthalene	2.8	4.0		U
85-01-8	Phenanthrene	2.0	4.0		U
129-00-0	Pyrene	1.8	4.0		U

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB01-SO-0002

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL003

Matrix (soil/water): SOLID Lab Sample ID: 0812073-01

Level (low/med): LOW Date Received: 12/05/08

% Solids: 82.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	14100			P
7440-36-0	Antimony	1.2	U		P
7440-38-2	Arsenic	12.9			P
7440-39-3	Barium	103			P
7440-41-7	Beryllium	0.95	J		P
7440-43-9	Cadmium	0.43	J		P
7440-70-2	Calcium	12900			P
7440-47-3	Chromium	23.1			P
7440-48-4	Cobalt	9.7			P
7440-50-8	Copper	23.1			P
7439-89-6	Iron	31600			P
7439-92-1	Lead	80.9			P
7439-95-4	Magnesium	9330			P
7439-96-5	Manganese	954			P
7439-97-6	Mercury	0.084			AV
7440-02-0	Nickel	27.3			P
7440-09-7	Potassium	2190			P
7782-49-2	Selenium	0.73	U		P
7440-22-4	Silver	0.24	U		P
7440-23-5	Sodium	443	J		P
7440-28-0	Thallium	0.73	U		P
7440-62-2	Vanadium	34.0			P
7440-66-6	Zinc	128			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB03-SO-0001

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL003

Matrix (soil/water): SOLID Lab Sample ID: 0812073-02

Level (low/med): LOW Date Received: 12/05/08

% Solids: 78.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	15300			P
7440-36-0	Antimony	1.3	U	N	P
7440-38-2	Arsenic	8.5			P
7440-39-3	Barium	100			P
7440-41-7	Beryllium	0.96	J		P
7440-43-9	Cadmium	0.54	J		P
7440-70-2	Calcium	21500		E	P
7440-47-3	Chromium	24.3			P
7440-48-4	Cobalt	10.4			P
7440-50-8	Copper	28.2			P
7439-89-6	Iron	24900			P
7439-92-1	Lead	480		N*	P
7439-95-4	Magnesium	12000		*	P
7439-96-5	Manganese	746		N	P
7439-97-6	Mercury	0.32			AV
7440-02-0	Nickel	25.1			P
7440-09-7	Potassium	2330		N	P
7782-49-2	Selenium	0.77	U		P
7440-22-4	Silver	0.48	J		P
7440-23-5	Sodium	256	U		P
7440-28-0	Thallium	0.77	U		P
7440-62-2	Vanadium	32.4			P
7440-66-6	Zinc	190		N*E	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB06-SO-0001

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL003

Matrix (soil/water): SOLID Lab Sample ID: 0812073-03

Level (low/med): LOW Date Received: 12/05/08

% Solids: 79.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	19300			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	8.1			P
7440-39-3	Barium	188			P
7440-41-7	Beryllium	1.3			P
7440-43-9	Cadmium	0.92	J		P
7440-70-2	Calcium	7900		E	P
7440-47-3	Chromium	27.6			P
7440-48-4	Cobalt	10.9			P
7440-50-8	Copper	36.2			P
7439-89-6	Iron	31700			P
7439-92-1	Lead	133		N*	P
7439-95-4	Magnesium	6430		*	P
7439-96-5	Manganese	1280		N	P
7439-97-6	Mercury	0.47			AV
7440-02-0	Nickel	28.3			P
7440-09-7	Potassium	2180		N	P
7782-49-2	Selenium	0.74	U		P
7440-22-4	Silver	1.0	J		P
7440-23-5	Sodium	248	U		P
7440-28-0	Thallium	0.74	U		P
7440-62-2	Vanadium	37.1			P
7440-66-6	Zinc	250		N*E	P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB07-SO-0001

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: Case No.: SAS No.: SDG No.: GL003

Matrix (soil/water): SOLID Lab Sample ID: 0812073-04

Level (low/med): LOW Date Received: 12/05/08

% Solids: 84.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8640			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	5.7			P
7440-39-3	Barium	52.2			P
7440-41-7	Beryllium	0.66	J		P
7440-43-9	Cadmium	0.33	J		P
7440-70-2	Calcium	111000		E	P
7440-47-3	Chromium	13.5			P
7440-48-4	Cobalt	5.0			P
7440-50-8	Copper	17.6			P
7439-89-6	Iron	14600			P
7439-92-1	Lead	89.1		N*	P
7439-95-4	Magnesium	62100		*	P
7439-96-5	Manganese	466		N	P
7439-97-6	Mercury	0.12			AV
7440-02-0	Nickel	14.0			P
7440-09-7	Potassium	1650		N	P
7782-49-2	Selenium	0.69	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	231	U		P
7440-28-0	Thallium	0.92	U		P
7440-62-2	Vanadium	18.5			P
7440-66-6	Zinc	119		N*E	P

Color Before: Clarity Before: Texture:

Color After: Clarity After: Artifacts:

Comments: Thallium MDL increased due to negative bias.

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19-MW01-1208

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL003

Matrix (soil/water): GROUND WATER Lab Sample ID: 0812147-01

Level (low/med): LOW Date Received: 12/10/08

% Solids: _____

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	138	J		P
7440-36-0	Antimony	5.0	U		P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	52.9			P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	1.0	U		P
7440-70-2	Calcium	114000		E	P
7440-47-3	Chromium	2.0	U		P
7440-48-4	Cobalt	5.0	U		P
7440-50-8	Copper	5.0	U		P
7439-89-6	Iron	182			P
7439-92-1	Lead	1.5	U		P
7439-95-4	Magnesium	48200			P
7439-96-5	Manganese	37.6			P
7439-97-6	Mercury	0.080	U		AV
7440-02-0	Nickel	5.0	U		P
7440-09-7	Potassium	9000			P
7782-49-2	Selenium	3.0	U		P
7440-22-4	Silver	1.0	U		P
7440-23-5	Sodium	68800			P
7440-28-0	Thallium	3.0	U		P
7440-62-2	Vanadium	5.0	U		P
7440-66-6	Zinc	5.0	U		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19-MW01-1208Soluble

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL003

Matrix (soil/water): GROUND WATER Lab Sample ID: 0812147-01Soluble

Level (low/med): LOW Date Received: 12/10/08

% Solids: _____

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	50.0	U		P
7440-36-0	Antimony	5.0	U		P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	52.4			P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	1.0	U		P
7440-70-2	Calcium	123000		E	P
7440-47-3	Chromium	2.0	U		P
7440-48-4	Cobalt	5.0	U		P
7440-50-8	Copper	5.0	U		P
7439-89-6	Iron	30.0	U		P
7439-92-1	Lead	1.5	U		P
7439-95-4	Magnesium	48800			P
7439-96-5	Manganese	34.5			P
7439-97-6	Mercury	0.080	U		AV
7440-02-0	Nickel	5.0	U		P
7440-09-7	Potassium	8570			P
7782-49-2	Selenium	3.0	U		P
7440-22-4	Silver	1.0	U		P
7440-23-5	Sodium	65000			P
7440-28-0	Thallium	3.8	J		P
7440-62-2	Vanadium	5.0	U		P
7440-66-6	Zinc	5.0	U		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19-MW02-1208

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL003

Matrix (soil/water): GROUND WATER Lab Sample ID: 0812147-02

Level (low/med): LOW Date Received: 12/10/08

% Solids: _____

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	272			P
7440-36-0	Antimony	5.0	U		P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	167			P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	1.0	U		P
7440-70-2	Calcium	88100		E	P
7440-47-3	Chromium	2.0	U		P
7440-48-4	Cobalt	5.0	U		P
7440-50-8	Copper	5.0	U		P
7439-89-6	Iron	489			P
7439-92-1	Lead	1.5	U		P
7439-95-4	Magnesium	46200			P
7439-96-5	Manganese	39.6			P
7439-97-6	Mercury	0.080	U		AV
7440-02-0	Nickel	5.0	U		P
7440-09-7	Potassium	7860			P
7782-49-2	Selenium	3.0	U		P
7440-22-4	Silver	1.0	U		P
7440-23-5	Sodium	36900			P
7440-28-0	Thallium	3.0	U		P
7440-62-2	Vanadium	5.0	U		P
7440-66-6	Zinc	9.4	J		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

USEPA - CLP

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19-MW02-1208Soluble

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL003

Matrix (soil/water): GROUND WATER Lab Sample ID: 0812147-02Soluble

Level (low/med): LOW Date Received: 12/10/08

% Solids: _____

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	50.0	U		P
7440-36-0	Antimony	5.0	U		P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	161			P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	1.0	U		P
7440-70-2	Calcium	93400		E	P
7440-47-3	Chromium	2.0	U		P
7440-48-4	Cobalt	5.0	U		P
7440-50-8	Copper	5.0	U		P
7439-89-6	Iron	30.0	U		P
7439-92-1	Lead	1.5	U		P
7439-95-4	Magnesium	45900			P
7439-96-5	Manganese	31.8			P
7439-97-6	Mercury	0.080	U		AV
7440-02-0	Nickel	5.0	U		P
7440-09-7	Potassium	7240			P
7782-49-2	Selenium	3.0	U		P
7440-22-4	Silver	1.0	U		P
7440-23-5	Sodium	33600			P
7440-28-0	Thallium	3.0	U		P
7440-62-2	Vanadium	5.0	U		P
7440-66-6	Zinc	5.0	U		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19FD120808-01

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL003

Matrix (soil/water): GROUND WATER Lab Sample ID: 0812147-04

Level (low/med): LOW Date Received: 12/10/08

% Solids: _____

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	134	J		P
7440-36-0	Antimony	5.0	U		P
7440-38-2	Arsenic	3.3	J		P
7440-39-3	Barium	51.8			P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	1.0	U		P
7440-70-2	Calcium	116000		E	P
7440-47-3	Chromium	2.0	U		P
7440-48-4	Cobalt	5.0	U		P
7440-50-8	Copper	5.0	U		P
7439-89-6	Iron	204			P
7439-92-1	Lead	1.5	U		P
7439-95-4	Magnesium	48900			P
7439-96-5	Manganese	35.8			P
7439-97-6	Mercury	0.080	U		AV
7440-02-0	Nickel	5.0	U		P
7440-09-7	Potassium	9120			P
7782-49-2	Selenium	3.0	U		P
7440-22-4	Silver	1.0	U		P
7440-23-5	Sodium	70300			P
7440-28-0	Thallium	3.0	U		P
7440-62-2	Vanadium	5.0	U		P
7440-66-6	Zinc	5.0	U		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

USEPA - CLP

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19FD120808-01Soluble

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL003

Matrix (soil/water): GROUND WATER Lab Sample ID: 0812147-04Soluble

Level (low/med): LOW Date Received: 12/10/08

% Solids: _____

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	50.0	U		P
7440-36-0	Antimony	5.0	U		P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	48.9			P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	1.0	U		P
7440-70-2	Calcium	117000		E	P
7440-47-3	Chromium	2.0	U		P
7440-48-4	Cobalt	5.0	U		P
7440-50-8	Copper	5.0	U		P
7439-89-6	Iron	30.0	U		P
7439-92-1	Lead	1.5	U		P
7439-95-4	Magnesium	46300			P
7439-96-5	Manganese	30.9			P
7439-97-6	Mercury	0.080	U		AV
7440-02-0	Nickel	5.0	U		P
7440-09-7	Potassium	8040			P
7782-49-2	Selenium	3.0	U		P
7440-22-4	Silver	1.0	U		P
7440-23-5	Sodium	62300			P
7440-28-0	Thallium	3.0	U		P
7440-62-2	Vanadium	5.0	U		P
7440-66-6	Zinc	5.0	U		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19-RB120308-01

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): WATER Lab Sample ID: 0812060-04

Level (low/med): LOW Date Received: 12/04/08

% Solids: _____

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	50.0	U		P
7440-36-0	Antimony	5.0	U		P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	5.0	U		P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	1.0	U		P
7440-70-2	Calcium	1000	U		P
7440-47-3	Chromium	2.0	U		P
7440-48-4	Cobalt	5.0	U		P
7440-50-8	Copper	5.0	U		P
7439-89-6	Iron	30.0	U		P
7439-92-1	Lead	1.5	U		P
7439-95-4	Magnesium	1000	U		P
7439-96-5	Manganese	3.0	U		P
7439-97-6	Mercury	0.080	U		AV
7440-02-0	Nickel	5.0	U		P
7440-09-7	Potassium	1000	U		P
7782-49-2	Selenium	3.0	U		P
7440-22-4	Silver	1.0	U		P
7440-23-5	Sodium	1000	U		P
7440-28-0	Thallium	3.0	U		P
7440-62-2	Vanadium	5.0	U		P
7440-66-6	Zinc	5.7	J		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19-SB120308-01

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): WATER Lab Sample ID: 0812060-05

Level (low/med): LOW Date Received: 12/04/08

% Solids: _____

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	50.0	U		P
7440-36-0	Antimony	5.0	U		P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	5.0	U		P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	1.0	U		P
7440-70-2	Calcium	1000	U		P
7440-47-3	Chromium	2.0	U		P
7440-48-4	Cobalt	5.0	U		P
7440-50-8	Copper	5.0	U		P
7439-89-6	Iron	30.0	U		P
7439-92-1	Lead	1.5	U		P
7439-95-4	Magnesium	1000	U		P
7439-96-5	Manganese	3.0	U		P
7439-97-6	Mercury	0.080	U		AV
7440-02-0	Nickel	5.0	U		P
7440-09-7	Potassium	1000	U		P
7782-49-2	Selenium	3.0	U		P
7440-22-4	Silver	1.0	U		P
7440-23-5	Sodium	1000	U		P
7440-28-0	Thallium	3.0	U		P
7440-62-2	Vanadium	5.0	U		P
7440-66-6	Zinc	5.0	U		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19-FD120308-01

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-01

Level (low/med): LOW Date Received: 12/04/08

% Solids: 87.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10400			P
7440-36-0	Antimony	1.1	U		P
7440-38-2	Arsenic	4.9			P
7440-39-3	Barium	40.8			P
7440-41-7	Beryllium	0.67	J		P
7440-43-9	Cadmium	0.23	U		P
7440-70-2	Calcium	77900			P
7440-47-3	Chromium	18.2			P
7440-48-4	Cobalt	9.3			P
7440-50-8	Copper	20.7			P
7439-89-6	Iron	19700			P
7439-92-1	Lead	9.9			P
7439-95-4	Magnesium	39300			P
7439-96-5	Manganese	534			P
7439-97-6	Mercury	0.015	U		AV
7440-02-0	Nickel	25.6			P
7440-09-7	Potassium	2920			P
7782-49-2	Selenium	0.92	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	225	U		P
7440-28-0	Thallium	0.68	U		P
7440-62-2	Vanadium	20.7			P
7440-66-6	Zinc	43.3			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: Selenium MDL increased due to negative bias.

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19-FD120308-02

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-02

Level (low/med): LOW Date Received: 12/04/08

% Solids: 87.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8170			P
7440-36-0	Antimony	1.1	U		P
7440-38-2	Arsenic	8.1			P
7440-39-3	Barium	44.1			P
7440-41-7	Beryllium	0.53	J		P
7440-43-9	Cadmium	0.34	J		P
7440-70-2	Calcium	66200			P
7440-47-3	Chromium	14.5			P
7440-48-4	Cobalt	7.1			P
7440-50-8	Copper	22.6			P
7439-89-6	Iron	19400			P
7439-92-1	Lead	34.2			P
7439-95-4	Magnesium	36100			P
7439-96-5	Manganese	768			P
7439-97-6	Mercury	0.022	J		AV
7440-02-0	Nickel	19.6			P
7440-09-7	Potassium	1740			P
7782-49-2	Selenium	0.92	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	230	U		P
7440-28-0	Thallium	0.69	U		P
7440-62-2	Vanadium	20.5			P
7440-66-6	Zinc	66.2			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Selenium MDL increased due to negative bias.**

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19-FD120308-03

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-03

Level (low/med): LOW Date Received: 12/04/08

% Solids: 88.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7140			P
7440-36-0	Antimony	1.1	U		P
7440-38-2	Arsenic	13.9			P
7440-39-3	Barium	61.8			P
7440-41-7	Beryllium	0.87	J		P
7440-43-9	Cadmium	0.44	J		P
7440-70-2	Calcium	94900			P
7440-47-3	Chromium	32.6			P
7440-48-4	Cobalt	8.7			P
7440-50-8	Copper	40.5			P
7439-89-6	Iron	26800			P
7439-92-1	Lead	86.4			P
7439-95-4	Magnesium	38200			P
7439-96-5	Manganese	1290			P
7439-97-6	Mercury	0.031	J		AV
7440-02-0	Nickel	47.9			P
7440-09-7	Potassium	1200			P
7782-49-2	Selenium	1.1	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	278	J		P
7440-28-0	Thallium	1.1	U		P
7440-62-2	Vanadium	16.4			P
7440-66-6	Zinc	204			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Selenium and Thallium MDLs increased due to negative bias.**

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB12-SO-0002

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-07

Level (low/med): LOW Date Received: 12/04/08

% Solids: 84.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	11900			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	6.4			P
7440-39-3	Barium	50.5			P
7440-41-7	Beryllium	0.71	J		P
7440-43-9	Cadmium	0.24	U		P
7440-70-2	Calcium	58000		E	P
7440-47-3	Chromium	20.8			P
7440-48-4	Cobalt	8.9			P
7440-50-8	Copper	21.5			P
7439-89-6	Iron	20800			P
7439-92-1	Lead	147		N*	P
7439-95-4	Magnesium	32900			P
7439-96-5	Manganese	561			P
7439-97-6	Mercury	0.029	J		AV
7440-02-0	Nickel	26.5			P
7440-09-7	Potassium	2270			P
7782-49-2	Selenium	0.71	U		P
7440-22-4	Silver	0.24	U		P
7440-23-5	Sodium	239	J		P
7440-28-0	Thallium	0.71	U		P
7440-62-2	Vanadium	21.6			P
7440-66-6	Zinc	76.7			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB12-SO-0507

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-08

Level (low/med): LOW Date Received: 12/04/08

% Solids: 83.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	11000			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	4.8			P
7440-39-3	Barium	45.5			P
7440-41-7	Beryllium	0.67	J		P
7440-43-9	Cadmium	0.24	U		P
7440-70-2	Calcium	119000		E	P
7440-47-3	Chromium	20.0			P
7440-48-4	Cobalt	9.3			P
7440-50-8	Copper	17.1			P
7439-89-6	Iron	18300			P
7439-92-1	Lead	10.3		N*	P
7439-95-4	Magnesium	32800			P
7439-96-5	Manganese	421			P
7439-97-6	Mercury	0.020	J		AV
7440-02-0	Nickel	23.3			P
7440-09-7	Potassium	2560			P
7782-49-2	Selenium	0.72	U		P
7440-22-4	Silver	0.24	U		P
7440-23-5	Sodium	239	U		P
7440-28-0	Thallium	0.72	U		P
7440-62-2	Vanadium	20.0			P
7440-66-6	Zinc	38.6			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB13-SO-0103

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-09

Level (low/med): LOW Date Received: 12/04/08

% Solids: 82.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	14700			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	13.7			P
7440-39-3	Barium	53.5			P
7440-41-7	Beryllium	0.86	J		P
7440-43-9	Cadmium	0.38	J		P
7440-70-2	Calcium	48000		E	P
7440-47-3	Chromium	23.8			P
7440-48-4	Cobalt	10.9			P
7440-50-8	Copper	30.2			P
7439-89-6	Iron	33000			P
7439-92-1	Lead	21.9		N*	P
7439-95-4	Magnesium	31100			P
7439-96-5	Manganese	725			P
7439-97-6	Mercury	0.018	J		AV
7440-02-0	Nickel	34.1			P
7440-09-7	Potassium	2350			P
7782-49-2	Selenium	1.2	U		P
7440-22-4	Silver	0.24	U		P
7440-23-5	Sodium	241	U		P
7440-28-0	Thallium	0.72	U		P
7440-62-2	Vanadium	29.4			P
7440-66-6	Zinc	95.0			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Selenium MDL increased due to negative bias.**

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB14-SO-0204

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-10

Level (low/med): LOW Date Received: 12/04/08

% Solids: 86.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5820			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	19.1			P
7440-39-3	Barium	29.2			P
7440-41-7	Beryllium	0.43	J		P
7440-43-9	Cadmium	0.39	J		P
7440-70-2	Calcium	108000		E	P
7440-47-3	Chromium	11.1			P
7440-48-4	Cobalt	9.5			P
7440-50-8	Copper	25.2			P
7439-89-6	Iron	22800			P
7439-92-1	Lead	19.2		N*	P
7439-95-4	Magnesium	56300			P
7439-96-5	Manganese	1220			P
7439-97-6	Mercury	0.043			AV
7440-02-0	Nickel	22.7			P
7440-09-7	Potassium	1510			P
7782-49-2	Selenium	1.2	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	230	U		P
7440-28-0	Thallium	0.69	U		P
7440-62-2	Vanadium	15.3			P
7440-66-6	Zinc	57.7			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: Selenium MDL increased due to negative bias.

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB14-SO-0507

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-11

Level (low/med): LOW Date Received: 12/04/08

% Solids: 86.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10000			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	7.7			P
7440-39-3	Barium	44.7			P
7440-41-7	Beryllium	0.66	J		P
7440-43-9	Cadmium	0.29	J		P
7440-70-2	Calcium	85100		E	P
7440-47-3	Chromium	17.6			P
7440-48-4	Cobalt	11.5			P
7440-50-8	Copper	20.5			P
7439-89-6	Iron	20300			P
7439-92-1	Lead	10.2		N*	P
7439-95-4	Magnesium	41300			P
7439-96-5	Manganese	841			P
7439-97-6	Mercury	0.018	J		AV
7440-02-0	Nickel	33.6			P
7440-09-7	Potassium	2610			P
7782-49-2	Selenium	0.68	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	228	U		P
7440-28-0	Thallium	0.68	U		P
7440-62-2	Vanadium	19.9			P
7440-66-6	Zinc	48.3			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB15-SO-0103

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-12

Level (low/med): LOW Date Received: 12/04/08

% Solids: 88.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8440			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	5.2			P
7440-39-3	Barium	31.5			P
7440-41-7	Beryllium	0.55	J		P
7440-43-9	Cadmium	0.22	U		P
7440-70-2	Calcium	63900		E	P
7440-47-3	Chromium	15.0			P
7440-48-4	Cobalt	7.3			P
7440-50-8	Copper	17.5			P
7439-89-6	Iron	16300			P
7439-92-1	Lead	9.5		N*	P
7439-95-4	Magnesium	28800			P
7439-96-5	Manganese	336			P
7439-97-6	Mercury	0.015	U		AV
7440-02-0	Nickel	21.4			P
7440-09-7	Potassium	2160			P
7782-49-2	Selenium	0.67	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	223	U		P
7440-28-0	Thallium	0.88	U		P
7440-62-2	Vanadium	17.8			P
7440-66-6	Zinc	40.0			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Thallium MDL increased due to negative bias.**

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB15-SO-0406

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-13

Level (low/med): LOW Date Received: 12/04/08

% Solids: 87.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8610			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	5.4			P
7440-39-3	Barium	33.6			P
7440-41-7	Beryllium	0.57	J		P
7440-43-9	Cadmium	0.23	J		P
7440-70-2	Calcium	80300		E	P
7440-47-3	Chromium	15.5			P
7440-48-4	Cobalt	8.6			P
7440-50-8	Copper	18.7			P
7439-89-6	Iron	17400			P
7439-92-1	Lead	9.5		N*	P
7439-95-4	Magnesium	40400			P
7439-96-5	Manganese	566			P
7439-97-6	Mercury	0.016	U		AV
7440-02-0	Nickel	22.6			P
7440-09-7	Potassium	2380			P
7782-49-2	Selenium	0.69	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	230	U		P
7440-28-0	Thallium	0.69	U		P
7440-62-2	Vanadium	17.6			P
7440-66-6	Zinc	48.9			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB16-SO-0103

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-14

Level (low/med): LOW Date Received: 12/04/08

% Solids: 80.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10500			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	9.9			P
7440-39-3	Barium	93.4			P
7440-41-7	Beryllium	0.72	J		P
7440-43-9	Cadmium	0.81	J		P
7440-70-2	Calcium	41000		E	P
7440-47-3	Chromium	16.3			P
7440-48-4	Cobalt	8.7			P
7440-50-8	Copper	28.9			P
7439-89-6	Iron	29000			P
7439-92-1	Lead	62.7		N*	P
7439-95-4	Magnesium	23400			P
7439-96-5	Manganese	1820			P
7439-97-6	Mercury	0.031	J		AV
7440-02-0	Nickel	28.9			P
7440-09-7	Potassium	1810			P
7782-49-2	Selenium	0.96	U		P
7440-22-4	Silver	0.24	U		P
7440-23-5	Sodium	240	U		P
7440-28-0	Thallium	0.72	U		P
7440-62-2	Vanadium	25.0			P
7440-66-6	Zinc	97.6			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Selenium MDL increased due to negative bias.**

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB16-SO-0507

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-15

Level (low/med): LOW Date Received: 12/04/08

% Solids: 88.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5050			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	6.6			P
7440-39-3	Barium	20.9			P
7440-41-7	Beryllium	0.39	J		P
7440-43-9	Cadmium	0.28	J		P
7440-70-2	Calcium	73600		E	P
7440-47-3	Chromium	10.0			P
7440-48-4	Cobalt	5.8			P
7440-50-8	Copper	21.3			P
7439-89-6	Iron	16400			P
7439-92-1	Lead	12.0		N*	P
7439-95-4	Magnesium	38800			P
7439-96-5	Manganese	675			P
7439-97-6	Mercury	0.015	U		AV
7440-02-0	Nickel	17.6			P
7440-09-7	Potassium	1340			P
7782-49-2	Selenium	0.88	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	221	U		P
7440-28-0	Thallium	0.66	U		P
7440-62-2	Vanadium	14.2			P
7440-66-6	Zinc	54.1			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: *Selenium MDL increased due to negative bias.*

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB17-SO-0002

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-16

Level (low/med): LOW Date Received: 12/04/08

% Solids: 85.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6640			P
7440-36-0	Antimony	1.2	J	N	P
7440-38-2	Arsenic	14.1			P
7440-39-3	Barium	36.3			P
7440-41-7	Beryllium	0.49	J		P
7440-43-9	Cadmium	0.43	J		P
7440-70-2	Calcium	78800		E	P
7440-47-3	Chromium	13.0			P
7440-48-4	Cobalt	7.3			P
7440-50-8	Copper	53.6			P
7439-89-6	Iron	22300			P
7439-92-1	Lead	236		N*	P
7439-95-4	Magnesium	39700			P
7439-96-5	Manganese	711			P
7439-97-6	Mercury	0.034	J		AV
7440-02-0	Nickel	19.8			P
7440-09-7	Potassium	1390			P
7782-49-2	Selenium	0.66	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	220	U		P
7440-28-0	Thallium	0.88	U		P
7440-62-2	Vanadium	18.6			P
7440-66-6	Zinc	109			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: Thallium MDL increased due to negative bias.

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INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB17-SO-0406

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-17

Level (low/med): LOW Date Received: 12/04/08

% Solids: 89.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5780			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	7.4			P
7440-39-3	Barium	18.8			P
7440-41-7	Beryllium	0.41	J		P
7440-43-9	Cadmium	0.22	U		P
7440-70-2	Calcium	67000		E	P
7440-47-3	Chromium	10.0			P
7440-48-4	Cobalt	6.0			P
7440-50-8	Copper	23.6			P
7439-89-6	Iron	15300			P
7439-92-1	Lead	9.6		N*	P
7439-95-4	Magnesium	32600			P
7439-96-5	Manganese	481			P
7439-97-6	Mercury	0.013	J		AV
7440-02-0	Nickel	17.2			P
7440-09-7	Potassium	1410			P
7782-49-2	Selenium	0.66	U		P
7440-22-4	Silver	0.22	U		P
7440-23-5	Sodium	249	J		P
7440-28-0	Thallium	0.88	U		P
7440-62-2	Vanadium	15.3			P
7440-66-6	Zinc	41.3			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: Thallium MDL increased due to negative bias.

Form I - IN

USEPA - CLP

-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB18-SO-0204

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-18

Level (low/med): LOW Date Received: 12/04/08

% Solids: 86.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10300			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	7.3			P
7440-39-3	Barium	39.9			P
7440-41-7	Beryllium	0.67	J		P
7440-43-9	Cadmium	0.30	J		P
7440-70-2	Calcium	76800		E	P
7440-47-3	Chromium	17.6			P
7440-48-4	Cobalt	9.2			P
7440-50-8	Copper	21.7			P
7439-89-6	Iron	20400			P
7439-92-1	Lead	25.0		N*	P
7439-95-4	Magnesium	39100			P
7439-96-5	Manganese	569			P
7439-97-6	Mercury	0.029	J		AV
7440-02-0	Nickel	24.5			P
7440-09-7	Potassium	2640			P
7782-49-2	Selenium	0.68	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	226	U		P
7440-28-0	Thallium	0.92	U		P
7440-62-2	Vanadium	20.9			P
7440-66-6	Zinc	53.6			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Thallium MDL increased due to negative bias.**

USEPA - CLP
-1-
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB18-SO-0406

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-19

Level (low/med): LOW Date Received: 12/04/08

% Solids: 86.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10600			P
7440-36-0	Antimony	1.1	U	N	P
7440-38-2	Arsenic	6.7			P
7440-39-3	Barium	42.1			P
7440-41-7	Beryllium	0.71	J		P
7440-43-9	Cadmium	0.24	J		P
7440-70-2	Calcium	80700		E	P
7440-47-3	Chromium	18.6			P
7440-48-4	Cobalt	10.5			P
7440-50-8	Copper	21.2			P
7439-89-6	Iron	20400			P
7439-92-1	Lead	11.1		N*	P
7439-95-4	Magnesium	39800			P
7439-96-5	Manganese	604			P
7439-97-6	Mercury	0.018	J		AV
7440-02-0	Nickel	27.5			P
7440-09-7	Potassium	2700			P
7782-49-2	Selenium	0.68	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	228	U		P
7440-28-0	Thallium	0.68	U		P
7440-62-2	Vanadium	20.7			P
7440-66-6	Zinc	50.0			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

USEPA - CLP

-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB19-SO-0002

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-20

Level (low/med): LOW Date Received: 12/04/08

% Solids: 81.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	16800			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	7.1			P
7440-39-3	Barium	101			P
7440-41-7	Beryllium	1.1	J		P
7440-43-9	Cadmium	0.25	J		P
7440-70-2	Calcium	23300		E	P
7440-47-3	Chromium	24.3			P
7440-48-4	Cobalt	10.5			P
7440-50-8	Copper	25.9			P
7439-89-6	Iron	25300			P
7439-92-1	Lead	25.7		N*	P
7439-95-4	Magnesium	12900			P
7439-96-5	Manganese	613			P
7439-97-6	Mercury	0.055			AV
7440-02-0	Nickel	26.2			P
7440-09-7	Potassium	2280			P
7782-49-2	Selenium	0.73	U		P
7440-22-4	Silver	0.24	U		P
7440-23-5	Sodium	242	U		P
7440-28-0	Thallium	0.73	U		P
7440-62-2	Vanadium	31.8			P
7440-66-6	Zinc	72.8			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

USEPA - CLP
-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB19-SO-0406

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-21

Level (low/med): LOW Date Received: 12/04/08

% Solids: 85.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10400			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	7.4			P
7440-39-3	Barium	45.4			P
7440-41-7	Beryllium	0.70	J		P
7440-43-9	Cadmium	0.23	U		P
7440-70-2	Calcium	81400		E	P
7440-47-3	Chromium	18.0			P
7440-48-4	Cobalt	14.7			P
7440-50-8	Copper	21.6			P
7439-89-6	Iron	20300			P
7439-92-1	Lead	11.7		N*	P
7439-95-4	Magnesium	38600			P
7439-96-5	Manganese	718			P
7439-97-6	Mercury	0.021	J		AV
7440-02-0	Nickel	31.8			P
7440-09-7	Potassium	2620			P
7782-49-2	Selenium	1.2	U		P
7440-22-4	Silver	0.23	U		P
7440-23-5	Sodium	235	U		P
7440-28-0	Thallium	1.2	U		P
7440-62-2	Vanadium	20.6			P
7440-66-6	Zinc	52.7			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: **Selenium and Thallium MDLs increased due to negative bias.**

Form I - IN

USEPA - CLP
-1-
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB20-SO-0002

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-22

Level (low/med): LOW Date Received: 12/04/08

% Solids: 84.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10900			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	8.9			P
7440-39-3	Barium	66.7			P
7440-41-7	Beryllium	0.69	J		P
7440-43-9	Cadmium	0.49	J		P
7440-70-2	Calcium	19800		E	P
7440-47-3	Chromium	19.2			P
7440-48-4	Cobalt	10.3			P
7440-50-8	Copper	31.8			P
7439-89-6	Iron	23700			P
7439-92-1	Lead	74.9		N*	P
7439-95-4	Magnesium	11500			P
7439-96-5	Manganese	648			P
7439-97-6	Mercury	0.087			AV
7440-02-0	Nickel	22.4			P
7440-09-7	Potassium	1370			P
7782-49-2	Selenium	0.70	U		P
7440-22-4	Silver	0.44	J		P
7440-23-5	Sodium	233	U		P
7440-28-0	Thallium	0.70	U		P
7440-62-2	Vanadium	28.5			P
7440-66-6	Zinc	127			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

Form I - IN

USEPA - CLP

-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

NTC19SB20-SO-0406

Lab Name: Empirical Laboratories Contract: TetraTech NUS, I

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: GL002

Matrix (soil/water): SOIL Lab Sample ID: 0812060-23

Level (low/med): LOW Date Received: 12/04/08

% Solids: 84.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	9250			P
7440-36-0	Antimony	1.2	U	N	P
7440-38-2	Arsenic	7.6			P
7440-39-3	Barium	34.3			P
7440-41-7	Beryllium	0.59	J		P
7440-43-9	Cadmium	0.24	U		P
7440-70-2	Calcium	76600		E	P
7440-47-3	Chromium	16.3			P
7440-48-4	Cobalt	8.4			P
7440-50-8	Copper	19.6			P
7439-89-6	Iron	19100			P
7439-92-1	Lead	10.6		N*	P
7439-95-4	Magnesium	38700			P
7439-96-5	Manganese	592			P
7439-97-6	Mercury	0.014	U		AV
7440-02-0	Nickel	23.5			P
7440-09-7	Potassium	2150			P
7782-49-2	Selenium	0.96	U		P
7440-22-4	Silver	0.24	U		P
7440-23-5	Sodium	238	U		P
7440-28-0	Thallium	0.71	U		P
7440-62-2	Vanadium	19.2			P
7440-66-6	Zinc	39.0			P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

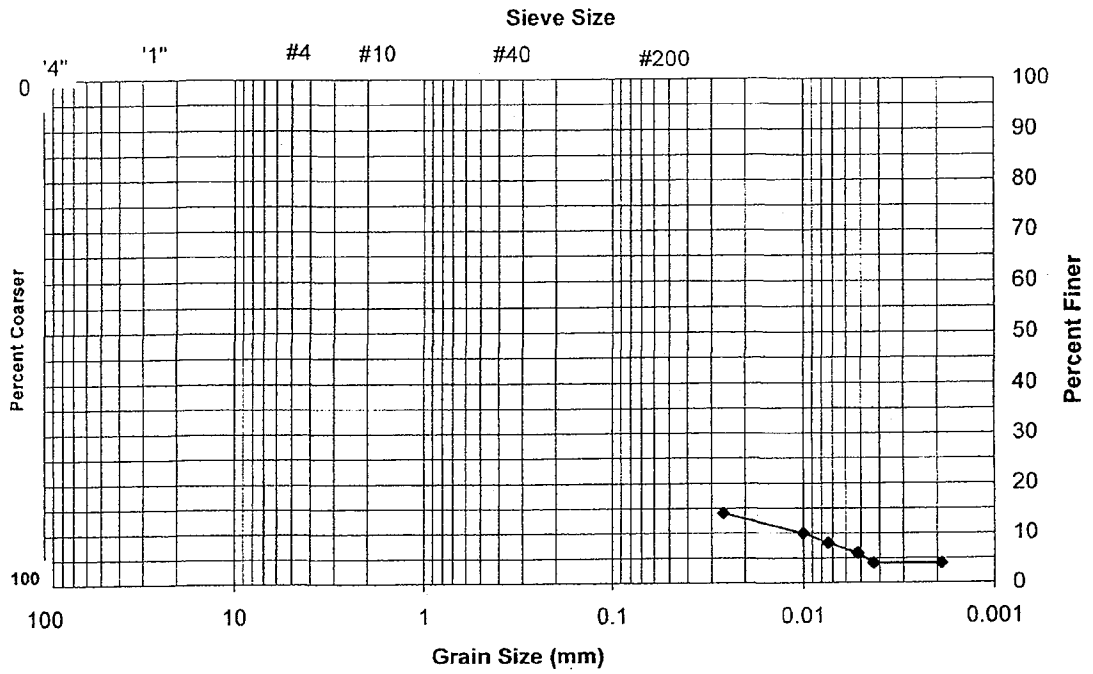
Comments: **Selenium MDL increased due to negative bias.**

Form I - IN

PARTICLE SIZE ANALYSIS

ASTM D 422

HYDROMETER ONLY



PERCENT PASSING

SAMPLE ID									Diameters for Hydrometer Analysis (mm)					
									0.026	0.01	0.0074	0.0052	0.0043	0.0019
0812060-19									14	10	8	6	4	4
LAB ID J 3074														

BEAVER ENGINEERING

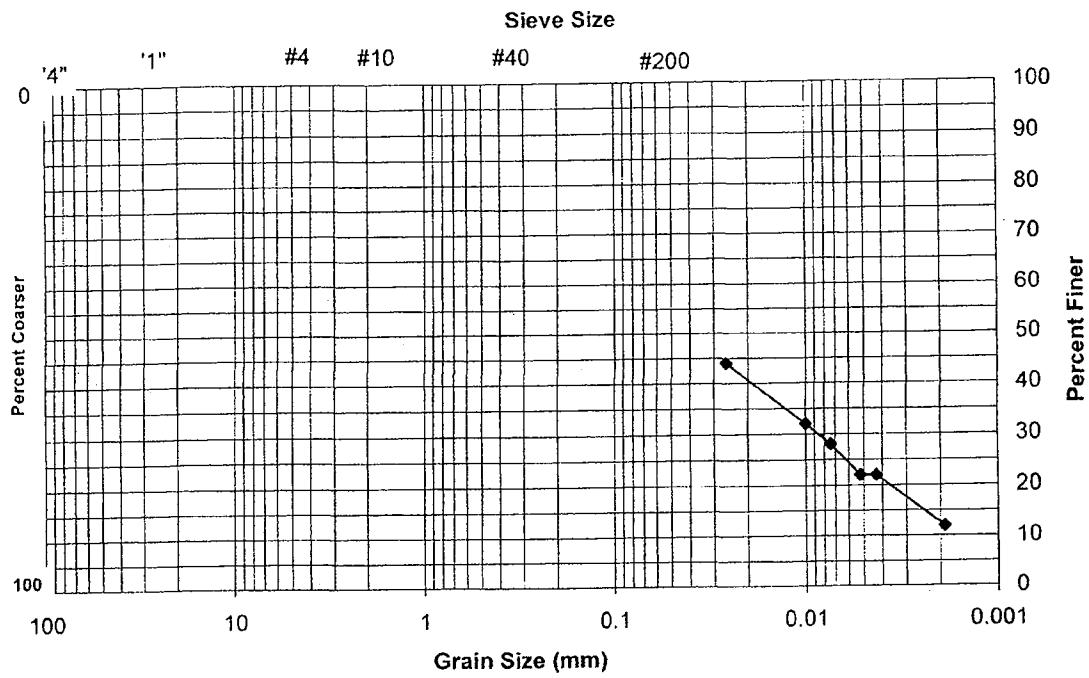
PROJECT: EMPIRICAL LABORATORIES
GREAT LAKES CTO 468
ADDITIONAL SAMPLES

PROJECT NUMBER: 08-5854

DATE: DECEMBER 18, 2008

Sample NTC 195B 18-50-0406

PARTICLE SIZE ANALYSIS
ASTM D 422
HYDROMETER ONLY



PERCENT PASSING

SAMPLE ID									Diameters for Hydrometer Analysis (mm)					
									0.026	0.01	0.0074	0.0052	0.0043	0.0019
0812060-08									44	32	28	22	22	12
LAB ID J 3073														

BEAVER ENGINEERING

PROJECT: EMPIRICAL LABORATORIES
GREAT LAKES CTO 468
ADDITIONAL SAMPLES

PROJECT NUMBER: 08-5854

DATE: DECEMBER 18, 2008

Sample NTC 19SB12-50-0507

APPENDIX D

AQUIFER CHARACTERISTICS, CALCULATIONS, AND RECORDS

HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

Tetra Tech NUS, Inc.

PROJECT NAME: GREAT LAKES NTC 19 WELL/BORING NO.: NTC19MW01

PROJECT NO.: 112G00936 GEOLOGIST: CHARLIE WARNO

WELL DIAMETER: 2" SCREEN LENGTH/DEPTH: 10'/15.5' TEST NO.: 01

STATIC WATER LEVEL (Depth/Elevation): 9.96 DATE: 12/8/08

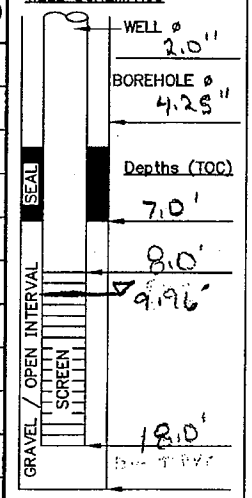
TEST TYPE (Rising/Falling/Constant Head): RISING HEAD CHECKED:

METHOD OF INDUCING WATER LEVEL CHANGE: SLUG (1.5" Φ) PAGE 1 OF 1

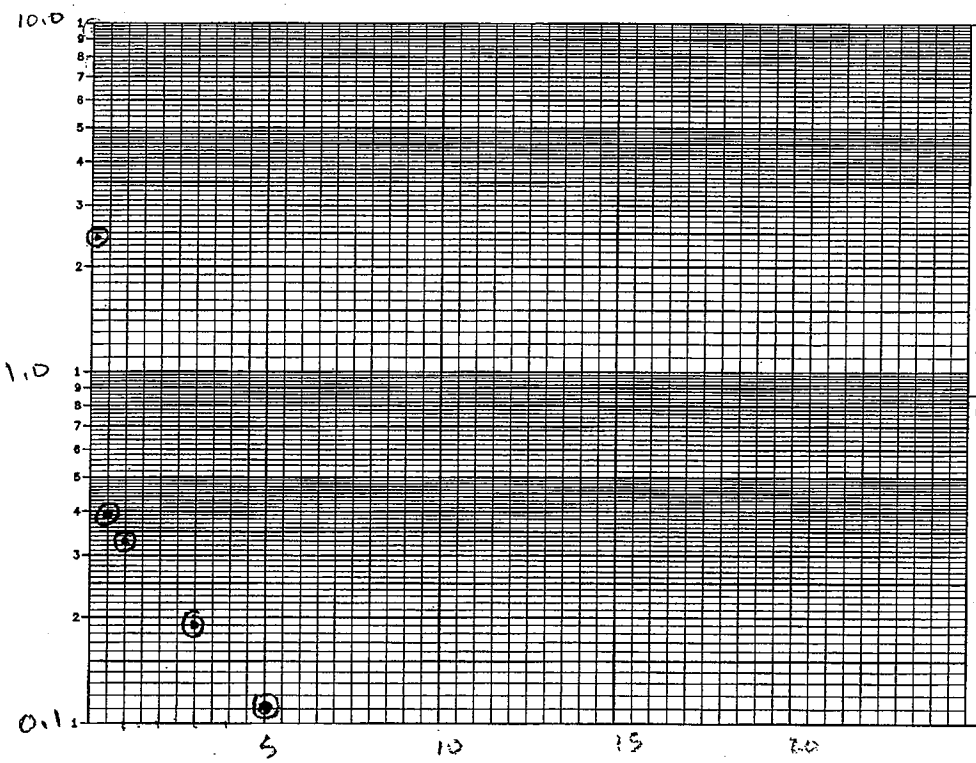
REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): T.O.C.

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)
0	9.96	0			
0.05	7.49	2.47			
0.50	9.57	0.39			
1.00	9.63	0.33			
3.00	9.77	0.19			
5.00	9.85	0.11			
7.50	9.89	0.07			
10.0	9.91	0.05			
15.0	9.91	0.05			

WELL SCHEMATIC



▽ Indicate SWL Depth on Drawing



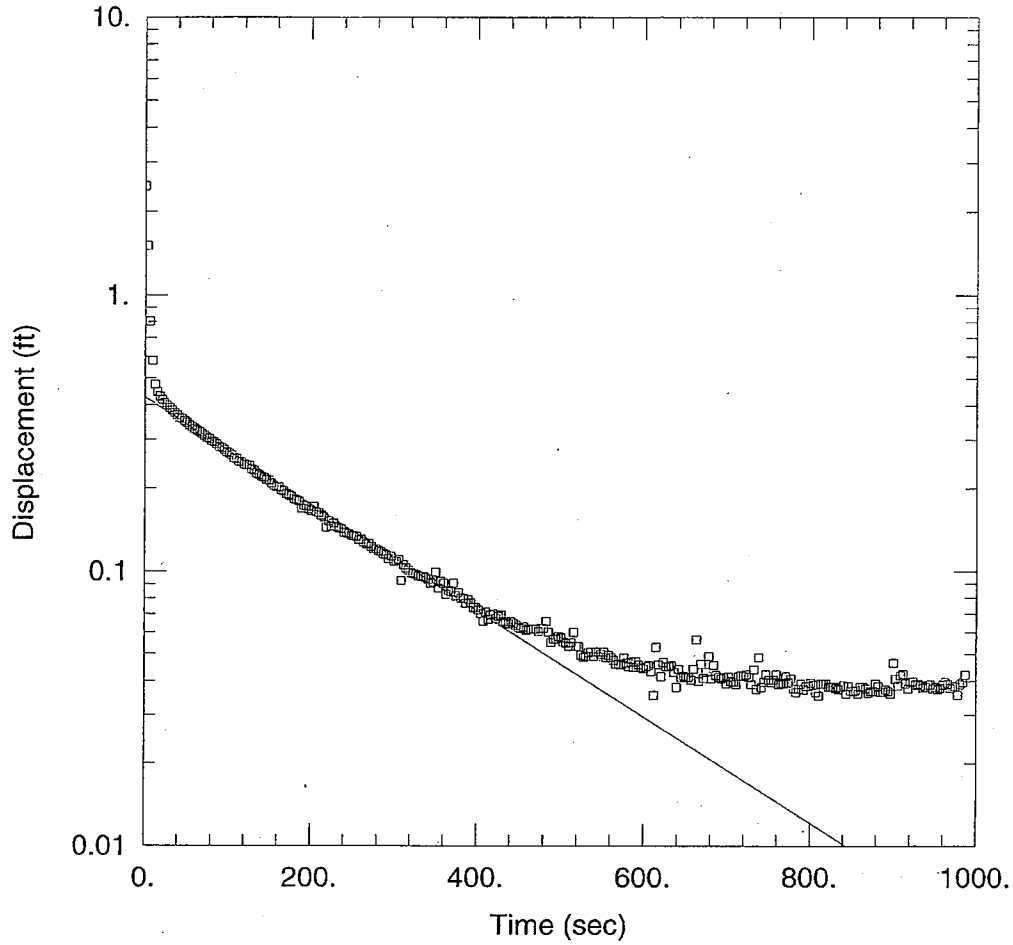
REMARKS:

SLUG Φ 1.5"

EACH SECTION 0.5 GAL DISPLACEMENT

CALCS,SKETCH MAPS, ETC.:

ACAD:FORM_HYDCONTST.dwg 07/06/99 INL



MW01 RISING HEAD

Data Set: H:\Great Lakes\MW01Rising.aqt
Date: 12/19/08 Time: 11:40:26

PROJECT INFORMATION

Company: Tetra Tech NUS
Client: NAVY
Project: 112G00936
Location: Great Lakes RTC Site 19
Test Well: MW01
Test Date: 12/8/08

AQUIFER DATA

Saturated Thickness: 8.04 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW01)

Initial Displacement: 2.47 ft
Total Well Penetration Depth: 8.04 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 8.04 ft
Screen Length: 10. ft
Wellbore Radius: 0.3333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.788 ft/day
y0 = 0.4274 ft

APPENDIX E

IDW WASTE PROFILES AND RECORDS

INDUSTRIAL WATER SERVICES

January 19, 2009

Robert Davis
Tetra Tech NUS
661 Andersen Dr #7
Pittsburgh Pennsylvania

Re: MATERIAL PROFILE APPROVAL #: 029906
Soil Cuttings
Naval Stations - Great Lakes
201 Decatur Ave Bldg#221
Great Lakes Illinois
IL Facility ID #: 0971255004

This letter is in response to your submission of a material profile form to IWS for approval and acceptance. IWS would like to inform you that your material profile form has been approved for acceptance at our facility located at:

12123 South Stony Island Avenue Chicago, IL 60633
IL EPA # 0316555071 US EPA # ILR 000 115 287

When shipping this material to our facility, you must ship with a Uniform Hazardous Waste Manifest. Be sure to include the generator's IL Facility ID Number on the manifest. Also, please reference the MATERIAL PROFILE APPROVAL # on your manifest. The MPA # should be written in the additional information block of the manifest. This approval applies only to the material referenced on the profile form. All other material must be profiled separately. To schedule this load into our facility, you may contact me at (773) 646-9700, or customer service at (800) 447-3592.

This approval is valid for one year. Upon expiration of this profile, you will be prompted to re-certify the profile. Re-certification may include a profile review, re-sample and analysis of the waste stream, or submission of more current material safety data sheets and/or laboratory analyticals. If you have any questions concerning this approval number, please do not hesitate to call. IWS appreciates the opportunity to serve you.

Sincerely,

Tom Reeder
Facility Manager

INDUSTRIAL WATER SERVICES

January 19, 2009

Robert Davis
Tetra Tech NUS
661 Andersen Dr #7
Pittsburgh Pennsylvania

Re: MATERIAL PROFILE APPROVAL #: 029907
Purge Water
Naval Stations - Great Lakes
201 Decatur Ave Bldg#221
Great Lakes Illinois
IL Facility ID #: 0971255004

This letter is in response to your submission of a material profile form to IWS for approval and acceptance. IWS would like to inform you that your material profile form has been approved for acceptance at our facility located at:

12123 South Stony Island Avenue Chicago, IL 60633
IL EPA # 0316555071 US EPA # ILR 000 115 287

When shipping this material to our facility, you must ship with a Uniform Hazardous Waste Manifest. Be sure to include the generator's IL Facility ID Number on the manifest. Also, please reference the MATERIAL PROFILE APPROVAL # on your manifest. The MPA # should be written in the additional information block of the manifest. This approval applies only to the material referenced on the profile form. All other material must be profiled separately. To schedule this load into our facility, you may contact me at (773) 646-9700, or customer service at (800) 447-3592.

This approval is valid for one year. Upon expiration of this profile, you will be prompted to re-certify the profile. Re-certification may include a profile review, re-sample and analysis of the waste stream, or submission of more current material safety data sheets and/or laboratory analyticals. If you have any questions concerning this approval number, please do not hesitate to call. IWS appreciates the opportunity to serve you.

Sincerely,

Tom Reeder
Facility Manager

INDUSTRIAL WATER SERVICES

Corporate Office
1010 East Adams St. • Jacksonville, FL 32202
P.O. Box 43369 • Jacksonville, FL 32203
Phone: (904) 354-0372 • (800) 447-3592
Fax: (904) 350-1313 • www.iwsww.com

CERTIFICATE OF COMPLIANCE AND DISPOSAL

Generator:: Naval Stations Great Lakes
Site Location: Great Lakes, Illinois
Manifest Number: 003898575JJK

This certifies that on the 29TH of January 1 drum 55 gallons of Non Hazardous Purged Water was disposed of and/or recycled incompliance with all applicable federal, state and local regulations.

Facility Name:	Industrial Water Services, Inc.
Facility Address:	12123 S. Stony Island Avenue
US EPA ID#:	ILR 000 115 287
IL EPA Operating Permit#	1994-552-OP
City Of Chicago Operating Permit # Metropolitan Water Reclamation District of	002-LW-2004
Greater Chicago Discharge Authorization#	25416-3.2

Certified By: Michelle Richardson

Signature:

Date: January 29, 2009

12123 South Stony Island Avenue
Chicago, IL 60633
(773) 646-9700
Fax: (773) 646-9730

1640 Talleyrand Avenue
Jacksonville, FL 32206
(904) 354-0372
Fax: (904) 353-4033

1980 Avenue "A"
Mobile, AL 36615
(251) 694-7500
Fax: (251) 694-7508

INDUSTRIAL WATER SERVICES

Corporate Office
1010 East Adams St. • Jacksonville, FL 32202
P.O. Box 43369 • Jacksonville, FL 32203
Phone: (904) 354-0372 • (800) 447-3592
Fax: (904) 350-1313 • www.iwsww.com

CERTIFICATE OF COMPLIANCE AND DISPOSAL

Generator:: Naval Stations Great Lakes
Site Location: Great Lakes, Illinois
Manifest Number: 003898575JJK

This certifies that on the 29TH of January 9 drums 495 gallons of Non Hazardous Soil Cuttings was disposed of and/or recycled incompliance with all applicable federal, state and local regulations.

Facility Name:	Industrial Water Services, Inc.
Facility Address:	12123 S. Stony Island Avenue
US EPA ID#:	ILR 000 115 287
IL EPA Operating Permit#	1994-552-OP
City Of Chicago Operating Permit # Metropolitan Water Reclamation District of	002-LW-2004
Greater Chicago Discharge Authorization#	25416-3.2

Certified By: Michelle Richardson

Signature:

Date: January 29, 2009

12123 South Stony Island Avenue
Chicago, IL 60633
(773) 646-9700
Fax: (773) 646-9730

1640 Talleyrand Avenue
Jacksonville, FL 32206
(904) 354-0372
Fax: (904) 353-4033

1980 Avenue "A"
Mobile, AL 36615
(251) 694-7500
Fax: (251) 694-7508

INDUSTRIAL WATER SERVICES

Corporate Office
1010 East Adams St. • Jacksonville, FL 32202
P.O. Box 43369 • Jacksonville, FL 32203
Phone: (904) 354-0372 • (800) 447-3592
Fax: (904) 350-1313 • www.iwsww.com

CERTIFICATE OF COMPLIANCE AND DISPOSAL

Generator:: Naval Stations Great Lakes
Site Location: Great Lakes, Illinois
Manifest Number: 003898575JJK

This certifies that on the 29TH of January 2 drums 110 gallons of Non Hazardous Concrete/Monitoring Well Manholes Debris was disposed of and/or recycled incompliance with all
applicable federal, state and local regulations.

Facility Name:	Industrial Water Services, Inc.
Facility Address:	12123 S. Stony Island Avenue
US EPA ID#:	ILR 000 115 287
IL EPA Operating Permit#	1994-552-OP
City Of Chicago Operating Permit # Metropolitan Water Reclamation District of	002-LW-2004
Greater Chicago Discharge Authorization#	25416-3.2

Certified By: Michelle Richardson

Signature:

Date: January 29, 2009

12123 South Stony Island Avenue
Chicago, IL 60633
(773) 646-9700
Fax: (773) 646-9730

1640 Talleyrand Avenue
Jacksonville, FL 32206
(904) 354-0372
Fax: (904) 353-4033

1980 Avenue "A"
Mobile, AL 36615
(251) 694-7500
Fax: (251) 694-7508

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

UNIFORM ~~HAZARDOUS~~ WASTE MANIFEST	1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Manifest Tracking Number
	IL7170024577	1	847-688-4820	003898575 JJK

5. Generator's Name and Mailing Address

Naval Stations Great Lakes
201 Decatur Ave. Building#221
Great Lakes, Illinois 60088 (847)688-6934 Attn: Mark S. Hoyer

Generator's Site Address (if different than mailing address)

Generator's Phone:

6. Transporter 1 Company Name: Si-Tech — U.S. EPA ID Number: ~~ILR000055319~~

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address — U.S. EPA ID Number

Industrial Water Services, Inc
12123 South Stony Island Ave
Chicago, Illinois 773-646-9700 — ILR 000115287

Facility's Phone:

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
	1. NON HAZARDOUS LIQUIDS PURGED WATER	001	DM	055	G	
	2. NON HAZARDOUS SOIL SOIL CUTTINGS 029906	009	DM	495	G	
	3. NON HAZARDOUS SOLIDS CONCRETE/MONITORING WELL MANHOLES	002	DM	110	G	
	4.					

14. Special Handling Instructions and Additional Information

Profile# 029907 & 029906 Job# 112G00936 Subcontract No. 1028703
COD Required within 30 days.
P.O.C. Mr. Mark S Hoyer #12411

G=Gallons

15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: Mark S. Hoyer — Signature: Mark S. Hoyer — Month 01 Day 29 Year 09

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Tom Rosen — Signature — Month 01 Day 29 Year 09

Transporter 2 Printed/Typed Name — Signature — Month Day Year

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

18c. Signature of Alternate Facility (or Generator) — Month Day Year

19. ~~Hazardous~~ Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1.	2.	3.	4.

20. Designated Facility Owner or Operator: Certification of receipt of ~~hazardous~~ materials covered by the manifest except as noted in Item 18a

Printed/Typed Name: Anthony Neary — Signature — Month 01 Day 29 Year 09

GENERATOR — TRANSPORTER INT'L — DESIGNATED FACILITY

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

FORM 1
HERB ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC-19-IDW02

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.H12145

Matrix: (soil/water) TCLP Lab Sample ID: 0812145-01

Sample wt/vol: 100.0 (g/mL) ML Lab File ID: 008F0101

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/08/08 19:45

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/29/08

Concentrated Extract Volume: 10.0(mL) Date Analyzed: 12/31/08 17:47

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) MG/L

CAS NO.	COMPOUND	EQL	TCLP Regulatory Limit	CONC	Q
94-75-7	2,4-D	0.0050	10	<0.0050	U
93-72-1	2,4,5-TP (Silvex)	0.00050	1.0	<0.00050	U

FORM 2
TCLP HERB SURROGATE RECOVERY

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.H12145

Column(1): RTX-CLP ID: 0.32 (mm) Column(2): RTX-CLP2 ID: 0.32 (mm)

	CLIENT SAMPLE NO.	S1 1 %REC #	S1 2 %REC #	S2 1 %REC #	S2 2 %REC #	S3 1 %REC #	S3 2 %REC #	TOT OUT
01	HW1BLK1229	86	109					0
02	HW1BLK1229LC	52	88					0
03	HW1BLK1229LC	59	93					0
04	NTC-19-IDW02	65	100					0
05	NTC-19-IDW02	63	101					0
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		EL QC LIMITS	SPIKE CONC (mg/L)
S1	= DCAA	(20-140)	0.010

Column to be used to flag recovery values
* Values outside of QC limits
D Surrogate results reported from a diluted analysis

FORM 3
TCLP HERB LAB CONTROL SAMPLE

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.H12145

Matrix Spike - Client Sample No.: HW1BLK1229

COMPOUND	SPIKE ADDED (mg/L)	SAMPLE CONCENTRATION (mg/L)	LCS CONCENTRATION (mg/L)	LCS % REC #	QC. LIMITS REC.
2,4-D	0.01000	0.0000	0.009006	90	35-115
2,4,5-TP (Silvex)	0.01000	0.0000	0.008369	84	50-115

COMPOUND	SPIKE ADDED (mg/L)	LCSD CONCENTRATION (mg/L)	LCSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
2,4-D	0.01000	0.01078	108	18	30	35-115
2,4,5-TP (Silvex)	0.01000	0.008591	86	3	30	50-115

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 2 outside limits
Spike Recovery: 0 out of 4 outside limits

COMMENTS: _____

FORM 3
TCLP HERB MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.H12145

Matrix Spike - Client Sample No.: NTC-19-IDW02 Lab Sample ID: 0812145-01

COMPOUND	SPIKE ADDED (mg/L)	SAMPLE CONCENTRATION (mg/L)	MS CONCENTRATION (mg/L)	MS % REC #	QC. LIMITS REC.
2,4-D	0.01000	0.0000	0.01123	112	35-115
2,4,5-TP (Silvex)	0.01000	0.0000	0.009233	92	50-115

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 0 outside limits
Spike Recovery: 0 out of 2 outside limits

COMMENTS: _____

FORM 4
HERB METHOD BLANK SUMMARY

CLIENT SAMPLE NO.

HW1BLK1229

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.H12145

Lab Sample ID: HW1BLK1229 Lab File ID: 005F0101

Matrix (soil/water) TCLP Extraction: (SepF/Cont/Sonc/Soxh) SEPF

Sulfur Cleanup (Y/N) N Date Extracted:

Date Analyzed (1): 12/31/08 Date Analyzed (2): 12/31/08

Time Analyzed (1): 1555 Time Analyzed (2): 1628

Instrument ID (1): ECD2 Instrument ID (2): ECD2

Column (1): RTX-CLP ID: 0.32(mm) Column (2): RTX-CLP2 ID: 0.32(mm)

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01	HW1BLK1229LC	HW1BLK1229LCS	12/31/08	12/31/08
02	HW1BLK1229LC	HW1BLK1229LCSD	12/31/08	12/31/08
03	NTC-19-IDW02	0812145-01	12/31/08	12/31/08
04	NTC-19-IDW02	0812145-01MS	12/31/08	12/31/08
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COMMENTS:

FORM IV HERB

FORM 1
HERB ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

HW1BLK1229

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.H12145

Matrix: (soil/water) TCLP Lab Sample ID: HW1BLK1229

Sample wt/vol: 100.0 (g/mL) ML Lab File ID: 005F0101

% Moisture: _____ decanted: (Y/N)___ Date Sampled: _____

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:

Concentrated Extract Volume: 10.0(mL) Date Analyzed: 12/31/08 15:55

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) MG/L

CAS NO.	COMPOUND	EQL	TCLP Regulatory Limit	CONC	Q
94-75-7	2,4-D	0.0050	10	<0.0050	U
93-72-1	2,4,5-TP (Silvex)	0.00050	1.0	<0.00050	U

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC-19-IDW02

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.B12145

Matrix: (soil/water) TCLP Lab Sample ID: 0812145-01

Sample wt/vol: 100.0 (g/mL) ML Lab File ID: 1214501T

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/08/08 19:45

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/23/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 01/06/09 16:09

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) MG/L

CAS NO.	COMPOUND	EQL	TCLP Regulatory Limit	CONC	Q
121-14-2	2,4-Dinitrotoluene	0.050	0.13	<0.050	U
118-74-1	Hexachlorobenzene	0.050	0.13	<0.050	U
87-68-3	Hexachlorobutadiene	0.050	0.50	<0.050	U
67-72-1	Hexachloroethane	0.050	3.0	<0.050	U
108-39-4	3-Methylphenol	0.050	200	<0.050	U
106-44-5	4-Methylphenol	0.050	200	<0.050	U
95-48-7	2-Methylphenol	0.050	200	<0.050	U
98-95-3	Nitrobenzene	0.050	2.0	<0.050	U
87-86-5	Pentachlorophenol	0.20	100	<0.20	U
110-86-1	Pyridine	0.20	5.0	<0.20	U
95-95-4	2,4,5-Trichlorophenol	0.050	400	<0.050	U
88-06-2	2,4,6-Trichlorophenol	0.050	2.0	<0.050	U

FORM 2
TCLP SEMIVOLATILE SURROGATE RECOVERY

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.B12145

	CLIENT SAMPLE NO.	S1 (2FP) #	S2 (PHL) #	S3 (NBZ) #	S4 (FBP) #	S5 (TBP) #	S6 (TPH) #	S7 #	S8 #	TOT OUT
01	SBLK1223BW1	30	18	68	70	95	93			0
02	SBLK1223BW1L	29	18	70	70	89	86			0
03	SBLK1223BW1L	29	18	69	69	91	89			0
04	NTC-19-IDW02	32	19	72	66	96	94			0
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		EL QC LIMITS	SPIKE CONC (MG/L)
S1 (2FP)	= 2-Fluorophenol	(15-110)	1.0
S2 (PHL)	= Phenol-d6	(15-110)	1.0
S3 (NBZ)	= Nitrobenzene-d5	(30-110)	0.50
S4 (FBP)	= 2-Fluorobiphenyl	(35-110)	0.50
S5 (TBP)	= 2,4,6-Tribromophenol	(45-125)	1.0
S6 (TPH)	= Terphenyl-d14	(55-125)	0.50

Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogate results reported from a diluted analysis

FORM 3
TCLP SEMIVOLATILE LAB CONTROL SAMPLE

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.B12145

Matrix Spike - Client Sample No.: SBLK1223BW1

COMPOUND	SPIKE ADDED (MG/L)	SAMPLE CONCENTRATION (MG/L)	LCS CONCENTRATION (MG/L)	LCS % REC #	QC. LIMITS REC.
2,4-Dinitrotoluene	0.5000	0.0000	0.4745	95	50-120
Hexachlorobenzene	0.5000	0.0000	0.4645	93	50-110
Hexachlorobutadiene	0.5000	0.0000	0.3572	71	25-105
Hexachloroethane	0.5000	0.0000	0.3258	65	30- 95
4-Methylphenol	0.5000	0.0000	0.2622	52	30-110
2-Methylphenol	0.5000	0.0000	0.3101	62	40-110
Nitrobenzene	0.5000	0.0000	0.3640	73	45-110
Pentachlorophenol	0.5000	0.0000	0.5646	113	40-115
Pyridine	0.5000	0.0000	0.03136	6*	10-110
2,4,5-Trichlorophenol	0.5000	0.0000	0.4465	89	50-110
2,4,6-Trichlorophenol	0.5000	0.0000	0.4390	88	50-115

COMPOUND	SPIKE ADDED (MG/L)	LCSD CONCENTRATION (MG/L)	LCSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
2,4-Dinitrotoluene	0.5000	0.4874	97	3	30	50-120
Hexachlorobenzene	0.5000	0.4651	93	0	30	50-110
Hexachlorobutadiene	0.5000	0.3188	64	11	30	25-105
Hexachloroethane	0.5000	0.2967	59	9	30	30- 95
4-Methylphenol	0.5000	0.2637	53	0	30	30-110
2-Methylphenol	0.5000	0.3208	64	3	30	40-110
Nitrobenzene	0.5000	0.3596	72	1	30	45-110
Pentachlorophenol	0.5000	0.5800	116*	3	30	40-115
Pyridine	0.5000	0.04282	8*	31*	30	10-110
2,4,5-Trichlorophenol	0.5000	0.4445	89	0	30	50-110
2,4,6-Trichlorophenol	0.5000	0.4385	88	0	30	50-115

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 1 out of 11 outside limits
Spike Recovery: 3 out of 22 outside limits

COMMENTS: _____

FORM 4
SEMIVOLATILE METHOD BLANK SUMMARY

CLIENT SAMPLE NO.

SBLK1223BW1

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.B12145

Lab File ID: S1BW1223 Lab Sample ID: SBLK1223BW1

Instrument ID: BNA3 Date Extracted: 12/23/08

Matrix: (soil/water) TCLP Date Analyzed: 01/06/09

Level:(low/med) LOW GPC Cleanup: (Y/N) N Time Analyzed: 1405

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED
01	SBLK1223BW1L	SBLK1223BW1LCS	S1LW1223	01/06/09
02	SBLK1223BW1L	SBLK1223BW1LCS	S1DW1223	01/06/09
03	NTC-19-IDW02	0812145-01	1214501T	01/06/09
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COMMENTS:

FORM IV SV

FORM 1
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

SBLK1223BW1

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.B12145

Matrix: (soil/water) TCLP Lab Sample ID: SBLK1223BW1

Sample wt/vol: 100.0 (g/mL) ML Lab File ID: S1BW1223

% Moisture: _____ decanted: (Y/N)___ Date Sampled: _____

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/23/08

Concentrated Extract Volume: 1000.0(uL) Date Analyzed: 01/06/09 14:05

Injection Volume: 0.5(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA

CONCENTRATION UNITS: (ug/L or ug/Kg) MG/L

CAS NO.	COMPOUND	EQL	TCLP Regulatory Limit	CONC	Q
121-14-2	2,4-Dinitrotoluene	0.050	0.13	<0.050	U
118-74-1	Hexachlorobenzene	0.050	0.13	<0.050	U
87-68-3	Hexachlorobutadiene	0.050	0.50	<0.050	U
67-72-1	Hexachloroethane	0.050	3.0	<0.050	U
108-39-4	3-Methylphenol	0.050	200	<0.050	U
106-44-5	4-Methylphenol	0.050	200	<0.050	U
95-48-7	2-Methylphenol	0.050	200	<0.050	U
98-95-3	Nitrobenzene	0.050	2.0	<0.050	U
87-86-5	Pentachlorophenol	0.20	100	<0.20	U
110-86-1	Pyridine	0.20	5.0	<0.20	U
95-95-4	2,4,5-Trichlorophenol	0.050	400	<0.050	U
88-06-2	2,4,6-Trichlorophenol	0.050	2.0	<0.050	U

FORM 1
PESTA ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

NTC-19-IDW02

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.P12145

Matrix: (soil/water) WATER Lab Sample ID: 0812145-01

Sample wt/vol: 100.0 (g/mL) ML Lab File ID: 075F7501

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/08/08 19:45

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/22/08

Concentrated Extract Volume: 10.0(mL) Date Analyzed: 12/30/08 12:19

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) MG/L

CAS NO.	COMPOUND	EQL	TCLP Regulatory Limit	CONC	Q
57-74-9	Chlordane	0.00050	0.030	<0.00050	U
72-20-8	Endrin	0.00010	0.020	<0.00010	U
58-89-9	Gamma-BHC	0.00010	0.40	<0.00010	U
76-44-8	Heptachlor	0.00010	0.0080	<0.00010	U
1024-57-3	Heptachlor Epoxide	0.00010	0.0080	<0.00010	U
72-43-5	Methoxychlor	0.00010	10	<0.00010	U
8001-35-2	Toxaphene	0.010	0.50	<0.010	U

FORM 2
WATER PESTICIDE SURROGATE RECOVERY

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.P12145

Column(1): ZB MR-1 ID: 0.32 (mm) Column(2): ZB MR-2 ID: 0.32 (mm)

	CLIENT SAMPLE NO.	S1 1 %REC #	S1 2 %REC #	S2 1 %REC #	S2 2 %REC #	OTHER (1)	OTHER (2)	TOT OUT
01	PW1BLK1222	84	85	83	88			0
02	PW1BLK1222LC	88	82	82	83			0
03	PW1BLK1222LC	87	82	86	86			0
04	NTC-19-IDW02	93	95	76	81			0
05	NTC-19-IDW02	74	70	88	89			0
06	NTC-19-IDW02	90	105	92	104			0
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		EL QC LIMITS	SPIKE CONC (mg/L)
S1	= TCMX	(25-120)	0.0050
S2	= DCB	(25-130)	0.0050

Column to be used to flag recovery values
* Values outside of QC limits
D Surrogate results reported from a diluted analysis

FORM 3
WATER PESTICIDE LAB CONTROL SAMPLE

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.P12145

Matrix Spike - Client Sample No.: PW1BLK1222

COMPOUND	SPIKE ADDED (mg/L)	SAMPLE CONCENTRATION (mg/L)	LCS CONCENTRATION (mg/L)	LCS % REC #	QC. LIMITS REC.
Endrin	0.01000	0.0000	0.009825	98	55-135
Gamma-BHC	0.01000	0.0000	0.01065	106	25-135
Heptachlor	0.01000	0.0000	0.009778	98	40-130
Heptachlor Epoxide	0.01000	0.0000	0.009306	93	60-130
Methoxychlor	0.01000	0.0000	0.01129	113	55-150

COMPOUND	SPIKE ADDED (mg/L)	LCSD CONCENTRATION (mg/L)	LCSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Endrin	0.01000	0.009833	98	0	30	55-135
Gamma-BHC	0.01000	0.01040	104	2	30	25-135
Heptachlor	0.01000	0.009725	97	0	30	40-130
Heptachlor Epoxide	0.01000	0.008815	88	5	30	60-130
Methoxychlor	0.01000	0.01083	108	4	30	55-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

COMMENTS: _____

FORM 3
WATER PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.P12145

Matrix Spike - Client Sample No.: NTC-19-IDW02 Lab Sample ID: 0812145-01

COMPOUND	SPIKE ADDED (mg/L)	SAMPLE CONCENTRATION (mg/L)	MS CONCENTRATION (mg/L)	MS % REC #	QC. LIMITS REC.
Endrin	0.01000	0.0000	0.009952	100	55-135
Gamma-BHC	0.01000	0.0000	0.01068	107	25-135
Heptachlor	0.01000	0.0000	0.009550	96	40-130
Heptachlor Epoxide	0.01000	0.0000	0.009434	94	60-130
Methoxychlor	0.01000	0.0000	0.01167	117	55-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 0 outside limits
Spike Recovery: 0 out of 5 outside limits

COMMENTS: _____

FORM 3
WATER PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.P12145

Matrix Spike - Client Sample No.: NTC-19-IDW02TC Lab Sample ID: 0812145-01TC

COMPOUND	SPIKE ADDED (mg/L)	SAMPLE CONCENTRATION (mg/L)	MS CONCENTRATION (mg/L)	MS % REC #	QC. LIMITS REC.
Chlordane	0.1000	0.0000	0.1213	121*	45-119
Toxaphene	0.1000	0.0000	0.1080	108	41-126

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 0 outside limits
Spike Recovery: 1 out of 2 outside limits

COMMENTS: _____

FORM 4
PESTICIDE METHOD BLANK SUMMARY

CLIENT SAMPLE NO.

PW1BLK1222

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.P12145

Lab Sample ID: PW1BLK1222 Lab File ID: 061F6101

Matrix (soil/water) WATER Extraction: (SepF/Cont/Sonc/Soxh) SEPF

Sulfur Cleanup (Y/N) N Date Extracted: 12/22/08

Date Analyzed (1): 12/30/08 Date Analyzed (2): 12/30/08

Time Analyzed (1): 0803 Time Analyzed (2): 0803

Instrument ID (1): ECD3 Instrument ID (2): ECD3

Column (1): ZB MR-1 ID: 0.32(mm) Column (2): ZB MR-2 ID: 0.32(mm)

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01	PW1BLK1222LC	PW1BLK1222LCS	12/30/08	12/30/08
02	PW1BLK1222LC	PW1BLK1222LCSD	12/30/08	12/30/08
03	NTC-19-IDW02	0812145-01	12/30/08	12/30/08
04	NTC-19-IDW02	0812145-01MS	12/30/08	12/30/08
05	NTC-19-IDW02	0812145-01TC	12/30/08	12/30/08
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				

COMMENTS:

FORM IV PESTA

FORM 1
PESTA ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PW1BLK1222

Lab Name: EMPIRICAL LABS Contract: TETRATECH

Lab Code: NA Case No.: NA SAS No.: NA SDG No.: TET.P12145

Matrix: (soil/water) WATER Lab Sample ID: PW1BLK1222

Sample wt/vol: 100.0 (g/mL) ML Lab File ID: 061F6101

% Moisture: _____ decanted: (Y/N)___ Date Sampled: _____

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/22/08

Concentrated Extract Volume: 10.0(mL) Date Analyzed: 12/30/08 08:03

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) MG/L

CAS NO.	COMPOUND	EQL	TCLP Regulatory Limit	CONC	Q
57-74-9	Chlordane	0.00050	0.030	<0.00050	U
72-20-8	Endrin	0.00010	0.020	<0.00010	U
58-89-9	Gamma-BHC	0.00010	0.40	<0.00010	U
76-44-8	Heptachlor	0.00010	0.0080	<0.00010	U
1024-57-3	Heptachlor Epoxide	0.00010	0.0080	<0.00010	U
72-43-5	Methoxychlor	0.00010	10	<0.00010	U
8001-35-2	Toxaphene	0.010	0.50	<0.010	U

APPENDIX F

HUMAN HEALTH RISK ASSESSMENT SUPPORT

APPENDIX F.1

RISK ASSESSMENT CALCULATIONS AND RAGS-PART D TABLES

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL - DIRECT CONTACT AND INHALATION
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Parameter	Frequency of Detection	Minimum Result[1]		Maximum Result[1,2]		Units	Location of Maximum Detect	Sample of Maximum Detect	Range of Non Detects	Background Concentration[4]	ORNL Residential Soil Criteria[5]	USEPA SSLs for Migration from Soil to Air - Residential[3a]	USEPA Industrial SSLs for Inhalation[3b]	SSLs for Inhalation Construction Worker Scenario[6]	TACO - Residential Soil Ingestion[8]	TACO - Residential Soil Inhalation[8]	TACO - Industrial - Commercial Inhalation[8]	TACO - Construction Worker Soil Inhalation[8]	NON-TACO - Residential Soil Ingestion[9]	NON-TACO - Residential Soil Inhalation[9]	NON-TACO - Industrial/ Commercial/Soil Inhalation[9]	NON-TACO - Construction Worker Soil Inhalation[9]	COPC Flag[7]	Rationale for Contaminant Deletion or Selection
Volatile Organics (ug/kg)																									
2-BUTANONE	2/12	1.6		2.5		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.2 - 1.8	NA	2800000	NA	NA	1800000000	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
ACETONE	6/12	4.3	J	29		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 2.5	NA	6100000	NA	NA	11000000000	7000000	100000000	100000000	100000000	NA	NA	NA	NA	No	BSL
Polynuclear Aromatic Hydrocarbons (ug/kg)																									
2-METHYLNAPHTHALENE	6/12	2		53		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 2.1	140	31000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
ACENAPHTHENE	7/12	1.6		240		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.4 - 1.5	130	340000	NA	NA	NA	470000	NA	NA	NA	NA	NA	NA	NA	No	BSL
ACENAPHTHYLENE[12]	7/12	1.4		74		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.3 - 1.4	70	340000	NA	NA	NA	NA	NA	NA	NA	230000	NA	NA	NA	No	BSL
ANTHRACENE	8/12	2.1		590		UG/KG	NTC19SB11	NTC19SB11-SO-0002	0.9 - 0.97	400	1700000	NA	NA	NA	2300000	NA	NA	NA	NA	NA	NA	NA	No	BSL
BAP EQUIVALENTS	11/12	1.6641		1758.8		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.2 - 1.2	NA	15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
BENZO(A)ANTHRACENE	10/12	2.3		1700		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.6 - 1.7	1800	150	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
BENZO(A)PYRENE	10/12	4.2		1200		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.1 - 1.2	2100	15	NA	NA	230000	90	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
BENZO(B)FLUORANTHENE	9/12	6.7		1700		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.7 - 1.9	2100	150	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
BENZO(G,H,I)PERYLENE[13]	10/12	3.4		940		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.7 - 1.8	1700	170000	NA	NA	NA	230000	NA	NA	NA	230000	NA	NA	NA	No	BSL
BENZO(K)FLUORANTHENE	9/12	2.7		460		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.4 - 1.5	1700	1500	NA	NA	2300000	9000	NA	NA	NA	NA	NA	NA	NA	No	BSL
CHRYSENE	11/12	2.4		1900		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.3 - 1.3	2700	15000	NA	NA	23000000	88000	NA	NA	NA	NA	NA	NA	NA	No	BSL
DIBENZO(A,H)ANTHRACENE	5/12	4.8	J	160		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.7 - 1.9	420	15	NA	NA	210000	90	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
FLUORANTHENE	10/12	2.2		5100		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 2	4100	230000	NA	NA	NA	310000	NA	NA	NA	NA	NA	NA	NA	No	BSL
FLUORENE	7/12	1.8		250		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.4 - 1.5	180	230000	NA	NA	NA	310000	NA	NA	NA	NA	NA	NA	NA	No	BSL
INDENO(1,2,3-CD)PYRENE	9/12	4.4		730		UG/KG	NTC19SB19	NTC19SB20-SO-0002	1.7 - 1.9	1600	150	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
NAPHTHALENE	3/12	4.9		62		UG/KG	NTC19SB11	NTC19SB11-SO-0002	2.6 - 28	200	3600	17000	24000	7300000	160000	17000	27000	1800	NA	NA	NA	NA	No	BSL
PHENANTHRENE[13]	10/12	4.2		3200		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 2	2500	170000	NA	NA	NA	230000	NA	NA	NA	230000	NA	NA	NA	No	BSL
PYRENE	11/12	2.4		3500		UG/KG	NTC19SB11	NTC19SB11-SO-0002	1.9 - 1.9	3000	170000	NA	NA	NA	230000	NA	NA	NA	NA	NA	NA	NA	No	BSL
Inorganics (mg/kg)																									
ALUMINUM	16/16	6640		19300		MG/KG	NTC19SB06	NTC19SB06-SO-0001	---	9500	7700	NA	NA	1800	NA	NA	NA	NA	7800	100000	100000	87000	Yes	ASL
ANTIMONY	1/13	1.2		1.2		MG/KG	NTC19SB17	NTC19SB17-SO-0002	---	4	3.1	NA	NA	NA	3.1	NA	NA	NA	NA	NA	NA	NA	No	BSL
ARSENIC	16/16	5.2		32.2		MG/KG	NTC19SB10	NTC19SB10-SO-0002	---	13	0.39	770	1400	5.3	13	750	1200	25000	NA	NA	NA	NA	Yes	ASL
BARIUM	16/16	31.5		188		MG/KG	NTC19SB06	NTC19SB06-SO-0001	---	110	1500	71000	100000	180	550	69000	91000	87000	NA	NA	NA	NA	Yes[16]	ASL
BERYLLIUM	16/16	0.49		2		MG/KG	NTC19SB11	NTC19SB11-SO-0002	---	0.59	16	1400	2600	7.1	16	1300	2100	44000	NA	NA	NA	NA	No	BSL
CADMIUM	14/16	0.25		0.92	J	MG/KG	NTC19SB06	NTC19SB06-SO-0001	0.22 - 0.24	0.6	7	1800	3400	3.6	7.8	1800	2800	59000	NA	NA	NA	NA	No	BSL
CALCIUM	16/16	5210	J	111000	J	MG/KG	NTC19SB07	NTC19SB07-SO-0001	---	9300	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
CHROMIUM	16/16	13	J	32.6	J	MG/KG	NTC19SB17	NTC19SB17-SO-0002-D	---	16.2	0.29	280	510	3	23	270	420	69	NA	NA	NA	NA	Yes	ASL
COBALT	16/16	5		13.3		MG/KG	NTC19SB10	NTC19SB10-SO-0002	---	8.9	2.3	NA	NA	2.1	470	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
COPPER	16/16	17.5		53.6		MG/KG	NTC19SB17	NTC19SB17-SO-0002	---	19.6	310	NA	NA	NA	290	NA	NA	NA	NA	NA	NA	NA	No	BSL
IRON	16/16	14600		36800		MG/KG	NTC19SB10	NTC19SB10-SO-0002	---	15900	5500	NA	NA	NA	NA	NA	NA	NA	5500	NA	NA	NA	Yes	ASL
LEAD	16/16	9.5	J	480	J	MG/KG	NTC19SB03	NTC19SB03-SO-0001	---	36	400	NA	NA	NA	400	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
MAGNESIUM	16/16	5270	J	62100		MG/KG	NTC19SB07	NTC19SB07-SO-0001	---	4820	NA	NA	NA	NA	325000	NA	NA	NA	NA	NA	NA	NA	No	BSL
MANGANESE	16/16	336		1820	J	MG/KG	NTC19SB16	NTC19SB16-SO-0103	---	636	180	NA	NA	18	160	6900	9100	870	NA	NA	NA	NA	Yes	ASL
MERCURY	15/16	0.018		0.47		MG/KG	NTC19SB06	NTC19SB06-SO-0001	0.015 - 0.015	0.06	0.56	1	1.4	10.7	2.3	1	1.6	NA[15]	NA	NA	NA	NA	No	ASL
NICKEL[14]	16/16	14		47.9	J	MG/KG	NTC19SB17	NTC19SB17-SO-0002-D	---	18	150	14000	26000	32	160	13000	21000	440000	NA	NA	NA	NA	Yes[16]	BSL
POTASSIUM	16/16	1030		2720		MG/KG	NTC19SB11	NTC19SB11-SO-0002	---	1268	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
SILVER	3/16	0.44		1		MG/KG	NTC19SB06	NTC19SB06-SO-0001	0.22 - 0.25	0.55	39	NA	NA	NA	39	NA	NA	NA	NA	NA	NA	NA	No	BSL
SODIUM	4/16	239		565		MG/KG	NTC19SB11	NTC19SB11-SO-0002	220 - 256	130	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
VANADIUM	16/16	16.4		37.1		MG/KG	NTC19SB06	NTC19SB06-SO-0001	---	25.2	39	NA	NA	NA	55	NA	NA	NA	NA	NA	NA	NA	No	BSL
ZINC	16/16	40		250	J	MG/KG	NTC19SB06	NTC19SB06-SO-0001	---	95	2300	NA	NA	NA	2300	NA	NA	NA	NA	NA	NA	NA	No	BSL

Associated Samples:
NTC19SB01-SO-0002
NTC19SB03-SO-0001
NTC19SB03-SO-0103
NTC19SB06-SO-0001
NTC19SB11-SO-0002
NTC19SB12-SO-0002
NTC19SB13-SO-0103
NTC19SB15-SO-0103
NTC19SB07-SO-0001
NTC19SB08-SO-0103
NTC19SB09-SO-0002
NTC19SB10-SO-0002
NTC19SB16-SO-0103
NTC19SB16-SO-0103-AVG
NTC19SB16-SO-0103-D
NTC19SB17-SO-0002
NTC19SB17-SO-0002-AVG
NTC19SB17-SO-0002-D
NTC19SB19-SO-0002
NTC19SB20-SO-0002

Footnotes:
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - The maximum detected concentration is used for screening purposes
3a - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites; USEPA, OSWER 9355.4-24, December 2002. Appendix A Exhibit A-1
3b - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites; USEPA, OSWER 9355.4-24, December 2002. Appendix A Exhibit A-2
4 - Background data used - Illinois EPA background concentration (Illinois EPA, Appendix A, Table G of TACO)
5 - USEPA ORNL Screening Level. The noncarcinogenic values (denoted with a "N" flag) are the ORNL value divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag) (USEPA Region IX, October 2004, Updated December 28, 2004).
6 - Soil Screening Levels for Migration from Soil to Air for Construction Worker Scenario were calculated by Tetra Tech, NUS using methodology and equations presented in the Supplemental Guidance For Developing Soil Screening Levels for Superfund Sites, OSWER 93355.4-24, December 2002.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - Section 742 Table A, Tier 1, Soil Remediation Objectives - Residential/Industrial/Commercial (Ingestion or Inhalation)(Online, 2009)
9 - Soil Remediation Objectives for Residential/Industrial/Commercial roperties, Non-TACO Chemicals (2009)
10 - Ten percent of the noncarcinogenic value is less than the carcinogenic value, therefore the noncarcinogenic value is presented.
11 - Values are for hexavalent chromium.
12 - Acenaphthene is used as a surrogate for acenaphthylene
13 - Pyrene is used as a surrogate for benzo(ghi)perylene and phenanthrene
14 - Nickle criteria based on nickle soluble salts
15 - TACO table footnote indicates that elemental Hg " inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern." Site 19 is a former gun range and elemental mercury is not a contaminant of concern at this site.
16 - COPC flag for construction worker inhalation scenario only
BAP equivalent criteria based on BaP
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL - MIGRATION TO GROUNDWATER
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

CAS #	Parameter	Frequency of Detection	Minimum Result[1]	Maximum Result[1,2]	Units	Sample of Maximum Detect	Range of Non-detects[3]	Background Concentration[4]	ORNL Risk-Based Migration to GW SSL[5]		ORNL MCL Based Migration to GW SSL[5]	TACO - Residential Migration to Groundwater - Class 1[6]	NON-TACO - Residential Migration to Groundwater - Class 1[7]	Above SSL
	Volatile Organics (ug/kg)													
78-93-3	2-BUTANONE	2/12	1.6	2.5	UG/KG	NTC19SB11-SO-0002	1.2 - 1.8	NA	1500	N	NA	NA	17000	No
67-64-1	ACETONE	6/12	4.3 J	29	UG/KG	NTC19SB11-SO-0002	1.9 - 2.5	NA	4400	N	NA	25000	NA	No
	Polynuclear Aromatic Hydrocarbons (ug/kg)													
91-57-6	2-METHYLNAPHTHALENE	6/12	2	53	UG/KG	NTC19SB11-SO-0002	1.9 - 2.1	140	900	N	NA	NA	NA	No
83-32-9	ACENAPHTHENE	7/12	1.6	240	UG/KG	NTC19SB11-SO-0002	1.4 - 1.5	130	27000	N	NA	570000	NA	No
208-96-8	ACENAPHTHYLENE	7/12	1.4	74	UG/KG	NTC19SB11-SO-0002	1.3 - 1.4	70	27000	N	NA	NA	85000	No
120-12-7	ANTHRACENE	8/12	2.1	590	UG/KG	NTC19SB11-SO-0002	0.9 - 0.97	400	450000	N	NA	12000000	NA	No
CALC055	BAP EQUIVALENTS	11/12	1.6641	1758.8	UG/KG	NTC19SB20-SO-0002	1.2 - 1.2	NA	4.6	C	310	8000	NA	Yes
56-55-3	BENZO(A)ANTHRACENE	10/12	2.3	1700	UG/KG	NTC19SB11-SO-0002	1.6 - 1.7	1800	14	C	NA	2000	NA	Yes
50-32-8	BENZO(A)PYRENE	10/12	4.2	1200	UG/KG	NTC19SB11-SO-0002	1.1 - 1.2	2100	4.6	C	310	8000	NA	Yes
205-99-2	BENZO(B)FLUORANTHENE	9/12	6.7	1700	UG/KG	NTC19SB20-SO-0002	1.7 - 1.9	2100	47	C	NA	5000	NA	Yes
191-24-2	BENZO(G,H,I)PERYLENE	10/12	3.4	940	UG/KG	NTC19SB20-SO-0002	1.7 - 1.8	1700	150000	N	NA	NA	27000000	No
207-08-9	BENZO(K)FLUORANTHENE	9/12	2.7	460	UG/KG	NTC19SB20-SO-0002	1.4 - 1.5	1700	460	C	NA	49000	NA	No
218-01-9	CHRYSENE	11/12	2.4	1900	UG/KG	NTC19SB11-SO-0002	1.3 - 1.3	2700	1400	C	NA	160000	NA	Yes
53-70-3	DIBENZO(A,H)ANTHRACENE	5/12	4.8 J	160	UG/KG	NTC19SB20-SO-0002	1.7 - 1.9	420	15	C	NA	2000	NA	Yes
206-44-0	FLUORANTHENE	10/12	2.2	5100	UG/KG	NTC19SB11-SO-0002	1.9 - 2	4100	210000	N	NA	4300000	NA	No
86-73-7	FLUORENE	7/12	1.8	250	UG/KG	NTC19SB11-SO-0002	1.4 - 1.5	180	33000	N	NA	560000	NA	No
193-39-5	INDENO(1,2,3-CD)PYRENE	9/12	4.4	730	UG/KG	NTC19SB20-SO-0002	1.7 - 1.9	1600	160	C	NA	69000	NA	Yes
91-20-3	NAPHTHALENE	3/12	4.9	62	UG/KG	NTC19SB11-SO-0002	2.6 - 28	200	0.55	C	NA	12000	NA	Yes
85-01-8	PHENANTHRENE	10/12	4.2	3200	UG/KG	NTC19SB11-SO-0002	1.9 - 2	2500	150000	N	NA	NA	200000	No
129-00-0	PYRENE	11/12	2.4	3500	UG/KG	NTC19SB11-SO-0002	1.9 - 1.9	3000	150000	N	NA	4200000	NA	No
	Inorganics (mg/kg)													
7429-90-5	ALUMINUM	16/16	6640	19300	MG/KG	NTC19SB06-SO-0001	---	9500	55000	N	NA	NA	NA	No
7440-36-0	ANTIMONY	1/13	1.2	1.2	MG/KG	NTC19SB17-SO-0002	---	4	0.66	N	0.27	NA	NA	Yes
7440-38-2	ARSENIC	16/16	5.2	32.2	MG/KG	NTC19SB10-SO-0002	---	13	0.0013	C	0.29	30	NA	Yes
7440-39-3	BARIUM	16/16	31.5	188	MG/KG	NTC19SB06-SO-0001	---	110	300	N	82	1800	NA	Yes
7440-41-7	BERYLLIUM	16/16	0.49	2	MG/KG	NTC19SB11-SO-0002	---	0.59	58	N	3.2	1000	NA	No
7440-43-9	CADMIUM	14/16	0.25	0.92 J	MG/KG	NTC19SB06-SO-0001	0.22 - 0.24	0.6	1.4	N	0.38	59	NA	Yes
7440-70-2	CALCIUM	16/16	5210 J	111000 J	MG/KG	NTC19SB07-SO-0001	---	9300	NA		NA	NA	NA	No
7440-47-3	CHROMIUM	16/16	13 J	32.6 J	MG/KG	NTC19SB17-SO-0002-D	---	16.2	NA	C	NA	32	NA	Yes
7440-48-4	COBALT	16/16	5	13.3	MG/KG	NTC19SB10-SO-0002	---	8.9	0.49	N	NA	NA	NA	Yes
7440-50-8	COPPER	16/16	17.5	53.6	MG/KG	NTC19SB17-SO-0002	---	19.6	51	N	46	330000	NA	Yes
7439-89-6	IRON	16/16	14600	36800	MG/KG	NTC19SB10-SO-0002	---	15900	640	N	NA	NA	NA	Yes
7439-92-1	LEAD	16/16	9.5 J	480 J	MG/KG	NTC19SB03-SO-0001	---	36	NA		14	107	NA	Yes
7439-95-4	MAGNESIUM	16/16	5270 J	62100	MG/KG	NTC19SB07-SO-0001	---	4820	NA		NA	NA	NA	No
7439-96-5	MANGANESE	16/16	336	1820 J	MG/KG	NTC19SB16-SO-0103	---	636	57	N	NA	NA	NA	Yes
7439-97-6	MERCURY	15/16	0.018	0.47	MG/KG	NTC19SB06-SO-0001	0.015	0.06	0.033	N	0.1	6.4	NA	Yes
7440-02-0	NICKEL	16/16	14	47.9 J	MG/KG	NTC19SB17-SO-0002-D	---	18	48	N	NA	700	NA	No
7440-09-7	POTASSIUM	16/16	1030	2720	MG/KG	NTC19SB11-SO-0002	---	1268	NA		NA	NA	NA	No
7440-22-4	SILVER	3/16	0.44	1	MG/KG	NTC19SB06-SO-0001	0.22 - 0.25	0.55	1.6	N	NA	39	NA	No
7440-23-5	SODIUM	4/16	239	565	MG/KG	NTC19SB11-SO-0002	220 - 256	130	NA		NA	NA	NA	No
7440-62-2	VANADIUM	16/16	16.4	37.1	MG/KG	NTC19SB06-SO-0001	---	25.2	180	N	180	980	NA	No
7440-66-6	ZINC	16/16	40	250 J	MG/KG	NTC19SB06-SO-0001	---	95	680	N	NA	16000	NA	No

Associated Samples:
NTC19SB01-SO-0002
NTC19SB03-SO-0001
NTC19SB03-SO-0103
NTC19SB06-SO-0001
NTC19SB11-SO-0002
NTC19SB12-SO-0002
NTC19SB13-SO-0103
NTC19SB15-SO-0103
NTC19SB07-SO-0001
NTC19SB08-SO-0103
NTC19SB09-SO-0002
NTC19SB10-SO-0002
NTC19SB16-SO-0103
NTC19SB16-SO-0103-D
NTC19SB17-SO-0002
NTC19SB17-SO-0002-D
NTC19SB19-SO-0002
NTC19SB20-SO-0002

Footnotes:
1 - Sample and duplicate are counted as two separate samples when determining minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - If the maximum concentration of a chemical is less than the Illinois EPA background concentration (illinois EPA, Appendix A, Table G of TACO), that chemical was not selected as a COPC.
5 - USEPA ORNL Soil Screening Level for the Potection of Groundwater (USEPA, 2008)
6 - Section 742 Table A, Tier 1 Soil Remediation Objectives for Residential Properties (online, 2009).
7 - Soil Remediation Objectives for Residential Properties, Non-TACO Chemicals (2007)
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria.

Definitions:
C = Carcinogen
COPC = Chemical of potentia
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not avail

TABLE 2.3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SUBSURFACE SOIL - DIRECT CONTACT AND INHALATION
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

CAS #	Parameter	Frequency of Detection	Minimum Result[1]	Maximum Result[1,2]	ORNL Residential Soil Criteria [5]		USEPA SSLs for Migration from Soil to Air - Residential[6a]	USEPA Industrial SSLs for Inhalation[6b]	SSLs for Inhalation Construction Worker Scenario[7]	TACO - Residential Soil Ingestion[8]	TACO - Residential Soil Inhalation[8]	TACO - Industrial - Commercial Inhalation [9]	TACO - Construction Worker Soil Inhalation[9]	Non-TACO - Residential Soil Ingestion[10]	Non-TACO - Residential Soil Inhalation[10]	Non-TACO - Industrial/Commercial/Soil Inhalation [11]	Non-TACO - Construction Worker Soil Inhalation[11]	COPC Flag	Rationale for Contaminant Deletion or Selection [12]
	Volatile Organics (µg/kg)																		
108-10-1	4-METHYL-2-PENTANONE (Methy	1/22	0.65	0.65	530000	N	NA	NA	1100000000	NA	NA	NA	NA	NA	310000	310000	34000	No	BSL
67-64-1	ACETONE	12/22	2.3 J	12	6100000	N	NA	NA	11000000000	7000000	100000000	100000000	100000000	NA	NA	NA	NA	No	BSL
75-69-4	TRICHLOROFLUOROMETHANE	1/22	3.9	3.9	79000	N	NA	NA	250000000	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
	Polynuclear Aromatic Hydrocarbons (µg/kg)																		
91-57-6	2-METHYLNAPHTHALENE	4/22	2.2	6.5	31000	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
208-96-8	ACENAPHTHYLENE[13]	1/22	1.7	1.7	340000	N	NA	NA	NA	NA	NA	NA	NA	230000	NA	NA	NA	No	BSL
120-12-7	ANTHRACENE	1/22	4.2	4.2	1700000	N	NA	NA	NA	2300000	NA	NA	NA	NA	NA	NA	NA	No	BSL
CALC055	BAP EQUIVALENTS	8/22	1.6637	26.7	15	C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
56-55-3	BENZO(A)ANTHRACENE	3/22	15	20	150	C	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	No	BSL
50-32-8	BENZO(A)PYRENE	6/22	7.1	22	15	C	NA	NA	230000	90	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	3/22	15	18	150	C	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	No	BSL
191-24-2	BENZO(G,H,I)PERYLENE	19/	2.2	11	170000	N	NA	NA	NA	230000	NA	NA	NA	230000	NA	NA	NA	No	
207-08-9	BENZO(K)FLUORANTHENE	3/22	4.5	8.3	1500	C	NA	NA	2300000	9000	NA	NA	NA	NA	NA	NA	NA	No	BSL
218-01-9	CHRYSENE	6/22	2.4	18	15000	C	NA	NA	23000000	880000	NA	NA	NA	NA	NA	NA	NA	No	BSL
206-44-0	FLUORANTHENE	5/22	3	28	230000	N	NA	NA	NA	310000	NA	NA	NA	NA	NA	NA	NA	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	3/22	6.5	7.4	150	C	NA	NA	2300000	900	NA	NA	NA	NA	NA	NA	NA	No	BSL
85-01-8	PHENANTHRENE[14]	/	2.4	17	170000	N	NA	NA	NA	230000	NA	NA	NA	230000	NA	NA	NA	No	
129-00-0	PYRENE	12/22	2	27	170000	N	NA	NA	NA	230000	NA	NA	NA	NA	NA	NA	NA	No	BSL
	Inorganics (mg/kg)																		
7429-90-5	ALUMINUM	22/22	4500	14700	7700	N	NA	NA	1800	NA	NA	NA	NA	7800	100000	100000	87000	Yes	ASL
7440-38-2	ARSENIC	22/22	4	25.1	0.39	C	770	1440	5.3	13	750	1200	25000	NA	NA	NA	NA	Yes	ASL
7440-39-3	BARIUM	22/22	10.9	81.9	1500	N	71000	100000	180	550	69000	91000	87000	NA	NA	NA	NA	No	BSL
7440-41-7	BERYLLIUM	22/22	0.36	0.94	16	N	1400	2600	7.1	16	1300	2100	44000	NA	NA	NA	NA	No	BSL
7440-43-9	CADMIUM	13/22	0.23 J	0.43 J	7	N	1800	3400	3.6	7.8	1800	2800	59000	NA	NA	NA	NA	No	BSL
7440-70-2	CALCIUM	22/22	2850 J	119000 J	NA	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
7440-47-3	CHROMIUM	22/22	9	25.8	0.29	N	280	510	3	23	270	420	69	NA	NA	NA	NA	Yes	ASL
7440-48-4	COBALT	22/22	5.2	22.1	2.3	N	NA	NA	2.1	470	NA	NA	NA	NA	NA	NA	NA	Yes	ASL
7440-50-8	COPPER	22/22	15.4	34.2	310	N	NA	NA	NA	290	NA	NA	NA	NA	NA	NA	NA	No	BSL
7439-89-6	IRON	22/22	12200	34900	5500	N	NA	NA	NA	NA	NA	NA	NA	5500	NA	NA	NA	Yes	ASL
7439-92-1	LEAD	22/22	8.1	54.8 J	400	N	NA	NA	NA	400	NA	NA	NA	NA	NA	NA	NA	No	BSL
7439-95-4	MAGNESIUM	22/22	6440 J	56300	NA	N	NA	NA	NA	325000	NA	NA	NA	NA	NA	NA	NA	No	BSL
7439-96-5	MANGANESE	22/22	421	1600	180	N	NA	NA	18	160	6900	9100	870	NA	NA	NA	NA	Yes	ASL
7439-97-6	MERCURY	13/22	0.013	0.049	0.56	N	1	1.4	10.7	2.3	1	1.6	NA[16]	NA	NA	NA	NA	No	BSL
7440-02-0	NICKEL[15]	22/22	14.9	48.8	150	N	14000	26000	32	160	13000	21000	440000	NA	NA	NA	NA	Yes[17]	BSL
7440-09-7	POTASSIUM	22/22	1210	2950 J	NA	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
7440-23-5	SODIUM	2/22	241	249	NA	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No	BSL
7440-62-2	VANADIUM	22/22	12.7	29.8	39	N	NA	NA	NA	55	NA	NA	NA	NA	NA	NA	NA	No	BSL
7440-66-6	ZINC	22/22	37.5	140 J	2300	N	NA	NA	NA	2300	NA	NA	NA	NA	NA	NA	NA	No	BSL

Associated Samples:

NTC19SB12-SO-0507
NTC19SB14-SO-0204
NTC19SB14-SO-0507
NTC19SB15-SO-0406
NTC19SB18-SO-0204
NTC19SB18-SO-0406
NTC19SB19-SO-0406
NTC19SB20-SO-0406
NTC19SB15-SO-0406-D
NTC19SB16-SO-0507
NTC19SB17-SO-0406
NTC19SB01-SO-0608
NTC19SB02-SO-0204
NTC19SB03-SO-0810
NTC19SB04-SO-0204
NTC19SB05-SO-0406
NTC19SB05-SO-0608
NTC19SB06-SO-0204
NTC19SB06-SO-0608
NTC19SB07-SO-0507
NTC19SB08-SO-0406
NTC19SB09-SO-0406
NTC19SB10-SO-0507

Footnotes:

1 - Sample and duplicate are counted as two separate samples when determining minimum and maximum detected concentrations.
2 - The maximum detected concentration is used for screening purposes.
3 - Values presented are sample-specific quantitation limits.
4 - If the maximum concentration of a chemical is less than the Illinois EPA background concentration (Illinois EPA, Appendix A, Table G of TACO), that chemical is not selected as a COPC.
5 - USEPA ORNL Screening Level. The non-carcinogenic values (denoted with a "N" flag) are the PRG divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag) (USEPA, 2008).
6a - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites; USEPA, OSWER 9355.4-24, December 2002. Appendix A – Exhibit A-1
6b - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites; USEPA, OSWER 9355.4-24, December 2002. Appendix A – Exhibit A-2
7 - Soil Screening Levels for Migration from Soil to Air for Construction Worker Scenario were calculated by Tetra Tech, NUS using methodology and equations presented in the Supplemental Guidanc
8 - Section 742 Table A, Tier 1 Soil Remediation Objectives for Residential Properties (Ingestion, Inhalation, or Soil Component of Groundwater Ingestion Route)(online , 2009).
9 - Section 742 Table B, Tier 1 Soil Remediation Objectives for Industrial/Commercial Properties (Ingestion or Inhalation) (online , 2009).
10 - Soil Remediation Objectives for Residential Properties, Non-TACO Chemicals (2007).
11 - Soil Remediation Objectives for Indusrial/Commercial Properties, Non-TACO Chemicals (2007).
12 -The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and background levels for metals.
13 - Acenaphthene is used as a surrogate for acenaphthylene.
14 - Pyrene is used as a surrogate for benzo(ghi)perylene and phenanthrene.
15 - Nickle criteria are based on nickle soluble salts
16 - TACO table footnote indicates that elemental Hg " Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern." Site 19 is a former gun range and elemental mercury is not a contaminant of concern at this site.
17 - COPC flag for construction worker inhalation scenario only
BAP equivalent criteria based on BaP
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:

C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable.

Rationale Codes:

For Selection as a COPC:
ASL = Above COPC screening level

For Elimination as a COPC:
BSL = Below COPC screening level
NUT = Essential nutrient

TABLE 2.4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SUBSURFACE SOIL - MIGRATION TO GROUNDWATER
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

CAS #	Parameter	Frequency of Detection	Minimum Result[1]	Maximum Result[1,2]	Units	Sample of Maximum Detect	Range of Non-detects[3]	Background Concentration[4]	ORNL Risk-Based Migration to GW SSL[5]		ORNL MCL Based Migration to GW SSL[5]	TACO - Residential Migration to Groundwater - Class 1[6]	NON-TACO - Residential Migration to Groundwater - Class 1[7]	Above SSL
	Volatile Organics (ug/kg)													
108-10-1	4-METHYL-2-PENTANONE	1/22	0.65	0.65	UG/KG	NTC19SB17-SO-0406	0.48 - 0.81	NA	440	N	NA	NA	NA	No
67-64-1	ACETONE	12/22	2.3 J	12	UG/KG	NTC19SB15-SO-0406-D	1.7 - 2.8	NA	4400	N	NA	25000	NA	No
75-69-4	TRICHLOROFLUOROMETHANE	1/22	3.9	3.9	UG/KG	NTC19SB07-SO-0507	0.78 - 1.3	NA	840	N	NA	NA	34000	No
	Polynuclear Aromatic Hydrocarbons (ug/kg)													
91-57-6	2-METHYLNAPHTHALENE	4/22	2.2	6.5	UG/KG	NTC19SB15-SO-0406-D	1.8 - 2.1	NA	900	N	NA	NA	NA	No
208-96-8	ACENAPHTHYLENE	1/22	1.7	1.7	UG/KG	NTC19SB04-SO-0204	1.2 - 1.4	NA	27000	N	NA	NA	85000	No
120-12-7	ANTHRACENE	1/22	4.2	4.2	UG/KG	NTC19SB18-SO-0204	0.88 - 0.99	NA	450000	N	NA	12000000	NA	No
CALC055	BAP EQUIVALENT-HALFND	8/22	1.6637	26.697	UG/KG	NTC19SB18-SO-0204	1.1 - 1.2	NA	4.6	C	310	8000	NA	Yes
56-55-3	BENZO(A)ANTHRACENE	3/22	15	20	UG/KG	NTC19SB06-SO-0204	1.5 - 1.7	NA	14	C	NA	2000	NA	Yes
50-32-8	BENZO(A)PYRENE	6/22	7.1	22	UG/KG	NTC19SB18-SO-0204	1.1 - 1.2	NA	4.6	C	310	8000	NA	Yes
205-99-2	BENZO(B)FLUORANTHENE	3/22	15	18	UG/KG	NTC19SB06-SO-0204	1.7 - 1.9	NA	47	C	NA	5000	NA	No
191-24-2	BENZO(G,H,I)PERYLENE	19/	2.2	11	UG/KG	NTC19SB06-SO-0204	1.7 - 1.8	NA	150000	N	NA	NA	27000000	No
207-08-9	BENZO(K)FLUORANTHENE	3/22	4.5	8.3	UG/KG	NTC19SB06-SO-0204	1.4 - 1.6	NA	460	C	NA	49000	NA	No
218-01-9	CHRYSENE	6/22	2.4	18	UG/KG	NTC19SB06-SO-0204	1.2 - 1.3	NA	1400	C	NA	160000	NA	No
206-44-0	FLUORANTHENE	5/22	3	28	UG/KG	NTC19SB04-SO-0204	1.8 - 2.1	NA	210000	N	NA	4300000	NA	No
193-39-5	INDENO(1,2,3-CD)PYRENE	3/22	6.5	7.4	UG/KG	NTC19SB18-SO-0204	1.7 - 1.9	NA	160	C	NA	69000	NA	No
85-01-8	PHENANTHRENE	/	2.4	17	UG/KG	NTC19SB18-SO-0204	1.8 - 2.1	NA	150000	N	NA	NA	200000	No
129-00-0	PYRENE	12/22	2	27	UG/KG	NTC19SB04-SO-0204	1.7 - 1.9	NA	150000	N	NA	4200000	NA	No
	Inorganics (mg/kg)													
7429-90-5	ALUMINUM	22/22	4500	14700	MG/KG	NTC19SB02-SO-0204	---	9500	55000	N	NA	NA	NA	No
7440-38-2	ARSENIC	22/22	4	25.1	MG/KG	NTC19SB05-SO-0406	---	13	0.0013	C	0.29	30	NA	Yes
7440-39-3	BARIUM	22/22	10.9	81.9	MG/KG	NTC19SB02-SO-0204	---	110	300	N	82	1800	NA	No
7440-41-7	BERYLLIUM	22/22	0.36	0.94	MG/KG	NTC19SB01-SO-0608	---	0.59	58	N	3.2	1000	NA	No
7440-43-9	CADMIUM	13/22	0.23 J	0.43 J	MG/KG	NTC19SB06-SO-0204	0.22 - 0.24	0.6	1.4	N	0.38	59	NA	Yes
7440-70-2	CALCIUM	22/22	2850 J	119000 J	MG/KG	NTC19SB12-SO-0507	---	9300	NA	N	NA	NA	NA	No
7440-47-3	CHROMIUM	22/22	9	25.8	MG/KG	NTC19SB02-SO-0204	---	16.2	NA	N	NA	32	NA	No
7440-48-4	COBALT	22/22	5.2	22.1	MG/KG	NTC19SB02-SO-0204	---	8.9	0.49	N	NA	NA	NA	Yes
7440-50-8	COPPER	22/22	15.4	34.2	MG/KG	NTC19SB02-SO-0204	---	19.6	51	N	46	330000	NA	No
7439-89-6	IRON	22/22	12200	34900	MG/KG	NTC19SB04-SO-0204	---	15900	640	N	NA	NA	NA	Yes
7439-92-1	LEAD	22/22	8.1	54.8 J	MG/KG	NTC19SB06-SO-0204	---	36	NA	N	14	107	NA	Yes
7439-95-4	MAGNESIUM	22/22	6440 J	56300	MG/KG	NTC19SB14-SO-0204	---	4820	NA	N	NA	NA	NA	No
7439-96-5	MANGANESE	22/22	421	1600	MG/KG	NTC19SB02-SO-0204	---	636	57	N	NA	NA	NA	Yes
7439-97-6	MERCURY	13/22	0.013	0.049	MG/KG	NTC19SB04-SO-0204	0.013 - 0.016	0.06	0.033	N	0.1	6.4	NA	Yes
7440-02-0	NICKEL	22/22	14.9	48.8	MG/KG	NTC19SB02-SO-0204	---	18	48	N	NA	700	NA	Yes
7440-09-7	POTASSIUM	22/22	1210	2950 J	MG/KG	NTC19SB02-SO-0204	---	1268	NA	N	NA	NA	NA	No
7440-23-5	SODIUM	2/22	241	249	MG/KG	NTC19SB17-SO-0406	216 - 249	130	NA	N	NA	NA	NA	No
7440-62-2	VANADIUM	22/22	12.7	29.8	MG/KG	NTC19SB06-SO-0204	---	25.2	180	N	180	980	NA	No
7440-66-6	ZINC	22/22	37.5	140 J	MG/KG	NTC19SB06-SO-0204	---	95	680	N	NA	16000	NA	No

Footnotes:
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - If the maximum concentration of a chemical is less than the Illinois EPA background concentration (Illinois EPA, Appendix A, Table G of TACO), that chemical was not selected as a COPC.
5 - USEPA ORNL Soil Screening Level for the Potection of Groundwater (USEPA, 2008)
6 - Section 742 Table A, Tier 1 Soil Remediation Objectives for Residential Properties (online, 2009).
7 - Soil Remediation Objectives for Residential Properties, Non-TACO Chemicals (2007)
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria.

Definitions:
C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not available.

Associated Samples:

NTC19SB12-SO-0507	NTC19SB19-SO-0406	NTC19SB01-SO-0608	NTC19SB06-SO-0204
NTC19SB14-SO-0204	NTC19SB20-SO-0406	NTC19SB02-SO-0204	NTC19SB06-SO-0608
NTC19SB14-SO-0507	NTC19SB15-SO-0406-AVG	NTC19SB03-SO-0810	NTC19SB07-SO-0507
NTC19SB15-SO-0406	NTC19SB15-SO-0406-D	NTC19SB04-SO-0204	NTC19SB08-SO-0406
NTC19SB18-SO-0204	NTC19SB16-SO-0507	NTC19SB05-SO-0406	NTC19SB09-SO-0406
NTC19SB18-SO-0406	NTC19SB17-SO-0406	NTC19SB05-SO-0608	NTC19SB10-SO-0507

TABLE 2.5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

CAS #	Parameter	Frequency of Detection	Minimum Result[1]	Maximum Result[1,2]	Units	Location of Maximum Concentration	Sample with Maximum Concentration	Range of Non-detects [3]	USEPA ORNL Residential Tap Water Criteria [4]		USEPA MCL [5]	TACO - Class I Groundwater Criteria [6]	Non-TACO - Class I Groundwater Criteria [7]	Concentration Used for Vapor Intrusion Screening [8]	COPC Flag	Rationale for Contaminant Deletion or Selection [9]
	Volatile Organics (µg/L)															
67-64-1	ACETONE	1/2	8.5	8.5	UG/L	NTC19MW02	NTC19MW021208	1.8 - 1.8	2200	N	NA	6300	NA	220000	No	BSL
108-88-3	TOLUENE	1/2	0.22	0.22	UG/L	NTC19MW02	NTC19MW021208	0.14 - 0.14	230	N	1000	1000	NA	1500	No	BSL
	Polynuclear Aromatic Hydrocarbons (µg/L)															
91-57-6	2-METHYLNAPHTHALENE	2/2	0.0093	0.017	UG/L	NTC19MW02	NTC19MW021208	---	15	N	NA	NA	28	NA	No	BSL
83-32-9	ACENAPHTHENE	1/2	0.02	0.02	UG/L	NTC19MW02	NTC19MW021208	0.0057 - 0.0058	220	N	NA	420	NA	NA	No	BSL
208-96-8	ACENAPHTHYLENE (10)	1/2	0.016	0.016	UG/L	NTC19MW02	NTC19MW021208	0.0047 - 0.0048	220	N	NA	NA	210	NA	No	BSL
120-12-7	ANTHRACENE	1/2	0.026	0.026	UG/L	NTC19MW02	NTC19MW021208	0.0094 - 0.0096	1100	N	NA	2100	NA	NA	No	BSL
CALC055	BAP EQUIVALENTS	1/2	0.037795	0.037795	UG/L	NTC19MW02	NTC19MW021208	0.0057 - 0.0058	0.0029	C	0.2	0.2	NA	NA	Yes	ASL
56-55-3	BENZO(A)ANTHRACENE	1/2	0.036 J	0.036 J	UG/L	NTC19MW02	NTC19MW021208	0.012 - 0.012	0.029	C	NA	0.13	NA	NA	Yes	ASL
50-32-8	BENZO(A)PYRENE	1/2	0.018	0.018	UG/L	NTC19MW02	NTC19MW021208	0.0057 - 0.0058	0.0029	C	0.2	0.2	NA	NA	Yes	ASL
205-99-2	BENZO(B)FLUORANTHENE	1/2	0.019	0.019	UG/L	NTC19MW02	NTC19MW021208	0.011 - 0.012	0.029	C	NA	0.18	NA	NA	No	BSL
191-24-2	BENZO(G,H,I)PERYLENE	1/2	0.013	0.013	UG/L	NTC19MW02	NTC19MW021208	0.0066 - 0.0067	110	N	NA	NA	210	NA	No	BSL
207-08-9	BENZO(K)FLUORANTHENE (11)	1/2	0.016	0.016	UG/L	NTC19MW02	NTC19MW021208	0.0085 - 0.0086	0.29	C	NA	0.17	NA	NA	No	BSL
218-01-9	CHRYSENE	1/2	0.035	0.035	UG/L	NTC19MW02	NTC19MW021208	0.01 - 0.01	2.9	C	NA	1.5	NA	NA	No	BSL
53-70-3	DIBENZO(A,H)ANTHRACENE	1/2	0.013	0.013	UG/L	NTC19MW02	NTC19MW021208	0.0047 - 0.0048	0.0029	C	NA	0.3	NA	NA	Yes	ASL
206-44-0	FLUORANTHENE	1/2	0.03	0.03	UG/L	NTC19MW02	NTC19MW021208	0.012 - 0.012	150	N	NA	280	NA	NA	No	BSL
86-73-7	FLUORENE	1/2	0.028	0.028	UG/L	NTC19MW02	NTC19MW021208	0.0066 - 0.0067	150	N	NA	280	NA	NA	No	BSL
193-39-5	INDENO(1,2,3-CD)PYRENE	1/2	0.011	0.011	UG/L	NTC19MW02	NTC19MW021208	0.0038 - 0.0038	0.029	C	NA	0.43	NA	NA	No	BSL
85-01-8	PHENANTHRENE (11)	2/2	0.0091	0.038	UG/L	NTC19MW02	NTC19MW021208	---	110	N	NA	NA	210	NA	No	BSL
129-00-0	PYRENE	1/2	0.03	0.03	UG/L	NTC19MW02	NTC19MW021208	0.012 - 0.012	110	N	NA	210	NA	NA	No	BSL
	Inorganics (µg/L)															
7429-90-5	ALUMINUM	2/2	134	272	UG/L	NTC19MW02	NTC19MW021208	---	3700	N	NA	NA	3500	NA	No	BSL
7440-38-2	ARSENIC	1/2	3.3	3.3	UG/L	NTC19MW01	NTC19MW011208-D	3 - 3	0.045	C	10	50	NA	NA	Yes	ASL
7440-39-3	BARIUM	2/2	51.8	167	UG/L	NTC19MW02	NTC19MW021208	---	730	N	2000	2000	NA	NA	No	BSL
7440-70-2	CALCIUM	2/2	88100 J	116000 J	UG/L	NTC19MW01	NTC19MW011208-D	---	NA		NA	NA	NA	NA	No	BSL
7439-89-6	IRON	2/2	182	489	UG/L	NTC19MW02	NTC19MW021208	---	2600	N	NA	NA	5000	NA	No	BSL
7439-95-4	MAGNESIUM	2/2	46200	48900	UG/L	NTC19MW01	NTC19MW011208-D	---	NA		NA	NA	NA	NA	No	BSL
7439-96-5	MANGANESE	2/2	35.8	39.6	UG/L	NTC19MW02	NTC19MW021208	---	88	N	NA	150	NA	NA	No	BSL
7440-09-7	POTASSIUM	2/2	7860	9120	UG/L	NTC19MW01	NTC19MW011208-D	---	NA		NA	NA	NA	NA	No	BSL
7440-23-5	SODIUM	2/2	36900	70300	UG/L	NTC19MW01	NTC19MW011208-D	---	NA		NA	NA	NA	NA	No	BSL
7440-66-6	ZINC	1/2	9.4	9.4	UG/L	NTC19MW02	NTC19MW021208	5 - 5	1100	N	NA	5000	NA	NA	No	BSL

Footnotes:
1 - Sample and duplicate are counted as two separate samples when determining minimum and maximum detected concentrations.
2 - The maximum detected concentration is used for screening purposes.
3 - Values presented are sample-specific quantitation limits.
4 - USEPA ORNL Tap Water Screening Level. The non-carcinogenic values (denoted with a "N" flag) are the PRG divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag) (USEPA, 2008).
5 - Federal Maximum Contaminant Level (USEPA, 2006).
6 - Illinois EPA Remediation Objectives for Class 1 Groundwater (online 2009).
7 - Groundwater Remediation Objectives for Chemicals Not Listed in TACO (Illinois EPA, May 1, 2007).
8 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (USEPA, 2002).
Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or hazard index =1 and an attenuation factor of 0.001.
9 -The chemical is selected as a COPC if the maximum detected concentration exceeds the drinking water or vapor intrusion screening level.
10 - Acenaphthene is used as a surrogate for acenaphthylene.
11 - Pyrene is used as a surrogate for benzo(ghi)perylene and phenanthrene.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
C = Carcinogen
COPC = Chemical of potential concern
J = Estimated value
N = Non-carcinogen
NA = Not applicable/not available.

Rationale Codes:
For Selection as a COPC:
ASL = Above COPC screening level

For Elimination as a COPC:
BSL = Below COPC screening level
NUT = Essential nutrient

Associated Samples:
NTC19MW011208
NTC19MW011208-D
NTC19MW021208

TABLE 3.1
EXPOSURE POINT CONCENTRATION SUMMARY - SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site

Chemical of Potential Concern	Units	Arithmetic Mean	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency Exposure	
						EPC Value	EPC Statistic	EPC Rationale	EPC Statistic	EPC Rationale
PAHs/Semivolatile Organic Compounds										
BAP EQUIVALENT	mg/kg	0.4	1.8		mg/kg	1	Adjusted Gamma 95% UCL	Pro-UCL(1)	Adjusted Gamma 95% UCL	Pro-UCL(1)
Inorganics										
ALUMINUM	mg/kg	12000	19300		mg/kg	13800	Student-t	Pro-UCL	Student-t	Pro-UCL
ARSENIC	mg/kg	11.5	32.2		mg/kg	14.4	Approximate Gamma 95% UCL	Pro-UCL	Approximate Gamma 95% UCL	Pro-UCL
CHROMIUM	mg/kg	20.3	32.6		mg/kg	22.2	Student-t	Pro-UCL	Student-t	Pro-UCL
COBALT	mg/kg	9.8	13.3		mg/kg	10.8	Student-t	Pro-UCL	Student-t	Pro-UCL
IRON	mg/kg	26800	36800		mg/kg	29600	Student-t	Pro-UCL	Student-t	Pro-UCL
LEAD	mg/kg	92.9	480	J	mg/kg	92.9	Arithmetic Mean	(2)	Arithmetic Mean	(2)
MANGANESE	mg/kg	889	1820	J	mg/kg	1050	Student-t	Pro-UCL	Student-t	Pro-UCL
MERCURY	mg/kg	0.091	0.47		mg/kg	0.15	H-UCL	Pro-UCL	H-UCL	Pro-UCL

Footnotes:

1. Exposure point concentration is the value recommended by USEPA's ProUCL.
2. Per IEUBK and Adult Lead Model guidance, the arithmetic average is used as the EPC for lead.

TABLE 3.2
EXPOSURE POINT CONCENTRATION SUMMARY - SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: SubSurface Soil
Exposure Point: Entire Site

Chemical of Potential Concern	Units	Arithmetic Mean	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency Exposure	
						EPC Value	EPC Statistic	EPC Rationale	EPC Statistic	EPC Rationale
PAHs/Semivolatile Organic Compounds										
BAP EQUIVALENT	mg/kg	0.005	0.03		mg/kg	0.02	95% Chebyshev(Mean, Std) UCL	Pro-UCL(1)	95% Chebyshev(Mean, Std) UCL	Pro-UCL(1)
Inorganics										
ALUMINUM	mg/kg	8310	14700		mg/kg	9460	Student-t	Pro-UCL	Student-t	Pro-UCL
ARSENIC	mg/kg	9.8	25.1		mg/kg	12	Student-t	Pro-UCL	Student-t	Pro-UCL
CHROMIUM	mg/kg	15.4	25.8		mg/kg	17.5	Approximate Gamma 95% UCL	Pro-UCL	Approximate Gamma 95% UCL	Pro-UCL
COBALT	mg/kg	9.5	22.1		mg/kg	11.1	Student-t	Pro-UCL	Student-t	Pro-UCL
IRON	mg/kg	21500	34900		mg/kg	23800	Approximate Gamma 95% UCL	Pro-UCL	Approximate Gamma 95% UCL	Pro-UCL
MANGANESE	mg/kg	736	1600		mg/kg	845	Approximate Gamma 95% UCL	Pro-UCL	Approximate Gamma 95% UCL	Pro-UCL

Footnotes:

1. Exposure point concentration is the value recommended by USEPA's ProUCL.

TABLE 3.3
EXPOSURE POINT CONCENTRATION SUMMARY - GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site

Chemical of Potential Concern	Units	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency Exposure	
					EPC Value	EPC Statistic	EPC Rationale	EPC Statistic	EPC Rationale
PAHs/Semivolatile Organic Compounds									
BAP EQUIVALENT	ug/L	0.038		ug/L	0.038	Maximum	(1)	Maximum	(1)
Inorganics									
ARSENIC	ug/L	3.3		ug/L	3.3	Maximum	(1)	Maximum	(1)

Footnotes:

1. Per USEPA and IL Guidance the maximum concentration used as the EPC for both RME and CTE scenarios.

TABLE 5.1

NON-CANCER TOXICITY DATA - ORAL/DERMAL
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source	Date
Semivolatile Organic Compounds										
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics										
ALUMINUM	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	CNS	100	NCEA	10/23/2006
ARSENIC	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	4/2009
BARIUM	Chronic	2.0E-01	mg/kg/day	0.07	1.4E-02	mg/kg/day	Kidney	3/1	IRIS	4/2009
CHROMIUM	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	Fetotoxicity, GS, Bone	300/3	IRIS	2/2/2009
COBALT	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Blood	NA	ORNL	9/12/2008
IRON	Chronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	GS	1.5	NCEA	9/11/2006
LEAD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	1/3	IRIS	4/2009
MERCURY(3)	Chronic	3.0E-04	mg/kg/day	0.07	2.1E-05	mg/kg/day	Autoimmune	1000/1	IRIS	2/2/2009

Notes:

1 - USEPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

3 - Values are for mercuric chloride.

Definitions:

CNS = Central nervous system

CVS = Cardiovascular system

GS = Gastrointestinal System

HEAST= Health Effects Assessment Summary Tables

IRIS = Integrated Risk Information System

NA = Not applicable

NCEA = USEPA National Center for Environmental Assessment

ORNL = Oak Ridge National Laboratory Regional Screening Level Tables, September 2008

TABLE 5.2

NON-CANCER TOXICITY DATA - INHALATION
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s)
Semivolatile Organic Compounds									
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics									
ALUMINUM	Chronic	5.0E-03	mg/m3	1.4E-03	(mg/kg/day)	CNS	300	NCEA	10/23/2006
ARSENIC	NA	3.00E-05	mg/m^3	8.6E-06	(mg/kg/day)	CNS, GI, heart	NA	CA EPA	2000
BARIUM	Chronic	5.0E-04	mg/m^3	1.4E-04	(mg/kg/day)	Fetus	1000/1	HEAST	7/1997
CHROMIUM	Chronic	1.0E-04	mg/m^3	NA	(mg/kg/day)	Respiratory	300/1	IRIS	4/2009
COBALT	Chronic	6.0E-06	mg/m^3	NA	(mg/kg/day)	Respiratory	NA	ORNL	9/12/2008
IRON	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	Chronic	3.00E-04	mg/m^3	8.6E-05	(mg/kg/day)	CNS	1000/1	IRIS	4/2009
MERCURY	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1 - Extrapolated RfD = RfC *$20m^3$/day / 70 kg

Definitions:

IRIS = Integrated Risk Information System

CNS = Central Nervous System

HEAST= Health Effects Assessment Summary Tables

NA = Not Applicable

NCEA = USEPA National Center for Environmental Assessment

ORNL = Oak Ridge National Laboratory Screening Level Tables, September 2008

TABLE 6.1

CANCER TOXICITY DATA - ORAL/DERMAL
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source	Date
Semivolatile Organic Compounds								
BENZO(A)ANTHRACENE	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
BENZO(A)PYRENE	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	4/2009
BENZO(B)FLUORANTHENE	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
DIBENZO(A,H)ANTHRACENE	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
INDENO(1,2,3-CD)PYRENE	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	USEPA(1)	7/1993
Inorganics								
ALUMINUM	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	4/2009
BARIUM	NA	NA	NA	NA	NA	D	IRIS	4/2009
CHROMIUM	NA	NA	NA	NA	NA	D/Not classifiable as to human carcinogenicity	IRIS	2/2/2009
COBALT	NA	NA	NA	NA	NA	NA	NA	NA
IRON								
LEAD	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	NA	NA	NA	NA	NA	D	IRIS	4/2009
MERCURY	NA	NA	NA	NA	NA	C/Possible Human Carcinogen	IRIS	4/2009

Notes:

1 - USEPA, 2004

2 - Adjusted dermal cancer slope factor = oral cancer slope factor/oral absorption efficiency for dermal

EPA Group:

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of non-carcinogenicity.

Definitions:

IRIS = Integrated Risk Information System.

NA = Not available.

NCEA = National Center for Environmental Assessment, value from ORNL Regional Screening Level tables.

USEPA(1) = USEPA, 1993d

TABLE 6.2

CANCER TOXICITY DATA - INHALATION
SITE 19 - SMALL ARMS RANGE 910
NAVAL STATION GREAT LAKES, ILLINOIS

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source	Date
Semivolatile Organic Compounds (2)							
BENZO(A)ANTHRACENE	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
BENZO(A)PYRENE	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
BENZO(B)FLUORANTHENE	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
DIBENZO(A,H)ANTHRACENE	1.2E-03	$(ug/m^3)^{-1}$	4.1E+00	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
INDENO(1,2,3-CD)PYRENE	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CAEPA	4/2009
Inorganics							
ALUMINUM	NA	NA	NA	NA	NA	NA	NA
ARSENIC	4.3E+00	$(mg/m^3)^{-1}$	NA	NA	A	IRIS	4/2009
BARIUM	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	1.2E-02	$(ug/m^3)^{-1}$	NA	NA	A/Known human carcinogen	IRIS	4/2009
COBALT	9.0E-03	$(ug/m^3)^{-1}$	NA	NA	NA	ORNL	9/12/2008
IRON	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	D	IRIS	4/2009
MANGANESE	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	C/Possible Human Carcinogen	IRIS	4/2009

1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

Definitions:

IRIS = Integrated Risk Information System.

HEAST= Health Effects Assessment Summary Tables

ORNL = Oak Ridge National Laboratory Regional Screening Level tables, September 2008

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of non-carcinogenicity.

TABLE 4.1

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Ingestion Intake (mg/kg/day) =
	IR	Ingestion Rate of Soil	mg/day	330	USEPA, December 2002	165	Professional Judgment	Csoil x IR x Fi x EF x ED x CF
	Fi	Fraction Ingested	unitless	1	USEPA, May 1993	1	USEPA, May 1993	BW x AT
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	U.S. EPA, December 1989
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	USEPA, December 1989	42	USEPA, December 1989	
Dermal	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Dermal Intake (mg/kg/day) =
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	Csoil x CF x SA x AF x ABS x EF x ED
	SA	Skin Surface Area	cm^2/day	3,300	USEPA, July 2004	3,300	USEPA, July 2004	BW x AT
	AF	Soil to Skin Adherence Factor	mg/cm^2	0.3	USEPA, July 2004	0.1	USEPA, July 2004	U.S. EPA, December 1989
	ABS	Dermal Absorption Factor (Solid)	unitless	chemical -specific	USEPA, July 2004	chemical -specific	USEPA, July 2004	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Daily Intake Calculations

Ingestion Intake = (IR x Fi x EF x ED x CF) / (BW x AT)
Dermal Intake = (CF x SA x AF x ABS x EF x ED) / (BW x AT)

Cancer Ingestion Intake - RME = 5.54E-09
Noncancer Ingestion Intake - RME = 3.37E-06

Cancer Ingestion Intake - CTE = 2.77E-09
Noncancer Ingestion Intake - CTE = 1.68E-06

Cancer Dermal Intake - RME = 1.66E-08
Noncancer Dermal Intake - RME = 1.01E-05

Cancer Dermal Intake - CTE = 5.54E-09
Noncancer Dermal Intake - CTE = 3.37E-06

TABLE 7.1 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF CONSTRUCTION WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	3.4E-06	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	4.6E-02	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	4.6E-02
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	4.8E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.6E-01
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	7.5E-05	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	2.5E-02
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	3.6E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.2E-01
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.0E-01	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	1.4E-01
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	3.5E-03	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	2.5E-02
	(total)												**5.2E-01**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	1.3E-06	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	4.4E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.5E-02
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**1.5E-02**
												Total Hazard Index Across All Exposure Routes/Pathways	**5.4E-01**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.1 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF CONSTRUCTION WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	5.5E-09	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	4.0E-08
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	7.6E-05	mg/kg-day		(mg/kg-day)$^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	8.0E-08	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	1.2E-07
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	1.2E-07	mg/kg-day		(mg/kg-day)$^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	6.0E-08	mg/kg-day		(mg/kg-day)$^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.6E-04	mg/kg-day		(mg/kg-day)$^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	5.8E-06	mg/kg-day		(mg/kg-day)$^{-1}$	
	(total)										**1.6E-07**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	2.2E-09	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	1.6E-08
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	7.2E-09	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	1.1E-08
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	(total)										**2.7E-08**
										Total Risk Across All Exposure Routes/Pathways	**1.9E-07**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 7.1a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF CONSTRUCTION WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	1.7E-06	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	2.3E-02	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	2.3E-02
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.4E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	8.1E-02
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	3.7E-05	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	1.2E-02
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	1.8E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	6.1E-02
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	5.0E-02	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	7.1E-02
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	1.8E-03	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	1.3E-02
	(total)												**2.6E-01**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	4.4E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.5E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	4.8E-03
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**4.8E-03**
												Total Hazard Index Across All Exposure Routes/Pathways	**2.7E-01**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.1a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF CONSTRUCTION WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	2.8E-09	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	2.0E-08
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	3.8E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	4.0E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	6.0E-08
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	6.1E-08	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	3.0E-08	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	8.2E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	2.9E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**8.0E-08**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	7.2E-10	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	5.3E-09
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.4E-09	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	3.6E-09
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**8.8E-09**
										Total Risk Across All Exposure Routes/Pathways	**8.9E-08**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 4.2

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF MAINTENANCE WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Maintenance Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Ingestion Intake (mg/kg/day) =
	IR	Ingestion Rate of Soil	mg/day	100	USEPA, May 1993	50	USEPA, May 1993	Csoil x IR x Fi x EF x ED x CF
	Fi	Fraction Ingested	unitless	1	USEPA, May 1993	1	USEPA, May 1993	BW x AT
	EF	Exposure Frequency	days/year	250	Professional Judgment	219	Professional Judgment	U.S. EPA, December 1989
	ED	Exposure Duration	years	25	USEPA, May 1993	9	USEPA, May 1993	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	USEPA, December 1989	3,285	USEPA, December 1989	
Dermal	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Dermal Intake (mg/kg/day) =
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	Csoil x CF x SA x AF x ABS x EF x ED
	SA	Skin Surface Area	cm^2/day	3,300	USEPA, July 2004	3,300	USEPA, July 2004	BW x AT
	AF	Soil to Skin Adherence Factor	mg/cm^2	0.2	USEPA, July 2004	0.02	USEPA, July 2004	U.S. EPA, December 1989
	ABS	Dermal Absorption Factor (Solid)	unitless	chemical specific	USEPA, July 2004	chemical specific	USEPA, July 2004	
	EF	Exposure Frequency	days/year	250	Professional Judgment	219	Professional Judgment	
	ED	Exposure Duration	years	25	USEPA, May 1993	9	USEPA, May 1993	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	USEPA, December 1989	3,285	USEPA, December 1989	

Daily Intake Calculations

Ingestion Intake = (IR x Fi x EF x ED x CF) / (BW x AT)
Dermal Intake = (CF x SA x AF x ABS x EF x ED) / (BW x AT)

Cancer Ingestion Intake - RME = 3.49E-07
Noncancer Ingestion Intake - RME = 9.78E-07

Cancer Ingestion Intake - CTE = 5.51E-08
Noncancer Ingestion Intake - CTE = 4.29E-07

Cancer Dermal Intake - RME = 2.31E-06
Noncancer Dermal Intake - RME = 6.46E-06

Cancer Dermal Intake - CTE = 7.27E-08
Noncancer Dermal Intake - CTE = 5.66E-07

TABLE 7.2 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF MAINTENANCE WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Maintenance Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	9.8E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	1.4E-02	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	1.4E-02
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.4E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	4.7E-02
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	2.2E-05	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	7.2E-03
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	1.1E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	3.5E-02
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	2.9E-02	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	4.1E-02
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	1.0E-03	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	7.3E-03
	(total)												**1.5E-01**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	8.4E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.8E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	9.3E-03
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**9.3E-03**
												Total Hazard Index Across All Exposure Routes/Pathways	**1.6E-01**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.2 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF MAINTENANCE WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Maintenance Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	3.5E-07	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	2.6E-06
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	4.8E-03	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	5.0E-06	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	7.5E-06
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	7.8E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	3.8E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.0E-02	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	3.7E-04	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.0E-05**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	3.0E-07	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	2.2E-06
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.0E-06	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.5E-06
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**3.7E-06**
										Total Risk Across All Exposure Routes/Pathways	**1.4E-05**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 7.2a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF MAINTENANCE WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Maintenance Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	4.3E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	5.9E-03	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	5.9E-03
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	6.2E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	2.1E-02
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	9.5E-06	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	3.2E-03
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	4.6E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.5E-02
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.3E-02	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	1.8E-02
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	4.5E-04	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	3.2E-03
	(total)												**6.6E-02**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	7.4E-08	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.4E-07	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	8.1E-04
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**8.1E-04**
												Total Hazard Index Across All Exposure Routes/Pathways	**6.7E-02**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.2a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF MAINTENANCE WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Maintenance Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	5.5E-08	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	4.0E-07
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	7.6E-04	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	7.9E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.2E-06
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	1.2E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	6.0E-07	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.6E-03	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	5.8E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.6E-06**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	9.5E-09	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	6.9E-08
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	3.1E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	4.7E-08
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.2E-07**
										Total Risk Across All Exposure Routes/Pathways	**1.7E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 4.3

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF OCCUPATIONAL WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Occupational Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Ingestion Intake (mg/kg/day) =
	IR	Ingestion Rate of Soil	mg/day	100	USEPA, May 1993	50	USEPA, May 1993	Csoil x IR x Fi x EF x ED x CF
	Fi	Fraction Ingested	unitless	1	USEPA, May 1993	1	USEPA, May 1993	BW x AT
	EF	Exposure Frequency	days/year	250	USEPA, May 1993	219	USEPA, May 1993	U.S. EPA, December 1989
	ED	Exposure Duration	years	25	USEPA, May 1993	9	USEPA, May 1993	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	USEPA, December 1989	3,285	USEPA, December 1989	
Dermal	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Dermal Intake (mg/kg/day) =
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	Csoil x CF x SA x AF x ABS x EF x ED
	SA	Skin Surface Area	cm^2/day	3,300	USEPA, July 2004	3,300	USEPA, July 2004	BW x AT
	AF	Soil to Skin Adherence Factor	mg/cm^2	0.2	USEPA, July 2004	0.02	USEPA, July 2004	U.S. EPA, December 1989
	ABS	Dermal Absorption Factor (Solid)	unitless	chemical specific	USEPA, July 2004	chemical specific	USEPA, July 2004	
	EF	Exposure Frequency	days/year	250	USEPA, May 1993	219	USEPA, May 1993	
	ED	Exposure Duration	years	25	USEPA, May 1993	9	USEPA, May 1993	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	USEPA, December 1989	3,285	USEPA, December 1989	

Daily Intake Calculations

Ingestion Intake = (IR x Fi x EF x ED x CF) / (BW x AT)
Dermal Intake = (CF x SA x AF x ABS x EF x ED) / (BW x AT)

Cancer Ingestion Intake - RME = 3.49E-07
Noncancer Ingestion Intake - RME = 9.78E-07

Cancer Ingestion Intake - CTE = 5.51E-08
Noncancer Ingestion Intake - CTE = 4.29E-07

Cancer Dermal Intake - RME = 2.31E-06
Noncancer Dermal Intake - RME = 6.46E-06

Cancer Dermal Intake - CTE = 7.27E-08
Noncancer Dermal Intake - CTE = 5.66E-07

TABLE 7.3 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF OCCUPATIONAL WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Occupational Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	9.8E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	1.4E-02	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	1.4E-02
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.4E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	4.7E-02
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	2.2E-05	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	7.2E-03
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	1.1E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	3.5E-02
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	2.9E-02	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	4.1E-02
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	1.0E-03	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	7.3E-03
	(total)												**1.5E-01**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	8.4E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.8E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	9.3E-03
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												***9.3E-03***

Total Hazard Index Across All Exposure Routes/Pathways **1.6E-01**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.3 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF OCCUPATIONAL WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Occupational Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	3.5E-07	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	2.6E-06
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	4.8E-03	mg/kg-day		(mg/kg-day)$^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	5.0E-06	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	7.5E-06
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	7.8E-06	mg/kg-day		(mg/kg-day)$^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	3.8E-06	mg/kg-day		(mg/kg-day)$^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.0E-02	mg/kg-day		(mg/kg-day)$^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	3.7E-04	mg/kg-day		(mg/kg-day)$^{-1}$	
	(total)										**1.0E-05**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	3.0E-07	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	2.2E-06
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.0E-06	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	1.5E-06
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	(total)										**3.7E-06**
										Total Risk Across All Exposure Routes/Pathways	**1.4E-05**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 7.3a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF OCCUPATIONAL WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Occupational Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	4.3E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	5.9E-03	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	5.9E-03
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	6.2E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	2.1E-02
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	9.5E-06	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	3.2E-03
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	4.6E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.5E-02
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.3E-02	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	1.8E-02
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	4.5E-04	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	3.2E-03
	(total)												**6.6E-02**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	7.4E-08	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.4E-07	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	8.1E-04
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**8.1E-04**
												Total Hazard Index Across All Exposure Routes/Pathways	**6.7E-02**

(1) *Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.*

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.3a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF OCCUPATIONAL WORKERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Occupational Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	5.5E-08	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	4.0E-07
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	7.6E-04	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	7.9E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.2E-06
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	1.2E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	6.0E-07	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.6E-03	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	5.8E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.6E-06**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	9.5E-09	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	6.9E-08
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	3.1E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	4.7E-08
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.2E-07**
										Total Risk Across All Exposure Routes/Pathways	**1.7E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 4.4

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF ADOLESCENT TRESPASSERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Trespasser
Receptor Age: Adolescent (7 - 16 years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Ingestion Intake (mg/kg/day) =
	IR	Ingestion Rate of Soil	mg/day	100	USEPA, May 1993	50	Professional Judgement	Csoil x IR x Fi x EF x ED x CF
	Fi	Fraction Ingested	unitless	1	USEPA, May 1993	1	USEPA, May 1993	BW x AT
	EF	Exposure Frequency	days/year	26	Professional Judgement	13	Professional Judgement	U.S. EPA, December 1989
	ED	Exposure Duration	years	10	Adolescent, Age 7 - 16	10	Adolescent, Age 7 - 16	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	42	USEPA, August 1997	42	USEPA, August 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	USEPA, December 1989	3,650	USEPA, December 1989	
Dermal	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Dermal Intake (mg/kg/day) =
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	Csoil x CF x SA x AF x ABS x EF x ED
	SA	Skin Surface Area	cm^2/day	3,280	USEPA, August 1997	3,100	USEPA, August 1997	BW x AT
	AF	Soil to Skin Adherence Factor	mg/cm^2	0.2	USEPA, July 2004	0.04	USEPA, July 2004	U.S. EPA, December 1989
	ABS	Dermal Absorption Factor (Solid)	unitless	chemical specific	USEPA, July 2004	chemical specific	USEPA, July 2004	
	EF	Exposure Frequency	days/year	26	Professional Judgement	13	Professional Judgement	
	ED	Exposure Duration	years	10	Adolescent, Age 7 - 16	10	Adolescent, Age 7 - 16	
	BW	Body Weight	kg	42	USEPA, August 1997	42	USEPA, August 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	USEPA, December 1989	3,650	USEPA, December 1989	

Daily Intake Calculations

Ingestion Intake = (IR x Fi x EF x ED x CF) / (BW x AT)
Dermal Intake = (CF x SA x AF x ABS x EF x ED) / (BW x AT)

Cancer Ingestion Intake - RME = 2.42E-08
Noncancer Ingestion Intake - RME = 1.70E-07

Cancer Ingestion Intake - CTE = 6.06E-09
Noncancer Ingestion Intake - CTE = 4.24E-08

Cancer Dermal Intake - RME = 1.59E-07
Noncancer Dermal Intake - RME = 1.11E-06

Cancer Dermal Intake - CTE = 1.50E-08
Noncancer Dermal Intake - CTE = 1.05E-07

TABLE 7.4 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF ADOLESCENT TRESPASSERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Trespasser
Receptor Age: Adolescent (7 - 16 years)

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	1.7E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	2.3E-03	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	2.3E-03
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.4E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	8.1E-03
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	3.8E-06	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	1.3E-03
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	1.8E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	6.1E-03
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	5.0E-03	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	7.2E-03
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	1.8E-04	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	1.3E-03
	(total)												**2.6E-02**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	1.4E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	4.8E-07	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.6E-03
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**1.6E-03**
												Total Hazard Index Across All Exposure Routes/Pathways	**2.8E-02**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.4 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF ADOLESCENT TRESPASSERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Trespasser
Receptor Age: Adolescent (7 - 16 years)

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	7.3E-08	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	5.3E-07
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	3.3E-04	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	3.5E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	5.2E-07
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	5.4E-07	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	2.6E-07	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	7.2E-04	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	2.5E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.1E-06**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	6.2E-08	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	4.5E-07
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	6.9E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.0E-07
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**5.6E-07**
										Total Risk Across All Exposure Routes/Pathways	**1.6E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 7.4a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF ADOLESCENT TRESPASSERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Trespasser
Receptor Age: Adolescent (7 - 16 years)

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	4.2E-08	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	5.9E-04	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	5.9E-04
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	6.1E-07	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	2.0E-03
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	9.4E-07	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	3.1E-04
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	4.6E-07	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.5E-03
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.3E-03	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	1.8E-03
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	4.5E-05	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	3.2E-04
	(total)												**6.6E-03**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	1.4E-08	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	4.5E-08	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.5E-04
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**1.5E-04**
												Total Hazard Index Across All Exposure Routes/Pathways	**6.7E-03**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.4a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF ADOLESCENT TRESPASSERS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Trespasser
Receptor Age: Adolescent (7 - 16 years)

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	6.1E-09	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	4.4E-08
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	8.4E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	8.7E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.3E-07
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	1.3E-07	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	6.5E-08	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.8E-04	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	6.4E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.8E-07**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	2.0E-09	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1.4E-08
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	6.5E-09	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	9.7E-09
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**2.4E-08**
										Total Risk Across All Exposure Routes/Pathways	**2.0E-07**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 4.5

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF FUTURE CHILD RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Ingestion Intake (mg/kg/day) =
	IR	Ingestion Rate of Soil	mg/day	200	USEPA, May 1993	100	USEPA, May 1993	Csoil x IR x Fi x EF x ED x CF
	Fi	Fraction Ingested	unitless	1	USEPA, May 1993	1	USEPA, May 1993	BW x AT
	EF	Exposure Frequency	days/year	350	USEPA, May 1993	234	USEPA, May 1993	U.S. EPA, December 1989
	ED	Exposure Duration (Age 0-2) - RME	years	2	USEPA, May 1993, 2005)	2	USEPA, May 1993	
	ED	Exposure Duration (Age 3-6) - RME	years	4	USEPA, May 1993, 2005)	NA	NA	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	15	USEPA, May 1993	15	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, December 1989	730	USEPA, December 1989	
Dermal	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Dermal Intake (mg/kg/day) =
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	Csoil x CF x SA x AF x ABS x EF x ED
	SA	Skin Surface Area	cm^2/day	2,800	USEPA, July 2004	2,800	USEPA, July 2004	BW x AT
	AF	Soil to Skin Adherence Factor	mg/cm^2	0.2	USEPA, July 2004	0.04	USEPA, July 2004	U.S. EPA, December 1989
	ABS	Dermal Absorption Factor (Solid)	unitless	chemical specific	USEPA, July 2004	chemical specific	USEPA, July 2004	
	EF	Exposure Frequency	days/year	350	USEPA, May 1993	234	USEPA, May 1993	
	ED	Exposure Duration (Age 0-2) - RME	years	2	USEPA, May 1993, 2005)	2	USEPA, May 1993	
	ED	Exposure Duration (Age 3-6) - RME	years	4	USEPA, May 1993, 2005)	NA	NA	
	BW	Body Weight	kg	15	USEPA, May 1993	15	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, December 1989	730	USEPA, December 1989	

Unit Intake Calculations

Ingestion Intake = (IR x Fi x EF x ED x CF) / (BW x AT)
Dermal Intake = (CF x SA x AF x ABS x EF x ED) / (BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Ages 6-30) - RME = 1.10E-06
Cancer Dermal Intake (Ages 6-30) - RME = 3.07E-06

Cancer Ingestion Intake - CTE = 1.22E-07
Cancer Dermal Intake - CTE = 1.37E-07

Mutagenic Chemicals

Cancer Ingestion Intake (Ages 0-2) - RME = 3.65E-07
Cancer Ingestion Intake (Ages 3-6) - RME = 7.31E-07
Cancer Dermal Intake (Ages 0-2) - RME = 1.02E-06
Cancer Dermal Intake (Ages 3-6) - RME = 2.05E-06

Non-carcinogenic Chemicals

Noncancer Ingestion Intake - RME = 1.28E-05
Noncancer Dermal Intake - RME = 3.58E-05

Noncancer Ingestion Intake - CTE = 4.27E-06
Noncancer Dermal Intake - CTE = 4.79E-06

TABLE 7.5 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF FUTURE CHILD RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	1.3E-05	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	1.8E-01	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	1.8E-01
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.8E-04	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	6.1E-01
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	2.8E-04	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	9.5E-02
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	1.4E-04	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	4.6E-01
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	3.8E-01	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	5.4E-01
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	1.3E-02	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	9.6E-02
	(total)												**2.0E+00**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	4.7E-06	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.5E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	5.2E-02
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**5.2E-02**
												Total Hazard Index Across All Exposure Routes/Pathways	**2.0E+00**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

PAHs - 0.13 Arsenic - 0.03

Other Metals - not evaluated for dermal contact with soil.

TABLE 8.5 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF FUTURE CHILD RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	5.8E-06	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	4.3E-05
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	1.5E-02	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.6E-05	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	2.4E-05
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	2.4E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	1.2E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	3.2E-02	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	1.2E-03	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**6.6E-05**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	2.1E-06	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1.6E-05
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.3E-06	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	2.0E-06
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.8E-05**
										Total Risk Across All Exposure Routes/Pathways	**8.4E-05**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

PAHs - 0.13 Arsenic - 0.03

Other Metals - not evaluated for dermal contact with soil.

TABLE 7.5a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF FUTURE CHILD RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	4.3E-06	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	5.9E-02	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	5.9E-02
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	6.2E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	2.1E-01
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	9.5E-05	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	3.2E-02
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	4.6E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.5E-01
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.3E-01	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	1.8E-01
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	4.5E-03	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	3.2E-02
	(total)												**6.6E-01**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	6.2E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.1E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	6.9E-03
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**6.9E-03**
												Total Hazard Index Across All Exposure Routes/Pathways	**6.7E-01**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

PAHs - 0.13 Arsenic - 0.03

Other Metals - not evaluated for dermal contact with soil.

TABLE 8.5a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF FUTURE CHILD RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	1.2E-07	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	8.9E-07
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	1.7E-03	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	1.8E-06	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	2.6E-06
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	2.7E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	1.3E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	3.6E-03	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	1.3E-04	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**3.5E-06**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	1.8E-08	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1.3E-07
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	5.9E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	8.9E-08
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**2.2E-07**
										Total Risk Across All Exposure Routes/Pathways	**3.7E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

PAHs - 0.13 Arsenic - 0.03

Other Metals - not evaluated for dermal contact with soil.

TABLE 4.6

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF FUTURE ADULT RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Ingestion Intake (mg/kg/day) =
	IR	Ingestion Rate of Soil	mg/day	100	USEPA, May 1993	50	USEPA, May 1993	Csoil x IR x Fi x EF x ED x CF
	Fi	Fraction Ingested	unitless	1	USEPA, May 1993	1	USEPA, May 1993	BW x AT
	EF	Exposure Frequency	days/year	350	USEPA, May 1993	234	USEPA, May 1993	U.S. EPA, December 1989
	ED	Exposure Duration (Age 6-16) - RME	years	10	USEPA, May 1993, 2005	7	USEPA, May 1993	
	ED	Exposure Duration (Age 17-30) - RME	years	14	USEPA, May 1993, 2005	NA	NA	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, December 1989	2,555	USEPA, December 1989	
Dermal	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Dermal Intake (mg/kg/day) =
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	Csoil x CF x SA x AF x ABS x EF x ED
	SA	Skin Surface Area	cm^2/day	5,700	USEPA, July 2004	5,700	USEPA, July 2004	BW x AT
	AF	Soil to Skin Adherence Factor	mg/cm^2	0.07	USEPA, July 2004	0.01	USEPA, July 2004	U.S. EPA, December 1989
	ABS	Dermal Absorption Factor (Solid)	unitless	chemical specific	USEPA, July 2004	chemical specific	USEPA, July 2004	
	EF	Exposure Frequency	days/year	350	USEPA, May 1993	234	USEPA, May 1993	
	ED	Exposure Duration (Age 6-16) - RME	years	10	USEPA, May 1993, 2005	7	USEPA, May 1993	
	ED	Exposure Duration (Age 17-30) - RME	years	14	USEPA, May 1993, 2005	NA	NA	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, December 1989	2,555	USEPA, December 1989	

Unit Intake Calculations

Ingestion Intake = (IR x Fi x EF x ED x CF) / (BW x AT)
Dermal Intake = (CF x SA x AF x ABS x EF x ED) / (BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Ages 6-30) - RME = 4.70E-07
Cancer Dermal Intake (Ages 6-30) - RME = 1.87E-06

Cancer Ingestion Intake - CTE = 4.58E-08
Cancer Dermal Intake - CTE = 5.22E-08

Mutagenic Chemicals

Cancer Ingestion Intake (Ages 6-16) - RME = 1.96E-07
Cancer Ingestion Intake (Ages 17-30) - RME = 2.74E-07
Cancer Dermal Intake (Ages 6-16) - RME = 7.81E-07
Cancer Dermal Intake (Ages 17-30) - RME = 1.09E-06

Non-carcinogenic Chemicals

Noncancer Ingestion Intake - RME = 1.37E-06
Noncancer Dermal Intake - RME = 5.47E-06

Noncancer Ingestion Intake - CTE = 4.58E-07
Noncancer Dermal Intake - CTE = 5.22E-07

TABLE 7.6 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF FUTURE ADULT RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	1.4E-06	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	1.9E-02	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	1.9E-02
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.0E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	6.6E-02
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	3.0E-05	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	1.0E-02
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	1.5E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	4.9E-02
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	4.1E-02	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	5.8E-02
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	1.4E-03	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	1.0E-02
	(total)												**2.1E-01**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	7.1E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.4E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	7.9E-03
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**7.9E-03**
												Total Hazard Index Across All Exposure Routes/Pathways	**2.2E-01**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

PAHs - 0.13 Arsenic - 0.03

Other Metals - not evaluated for dermal contact with soil.

TABLE 8.6 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF FUTURE ADULT RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	8.6E-07	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	6.3E-06
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	6.5E-03	mg/kg-day		(mg/kg-day)$^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	6.8E-06	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	1.0E-05
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	1.0E-05	mg/kg-day		(mg/kg-day)$^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	5.1E-06	mg/kg-day		(mg/kg-day)$^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.4E-02	mg/kg-day		(mg/kg-day)$^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	4.9E-04	mg/kg-day		(mg/kg-day)$^{-1}$	
	(total)										**1.6E-05**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	4.5E-07	mg/kg-day	7.3E+00	(mg/kg-day)$^{-1}$	3.3E-06
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	8.1E-07	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	1.2E-06
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		(mg/kg-day)$^{-1}$	
	(total)										**4.5E-06**
										Total Risk Across All Exposure Routes/Pathways	**2.1E-05**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

PAHs - 0.13 Arsenic - 0.03

Other Metals - not evaluated for dermal contact with soil.

TABLE 7.6a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF FUTURE ADULT RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	4.6E-07	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	6.3E-03	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	6.3E-03
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	6.6E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	2.2E-02
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	1.0E-05	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	3.4E-03
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	4.9E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.6E-02
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.4E-02	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	1.9E-02
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	4.8E-04	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	3.4E-03
	(total)												**7.1E-02**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	6.8E-08	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.3E-07	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	7.5E-04
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**7.5E-04**
												Total Hazard Index Across All Exposure Routes/Pathways	**7.2E-02**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

PAHs - 0.13 Arsenic - 0.03

Other Metals - not evaluated for dermal contact with soil.

TABLE 8.6a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF FUTURE ADULT RESIDENTS TO SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	4.6E-08	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	3.3E-07
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M	6.3E-04	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	6.6E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	9.9E-07
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M	1.0E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M	4.9E-07	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M	1.4E-03	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M	4.8E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.3E-06**
Dermal	BAP EQUIVALENT (1/2 DL)	1.0E+00	mg/kg	1.00E+00	mg/kg	M	6.8E-09	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	5.0E-08
	ALUMINUM	1.4E+04	mg/kg	1.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.4E+01	mg/kg	1.44E+01	mg/kg	M	2.3E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	3.4E-08
	CHROMIUM	2.2E+01	mg/kg	2.22E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.08E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	3.0E+04	mg/kg	2.96E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	1.1E+03	mg/kg	1.05E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**8.3E-08**
										Total Risk Across All Exposure Routes/Pathways	**1.4E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

PAHs - 0.13 Arsenic - 0.03

Other Metals - not evaluated for dermal contact with soil.

TABLE 4.7

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS TO SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Subsurface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Ingestion Intake (mg/kg/day) =
	IR	Ingestion Rate of Soil	mg/day	330	USEPA, December 2002	165	Professional Judgment	Csoil x IR x Fi x EF x ED x CF
	Fi	Fraction Ingested	unitless	1	USEPA, May 1993	1	USEPA, May 1993	BW x AT
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	U.S. EPA, December 1989
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	USEPA, December 1989	42	USEPA, December 1989	
Dermal	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	USEPA, December 2002	95% UCL or Max	USEPA, December 2002	Dermal Intake (mg/kg/day) =
	CF	Conversion Factor	kg/mg	1.0E-06	USEPA, December 1989	1.0E-06	USEPA, December 1989	Csoil x CF x SA x AF x ABS x EF x ED
	SA	Skin Surface Area	cm^2/day	3,300	USEPA, July 2004	3,300	USEPA, July 2004	BW x AT
	AF	Soil to Skin Adherence Factor	mg/cm^2	0.3	USEPA, July 2004	0.1	USEPA, July 2004	U.S. EPA, December 1989
	ABS	Dermal Absorption Factor (Solid)	unitless	chemical -specific	USEPA, July 2004	chemical -specific	USEPA, July 2004	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	BW	Body Weight	kg	70	USEPA, May 1993	70	USEPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Daily Intake Calculations

Ingestion Intake = (IR x Fi x EF x ED x CF) / (BW x AT)
Dermal Intake = (CF x SA x AF x ABS x EF x ED) / (BW x AT)

Cancer Ingestion Intake - RME = 5.54E-09
Noncancer Ingestion Intake - RME = 3.37E-06

Cancer Ingestion Intake - CTE = 2.77E-09
Noncancer Ingestion Intake - CTE = 1.68E-06

Cancer Dermal Intake - RME = 1.66E-08
Noncancer Dermal Intake - RME = 1.01E-05

Cancer Dermal Intake - CTE = 5.54E-09
Noncancer Dermal Intake - CTE = 3.37E-06

TABLE 7.7 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF CONSTRUCTION WORKERS TO SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Subsurface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	2.0E-02	mg/kg	2.00E-02	mg/kg	M	6.7E-08	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	9.5E+03	mg/kg	9.46E+03	mg/kg	M	3.2E-02	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	3.2E-02
	ARSENIC	1.2E+01	mg/kg	1.20E+01	mg/kg	M	4.0E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.3E-01
	CHROMIUM	1.8E+01	mg/kg	1.75E+01	mg/kg	M	5.9E-05	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	2.0E-02
	COBALT	1.1E+01	mg/kg	1.11E+01	mg/kg	M	3.7E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.2E-01
	IRON	2.4E+04	mg/kg	2.38E+04	mg/kg	M	8.0E-02	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	1.1E-01
	MANGANESE	8.5E+02	mg/kg	8.45E+02	mg/kg	M	2.8E-03	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	2.0E-02
	(total)												**4.5E-01**
Dermal	BAP EQUIVALENT (1/2 DL)	2.0E-02	mg/kg	2.00E-02	mg/kg	M	2.6E-08	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	9.5E+03	mg/kg	9.46E+03	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.2E+01	mg/kg	1.20E+01	mg/kg	M	3.6E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	1.2E-02
	CHROMIUM	1.8E+01	mg/kg	1.75E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.11E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	2.4E+04	mg/kg	2.38E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	8.5E+02	mg/kg	8.45E+02	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**1.2E-02**
												Total Hazard Index Across All Exposure Routes/Pathways	**4.6E-01**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.7 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF CONSTRUCTION WORKERS TO SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Subsurface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	2.0E-02	mg/kg	2.00E-02	mg/kg	M	1.1E-10	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	8.1E-10
	ALUMINUM	9.5E+03	mg/kg	9.46E+03	mg/kg	M	5.2E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.2E+01	mg/kg	1.20E+01	mg/kg	M	6.6E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.0E-07
	CHROMIUM	1.8E+01	mg/kg	1.75E+01	mg/kg	M	9.7E-08	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.11E+01	mg/kg	M	6.1E-08	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	2.4E+04	mg/kg	2.38E+04	mg/kg	M	1.3E-04	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	8.5E+02	mg/kg	8.45E+02	mg/kg	M	4.7E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**1.0E-07**
Dermal	BAP EQUIVALENT (1/2 DL)	2.0E-02	mg/kg	2.00E-02	mg/kg	M	4.3E-11	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	3.2E-10
	ALUMINUM	9.5E+03	mg/kg	9.46E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.2E+01	mg/kg	1.20E+01	mg/kg	M	6.0E-09	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	9.0E-09
	CHROMIUM	1.8E+01	mg/kg	1.75E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.11E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	2.4E+04	mg/kg	2.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	8.5E+02	mg/kg	8.45E+02	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**9.3E-09**
										Total Risk Across All Exposure Routes/Pathways	**1.1E-07**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 7.7a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF CONSTRUCTION WORKERS TO SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Subsurface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL)	2.0E-02	mg/kg	2.00E-02	mg/kg	M	3.4E-08	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	9.5E+03	mg/kg	9.46E+03	mg/kg	M	1.6E-02	mg/kg-day	1.0E+00	mg/kg-day	NA	NA	1.6E-02
	ARSENIC	1.2E+01	mg/kg	1.20E+01	mg/kg	M	2.0E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	6.7E-02
	CHROMIUM	1.8E+01	mg/kg	1.75E+01	mg/kg	M	2.9E-05	mg/kg-day	3.0E-03	mg/kg-day	NA	NA	9.8E-03
	COBALT	1.1E+01	mg/kg	1.11E+01	mg/kg	M	1.9E-05	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	6.2E-02
	IRON	2.4E+04	mg/kg	2.38E+04	mg/kg	M	4.0E-02	mg/kg-day	7.0E-01	mg/kg-day	NA	NA	5.7E-02
	MANGANESE	8.5E+02	mg/kg	8.45E+02	mg/kg	M	1.4E-03	mg/kg-day	1.4E-01	mg/kg-day	NA	NA	1.0E-02
	(total)												**2.2E-01**
Dermal	BAP EQUIVALENT (1/2 DL)	2.0E-02	mg/kg	2.00E-02	mg/kg	M	8.8E-09	mg/kg-day		mg/kg-day	NA	NA	
	ALUMINUM	9.5E+03	mg/kg	9.46E+03	mg/kg	M		mg/kg-day	1.0E+00	mg/kg-day	NA	NA	
	ARSENIC	1.2E+01	mg/kg	1.20E+01	mg/kg	M	1.2E-06	mg/kg-day	3.0E-04	mg/kg-day	NA	NA	4.0E-03
	CHROMIUM	1.8E+01	mg/kg	1.75E+01	mg/kg	M		mg/kg-day	7.5E-05	mg/kg-day	NA	NA	
	COBALT	1.1E+01	mg/kg	1.11E+01	mg/kg	M		mg/kg-day	3.0E-04	mg/kg-day	NA	NA	
	IRON	2.4E+04	mg/kg	2.38E+04	mg/kg	M		mg/kg-day	7.0E-01	mg/kg-day	NA	NA	
	MANGANESE	8.5E+02	mg/kg	8.45E+02	mg/kg	M		mg/kg-day	5.6E-03	mg/kg-day	NA	NA	
	(total)												**4.0E-03**

Total Hazard Index Across All Exposure Routes/Pathways **2.3E-01**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03

PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 8.7a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF CONSTRUCTION WORKERS TO SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Subsurface Soil
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL)	2.0E-02	mg/kg	2.00E-02	mg/kg	M	5.5E-11	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	4.0E-10
	ALUMINUM	9.5E+03	mg/kg	9.46E+03	mg/kg	M	2.6E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.2E+01	mg/kg	1.20E+01	mg/kg	M	3.3E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	5.0E-08
	CHROMIUM	1.8E+01	mg/kg	1.75E+01	mg/kg	M	4.8E-08	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.11E+01	mg/kg	M	3.1E-08	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	2.4E+04	mg/kg	2.38E+04	mg/kg	M	6.6E-05	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	8.5E+02	mg/kg	8.45E+02	mg/kg	M	2.3E-06	mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**5.0E-08**
Dermal	BAP EQUIVALENT (1/2 DL)	2.0E-02	mg/kg	2.00E-02	mg/kg	M	1.4E-11	mg/kg-day	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1.1E-10
	ALUMINUM	9.5E+03	mg/kg	9.46E+03	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	ARSENIC	1.2E+01	mg/kg	1.20E+01	mg/kg	M	2.0E-09	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	3.0E-09
	CHROMIUM	1.8E+01	mg/kg	1.75E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	COBALT	1.1E+01	mg/kg	1.11E+01	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	IRON	2.4E+04	mg/kg	2.38E+04	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	MANGANESE	8.5E+02	mg/kg	8.45E+02	mg/kg	M		mg/kg-day		$(mg/kg\text{-}day)^{-1}$	
	(total)										**3.1E-09**
										Total Risk Across All Exposure Routes/Pathways	**5.3E-08**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

Dermal Absorption Fraction from Soil(ABS) (USEPA, July 2004):

Dioxins/furans - 0.03 Arsenic - 0.03
PAHs - 0.13 Other Metals and Volatiles - not evaluated for dermal contact with soil.

TABLE 4.8

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) =
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.27E+06	USEPA, December 2002	1.27E+06	USEPA, December 2002	$\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04
Noncancer Inhalation Intake(RME) = 2.38E-01

Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

TABLE 7.8. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-05	mg/m^3	R	2.6E-06	mg/m^3	1.5E-05	mg/m^3	1.7E-01
	BARIUM	9.8E+01	mg/kg	7.7E-05	mg/m^3	R	1.8E-05	mg/m^3	5.0E-04	mg/m^3	3.7E-02
	CHROMIUM	2.2E+01	mg/kg	1.7E-05	mg/m^3	R	4.2E-06	mg/m^3	1.0E-04	mg/m^3	4.2E-02
	COBALT	1.1E+01	mg/kg	8.7E-06	mg/m^3	R	2.1E-06	mg/m^3	6.0E-06	mg/m^3	3.4E-01
	MANGANESE	1.1E+03	mg/kg	8.3E-04	mg/m^3	R	2.0E-04	mg/m^3	5.0E-05	mg/m^3	3.9E+00
	NICKEL	2.9E+01	mg/kg	2.3E-05	mg/m^3	R	5.4E-06	mg/m^3	9.0E-05	mg/m^3	6.0E-02
	(total)										4.6E+00
										Total Hazard Index Across All Exposure Routes/Pathways	**4.6E+00**

8.8. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-05	mg/m^3	R	4.3E-09	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.9E-08
	BARIUM	9.8E+01	mg/kg	7.7E-05	mg/m^3	R	3.0E-08	mg/m^3			
	CHROMIUM	2.2E+01	mg/kg	1.7E-05	mg/m^3	R	6.8E-09	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	5.7E-07
	COBALT	1.1E+01	mg/kg	8.7E-06	mg/m^3	R	3.4E-09	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	3.1E-08
	MANGANESE	1.1E+03	mg/kg	8.3E-04	mg/m^3	R	3.2E-07	mg/m^3			
	NICKEL	2.9E+01	mg/kg	2.3E-05	mg/m^3	R	8.9E-09	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	2.3E-09
	(total)										6.3E-07
										Total Risk Across All Exposure Routes/Pathways	**6.3E-07**

TABLE 7.8a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-05	mg/m^3	R	1.3E-06	mg/m^3	1.5E-05	mg/m^3	8.7E-02
	BARIUM	9.8E+01	mg/kg	7.7E-05	mg/m^3	R	9.2E-06	mg/m^3	5.0E-04	mg/m^3	1.8E-02
	CHROMIUM	2.2E+01	mg/kg	1.7E-05	mg/m^3	R	2.1E-06	mg/m^3	1.0E-04	mg/m^3	2.1E-02
	COBALT	1.1E+01	mg/kg	8.7E-06	mg/m^3	R	1.0E-06	mg/m^3	6.0E-06	mg/m^3	1.7E-01
	MANGANESE	1.1E+03	mg/kg	8.3E-04	mg/m^3	R	9.9E-05	mg/m^3	5.0E-05	mg/m^3	2.0E+00
	NICKEL	2.9E+01	mg/kg	2.3E-05	mg/m^3	R	2.7E-06	mg/m^3	9.0E-05	mg/m^3	3.0E-02
	(total)										2.3E+00
										Total Hazard Index Across All Exposure Routes/Pathways	**2.3E+00**

8.8a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-05	mg/m^3	R	2.2E-09	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	9.3E-09
	BARIUM	9.8E+01	mg/kg	7.7E-05	mg/m^3	R	1.5E-08	mg/m^3			
	CHROMIUM	2.2E+01	mg/kg	1.7E-05	mg/m^3	R	3.4E-09	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	2.9E-07
	COBALT	1.1E+01	mg/kg	8.7E-06	mg/m^3	R	1.7E-09	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	1.5E-08
	MANGANESE	1.1E+03	mg/kg	8.3E-04	mg/m^3	R	1.6E-07	mg/m^3		$(mg/m^3)^{-1}$	
	NICKEL	2.9E+01	mg/kg	2.3E-05	mg/m^3	R	4.5E-09	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	1.2E-09
	(total)										3.1E-07
										Total Risk Across All Exposure Routes/Pathways	**3.1E-07**

TABLE 4.9

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) = $\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.27E+06	USEPA, December 2002	1.27E+06	USEPA, December 2002	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04
Noncancer Inhalation Intake(RME) = 2.38E-01

Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

TABLE 7.9. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.4E-03	mg/m^3	R	1.8E-03	mg/m^3	5.0E-03	mg/m^3	3.5E-01
	ARSENIC	1.2E+01	mg/kg	9.4E-06	mg/m^3	R	2.2E-06	mg/m^3	1.5E-05	mg/m^3	1.5E-01
	CHROMIUM	1.8E+01	mg/kg	1.4E-05	mg/m^3	R	3.3E-06	mg/m^3	1.0E-04	mg/m^3	3.3E-02
	COBALT	1.1E+01	mg/kg	8.7E-06	mg/m^3	R	2.1E-06	mg/m^3	6.0E-06	mg/m^3	3.4E-01
	MANGANESE	8.5E+02	mg/kg	6.7E-04	mg/m^3	R	1.6E-04	mg/m^3	5.0E-05	mg/m^3	3.2E+00
	NICKEL	2.8E+01	mg/kg	2.2E-05	mg/m^3	R	5.2E-06	mg/m^3	9.0E-05	mg/m^3	5.8E-02
	(total)										4.1E+00
										Total Hazard Index Across All Exposure Routes/Pathways	**4.1E+00**

8.9. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.4E-03	mg/m^3	R	2.9E-06	mg/m^3			
	ARSENIC	1.2E+01	mg/kg	9.4E-06	mg/m^3	R	3.7E-09	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.6E-08
	CHROMIUM	1.8E+01	mg/kg	1.4E-05	mg/m^3	R	5.4E-09	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	4.5E-07
	COBALT	1.1E+01	mg/kg	8.7E-06	mg/m^3	R	3.4E-09	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	3.1E-08
	MANGANESE	8.5E+02	mg/kg	6.7E-04	mg/m^3	R	2.6E-07	mg/m^3			
	NICKEL	2.8E+01	mg/kg	2.2E-05	mg/m^3	R	8.5E-09	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	2.2E-09
	(total)										5.0E-07
										Total Risk Across All Exposure Routes/Pathways	**5.0E-07**

TABLE 7.9a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.4E-03	mg/m^3	R	8.9E-04	mg/m^3	5.0E-03	mg/m^3	1.8E-01
	ARSENIC	1.2E+01	mg/kg	9.4E-06	mg/m^3	R	1.1E-06	mg/m^3	1.5E-05	mg/m^3	7.4E-02
	CHROMIUM	1.8E+01	mg/kg	1.4E-05	mg/m^3	R	1.6E-06	mg/m^3	1.0E-04	mg/m^3	1.6E-02
	COBALT	1.1E+01	mg/kg	8.7E-06	mg/m^3	R	1.0E-06	mg/m^3	6.0E-06	mg/m^3	1.7E-01
	MANGANESE	8.5E+02	mg/kg	6.7E-04	mg/m^3	R	7.9E-05	mg/m^3	5.0E-05	mg/m^3	1.6E+00
	NICKEL	2.8E+01	mg/kg	2.2E-05	mg/m^3	R	2.6E-06	mg/m^3	9.0E-05	mg/m^3	2.9E-02
	(total)										2.1E+00
										Total Hazard Index Across All Exposure Routes/Pathways	**2.1E+00**

8.9a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.4E-03	mg/m^3	R	1.5E-06	mg/m^3			
	ARSENIC	1.2E+01	mg/kg	9.4E-06	mg/m^3	R	1.8E-09	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	7.9E-09
	CHROMIUM	1.8E+01	mg/kg	1.4E-05	mg/m^3	R	2.7E-09	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	2.3E-07
	COBALT	8.5E+02	mg/kg	8.7E-06	mg/m^3	R	1.7E-09	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	1.5E-08
	MANGANESE	8.5E+02	mg/kg	6.7E-04	mg/m^3	R	1.3E-07	mg/m^3			
	NICKEL	2.8E+01	mg/kg	2.2E-05	mg/m^3	R	4.3E-09	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	1.1E-09
	(total)										2.5E-07
										Total Risk Across All Exposure Routes/Pathways	**2.5E-07**

TABLE 4.10
VALUES OF DAILY INTAKE CALCULATIONS FOR EXPOSURE OF FUTURE CONSTRUCTION WORKERS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Dermal	Cgw	Chemical Concentration in Groundwater	mg/L	Maximum	U.S. EPA, December 2002	Maximum	U.S. EPA, December 2002	The equations and parameters for for estimating DAevent and the chemical-specific dermally absorbed dose from water (DAD) are provided in Section 6.2.4.4 of the text.
	A	Skin Surface Area	cm^2	3,300	U.S. EPA, July 2004	3,300	U.S. EPA, July 2004	
	DAevent	Absorbed Dose per Event	mg/cm^2-event	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	years	1	Professional Judgement	1	U.S. EPA, May 1993	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	U.S. EPA, May 1993	
	t_{event}	Duration of Event	hour/event	4	Professional Judgement	2	Professional Judgement	USEPA, July 2004
	t*	Time to reach steady state	hour/event	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	T	Lag Time	hour/event	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	B	Bunge Model Constant	dimensionless	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	Kp	Permeability Coefficient from Water	cm/hour	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	BW	Body Weight	kg	70	USEPA, May 1993	70	U.S. EPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25,550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	U.S. EPA, December 1989	

Daily Intake Calculations

Dermal Intake = (A x EV x ED x EF) / (BW x AT)

Cancer Dermal Intake(RME) = 5.54E-02
Noncancer Dermal Intake(RME) = 3.37E+01

Cancer Dermal Intake(CTE) = 5.54E-02
Noncancer Dermal Intake(CTE) = 3.37E+01

CALCULATION OF DAevent - EXPOSURES THROUGH DERMAL CONTACT WITH GROUNDWATER
REASONABLE MAXIMUM EXPOSURE (RME --- FUTURE CONSTRUCTION WORKERS TO GROUNDWATER

SITE NAME: SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
LOCATION: NAVAL STATION GREAT LAKES, ILLINOIS
DATE: 07/14/10

REFERENCES: U.S. EPA, July 2004

DERMAL CONTACT:

DAD = (DAevent x EV x ED x EF x A)/(BW x AT)

WHERE: DAD = DERMALLY ABSORBED DOSE (MG/KG/DAY)
DAevent = ABSORBED DOSE PER EVENT (MG/CM^2/EVENT)
A = SKIN SURFACE AREA AVAILABLE FOR CONTACT(CM^2)
EV = EVENT FREQUENCY (EVENTS/DAY)
ED = EXPOSURE DURATION (YEARS)
EF = EXPOSURE FREQUENCY (DAYS/YEAR)
BW = BODY WEIGHT(KG)
AT = AVERAGING TIME (DAYS)

FOR INORGANICS: DAevent = Kp x C x tevent x CF

FOR ORGANICS: IF tevent < t*, DAevent = 2FA x Kp x C x CF x (6T x tevent/3.1416)$^{0.5}$

IF tevent > t*, DAevent = FA x Kp x C x CF x ((tevent/(1 + B)) + (2T x ((1+3B+3B^2)/(1 + B)^2)))

WHERE: FA = FRACTION ABSORBED (DIMENSIONLESS)
Kp = PERMEABILITY COEFFICIENT FROM WATER (CM/HR)
C = CONCENTRATION OF CHEMICAL IN WATER (MG/L)
tevent = DURATION OF EVENT (HR/EVENT)
CF = CONVERSION FACTOR (1L/1000 CM^3)
t* = TIME IT TAKES TO REACH STEADY-STATE (HOUR/EVENT)
T = LAG TIME (HOUR/EVENT)
B = BUNGE MODEL CONSTANT (DIMENSIONLESS)

CHEMICAL	GW CONC. (mg/L)		ORGANIC OR INORGANIC?		t* (HR)	tevent	T (HR)		Kp (CM/HR)		B	FA	DAevent
BAP EQUIVALENT (1/2 DL)	3.8E-05		o		1.17E+01	4.00E+00	2.69E+00		7.01E-01		4.27E+00	1	2.40E-07
ARSENIC	3.3E-03		i			4.00E+00			1.00E-03			1	1.32E-08

TABLE 7.10 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF CONSTRUCTION WORKERS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	8.1E-06	mg/kg-day		mg/kg-day	NA	NA	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	4.4E-07	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	1.5E-03
	(total)												1.5E-03
												Total Hazard Index Across All Exposure Routes/Pathways	**1.5E-03**

TABLE 8.10 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF CONSTRUCTION WORKERS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	1.3E-08	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	7.3E-10	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	1.1E-09
	(total)										**1.1E-09**
										Total Risk Across All Exposure Routes/Pathways	**1.1E-09**

CALCULATION OF DAevent - EXPOSURES THROUGH DERMAL CONTACT WITH GROUNDWATER
CENTRAL TENDENCY EXPOSURE (CTE) --- FUTURE CONSTRUCTION WORKERS TO GROUNDWATER

SITE NAME: SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
LOCATION: NAVAL STATION GREAT LAKES, ILLINOIS
DATE: 07/14/10

REFERENCES: U.S. EPA, July 2004

DERMAL CONTACT:

DAD = (DAevent x EV x ED x EF x A)/(BW x AT)

WHERE: DAD = DERMALLY ABSORBED DOSE (MG/KG/DAY)
DAevent = ABSORBED DOSE PER EVENT (MG/CM^2/EVENT)
A = SKIN SURFACE AREA AVAILABLE FOR CONTACT(CM^2)
EV = EVENT FREQUENCY (EVENTS/DAY)
ED = EXPOSURE DURATION (YEARS)
EF = EXPOSURE FREQUENCY (DAYS/YEAR)
BW = BODY WEIGHT(KG)
AT = AVERAGING TIME (DAYS)

FOR INORGANICS: DAevent = Kp x C x tevent x CF

FOR ORGANICS:
IF tevent < t*, DAevent = 2FA x Kp x C x CF x (6T x tevent/3.1416)$^{0.5}$
IF tevent > t*, DAevent = FA x Kp x C x CF x ((tevent/(1 + B)) + (2T x ((1+3B+3B^2)/(1 + B)^2)))

WHERE:
FA = FRACTION ABSORBED (DIMENSIONLESS)
Kp = PERMEABILITY COEFFICIENT FROM WATER (CM/HR)
C = CONCENTRATION OF CHEMICAL IN WATER (MG/L)
tevent = DURATION OF EVENT (HR/EVENT)
CF = CONVERSION FACTOR (1L/1000 CM^3)
t* = TIME IT TAKES TO REACH STEADY-STATE (HOUR/EVENT)
T = LAG TIME (HOUR/EVENT)
B = BUNGE MODEL CONSTANT (DIMENSIONLESS)

CHEMICAL	GW CONC. (mg/L)		ORGANIC OR INORGANIC?		t* (HR)	tevent	T (HR)		Kp (CM/HR)		B	FA	DAevent
BAP EQUIVALENT (1/2 DL)	3.8E-05		o		1.17E+01	2.00E+00	2.69E+00		7.01E-01		4.27E+00	1	1.70E-07
ARSENIC	3.3E-03		i			2.00E+00			1.00E-03			1	6.60E-09

TABLE 7.10a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF CONSTRUCTION WORKERS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer) *	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	5.7E-06	mg/kg-day		mg/kg-day	NA	NA	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	2.2E-07	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	7.4E-04
	(total)												**7.4E-04**

Total Hazard Index Across All Exposure Routes/Pathways **7.4E-04**

TABLE 8.10a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF CONSTRUCTION WORKERS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	9.4E-09	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	3.7E-10	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	5.5E-10
	(total)										**5.5E-10**
										Total Risk Across All Exposure Routes/Pathways	**5.5E-10**

TABLE 4.11
VALUES OF DAILY INTAKE CALCULATIONS FOR EXPOSURE OF FUTURE CHILD RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cgw	Chemical Concentration in Groundwater	mg/L	Maximum	U.S. EPA, December 2002	Maximum	U.S. EPA, December 2002	Ingestion CDI (mg/kg/day) =
	IRgw	Water Ingestion Rate	L/day	1.5	USEPA, August 1997	0.66	U.S. EPA, May 1993	Cgw x IRgw x EF x ED
	EF	Exposure Frequency	days/year	350	USEPA, May 1993	234	U.S. EPA, May 1993	BW x AT
	ED	Exposure Duration (Age 0-2) - RME	years	2	USEPA, May 1993, 2005	2	U.S. EPA, May 1993	CDI = Chronic Daily Intake
	ED	Exposure Duration (Age 3-6) - RME	years	4	USEPA, May 1993, 2005	NA	NA	
	BW	Body Weight	kg	15	U.S. EPA, May 1993	15	U.S. EPA, May 1993	USEPA, December 1989
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25,550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	U.S. EPA, December 1989	2,555	U.S. EPA, December 1989	
Dermal	Cgw	Chemical Concentration in Groundwater	mg/L	Maximum	U.S. EPA, December 2002	Maximum	U.S. EPA, December 2002	The equations and parameters for
	A	Skin Surface Area	cm^2	6,600	U.S. EPA, July 2004	6,600	U.S. EPA, July 2004	for estimating DAevent and the chemical-
	DAevent	Absorbed Dose per Event	mg/cm^2-event	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	specific dermally absorbed dose from
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	water (DAD) are provided in Section 6.2.4.4
	ED	Exposure Duration (Age 0-2) - RME	years	2	USEPA, May 1993, 2005	2	U.S. EPA, May 1993	of the text.
	ED	Exposure Duration (Age 3-6) - RME	years	4	USEPA, May 1993, 2005	NA	NA	
	EF	Exposure Frequency	days/year	350	U.S. EPA, May 1993	234	U.S. EPA, May 1993	
	t_{event}	Duration of Event	hour/event	0.33	Professional Judgement	0.25	Professional Judgement	USEPA, July 2004
	t*	Time to reach steady state	hour/event	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	T	Lag Time	hour/event	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	B	Bunge Model Constant	dimensionless	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	Kp	Permeability Coefficient from Water	cm/hour	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	BW	Body Weight	kg	15	U.S. EPA, May 1993	15	U.S. EPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25,550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	U.S. EPA, December 1989	2,555	U.S. EPA, December 1989	

Daily Intake Calculations

Ingestion Intake = (IRgw x EF x ED) / (BW x AT)
Dermal Intake = (A x EV x ED x EF) / (BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake(RME) = 8.22E-03
Cancer Dermal Intake(RME) = 3.62E+01

Cancer Ingestion Intake(CTE) = 8.06E-04
Cancer Dermal Intake(CTE) = 8.06E+00

Mutagenic Chemicals

Cancer Ingestion Intake (Ages 0-2) - RME = 2.74E-03
Cancer Ingestion Intake (Ages 3-6) - RME = 5.48E-03
Cancer Dermal Intake (Ages 0-2) - RME = 1.21E+01
Cancer Dermal Intake (Ages 3-6) - RME = 2.41E+01

Non-carcinogenic Chemicals

Noncancer Ingestion Intake(RME) = 9.59E-02
Noncancer Dermal Intake(RME) = 4.22E+02

Noncancer Ingestion Intake(CTE) = 8.06E-03
Noncancer Dermal Intake(CTE) = 8.06E+01

CALCULATION OF DAevent - EXPOSURES THROUGH DERMAL CONTACT WITH GROUNDWATER
REASONABLE MAXIMUM EXPOSURE (RME --- FUTURE CHILD RESIDENTS TO GROUNDWATER

SITE NAME: SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
LOCATION: NAVAL STATION GREAT LAKES, ILLINOIS
DATE: 07/14/10

REFERENCES: U.S. EPA, July 2004

DERMAL CONTACT:

DAD = (DAevent x EV x ED x EF x A)/(BW x AT)

WHERE: DAD = DERMALLY ABSORBED DOSE (MG/KG/DAY)
DAevent = ABSORBED DOSE PER EVENT (MG/CM^2/EVENT)
A = SKIN SURFACE AREA AVAILABLE FOR CONTACT(CM^2)
EV = EVENT FREQUENCY (EVENTS/DAY)
ED = EXPOSURE DURATION (YEARS)
EF = EXPOSURE FREQUENCY (DAYS/YEAR)
BW = BODY WEIGHT(KG)
AT = AVERAGING TIME (DAYS)

FOR INORGANICS: DAevent = Kp x C x tevent x CF

FOR ORGANICS:
IF tevent < t*, DAevent = 2FA x Kp x C x CF x (6T x tevent/3.1416)$^{0.5}$
IF tevent > t*, DAevent = FA x Kp x C x CF x ((tevent/(1 + B)) + (2T x ((1+3B+3B^2)/(1 + B)^2)))

WHERE:
FA = FRACTION ABSORBED (DIMENSIONLESS)
Kp = PERMEABILITY COEFFICIENT FROM WATER (CM/HR)
C = CONCENTRATION OF CHEMICAL IN WATER (MG/L)
tevent = DURATION OF EVENT (HR/EVENT)
CF = CONVERSION FACTOR (1L/1000 CM^3)
t* = TIME IT TAKES TO REACH STEADY-STATE (HOUR/EVENT)
T = LAG TIME (HOUR/EVENT)
B = BUNGE MODEL CONSTANT (DIMENSIONLESS)

CHEMICAL	GW CONC. (mg/L)		ORGANIC OR INORGANIC?		t* (HR)	tevent	T (HR)		Kp (CM/HR)		B	FA	DAevent
BAP EQUIVALENT (1/2 DL)	3.8E-05		o		1.17E+01	3.33E-01	2.69E+00		7.01E-01		4.27E+00	1	6.94E-08
ARSENIC	3.3E-03		i			3.33E-01			1.00E-03			1	1.10E-09

TABLE 7.11 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF CHILD RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	3.6E-06	mg/kg-day		mg/kg-day	NA	NA	
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	3.2E-04	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	1.1E+00
	(total)												**1.1E+00**
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	2.9E-05	mg/kg-day		mg/kg-day	NA	NA	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	4.6E-07	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	1.5E-03
	(total)												**1.5E-03**
												Total Hazard Index Across All Exposure Routes/Pathways	**1.1E+00**

TABLE 8.11 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF CHILD RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	1.7E-06	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	1.2E-05
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	2.7E-05	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	4.1E-05
	(total)		-								**5.3E-05**
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	1.3E-05	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	4.0E-08	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	6.0E-08
	(total)										**6.0E-08**
										Total Risk Across All Exposure Routes/Pathways	**5.3E-05**

CALCULATION OF DAevent - EXPOSURES THROUGH DERMAL CONTACT WITH GROUNDWATER
CENTRAL TENDENCY EXPOSURE (CTE) --- FUTURE CHILD RESIDENTS TO GROUNDWATER

SITE NAME: SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
LOCATION: NAVAL STATION GREAT LAKES, ILLINOIS
DATE: 07/15/10

REFERENCES: U.S. EPA, July 2004

DERMAL CONTACT:

DAD = (DAevent x EV x ED x EF x A)/(BW x AT)

WHERE: DAD = DERMALLY ABSORBED DOSE (MG/KG/DAY)
DAevent = ABSORBED DOSE PER EVENT (MG/CM^2/EVENT)
A = SKIN SURFACE AREA AVAILABLE FOR CONTACT(CM^2)
EV = EVENT FREQUENCY (EVENTS/DAY)
ED = EXPOSURE DURATION (YEARS)
EF = EXPOSURE FREQUENCY (DAYS/YEAR)
BW = BODY WEIGHT(KG)
AT = AVERAGING TIME (DAYS)

FOR INORGANICS: DAevent = Kp x C x tevent x CF

FOR ORGANICS:
IF tevent < t*, DAevent = 2FA x Kp x C x CF x (6T x tevent/3.1416)$^{0.5}$
IF tevent > t*, DAevent = FA x Kp x C x CF x ((tevent/(1 + B)) + (2T x ((1+3B+3B^2)/(1 + B)^2)))

WHERE:
FA = FRACTION ABSORBED (DIMENSIONLESS)
Kp = PERMEABILITY COEFFICIENT FROM WATER (CM/HR)
C = CONCENTRATION OF CHEMICAL IN WATER (MG/L)
tevent = DURATION OF EVENT (HR/EVENT)
CF = CONVERSION FACTOR (1L/1000 CM^3)
t* = TIME IT TAKES TO REACH STEADY-STATE (HOUR/EVENT)
T = LAG TIME (HOUR/EVENT)
B = BUNGE MODEL CONSTANT (DIMENSIONLESS)

CHEMICAL	GW CONC. (mg/L)		ORGANIC OR INORGANIC?		t* (HR)	tevent	T (HR)		Kp (CM/HR)		B	FA	DAevent
BAP EQUIVALENT (1/2 DL)	3.8E-05		o		1.17E+01	2.50E-01	2.69E+00		7.01E-01		4.27E+00	1	6.01E-08
ARSENIC	3.3E-03		i			2.50E-01			1.00E-03			1	8.25E-10

TABLE 7.11a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF CHILD RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	3.0E-07	mg/kg-day		mg/kg-day	NA	NA	
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	2.7E-05	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	8.9E-02
	(total)												**8.9E-02**
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	4.8E-06	mg/kg-day		mg/kg-day	NA	NA	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	6.6E-08	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	2.2E-04
	(total)												**2.2E-04**
												Total Hazard Index Across All Exposure Routes/Pathways	**8.9E-02**

TABLE 8.11a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF CHILD RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	3.0E-08	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	2.2E-07
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	2.7E-06	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	4.0E-06
	(total)										**4.2E-06**
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	4.8E-07	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	6.6E-09	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	1.0E-08
	(total)										**1.0E-08**
										Total Risk Across All Exposure Routes/Pathways	**4.2E-06**

TABLE 4.12
VALUES OF DAILY INTAKE CALCULATIONS FOR EXPOSURE OF FUTURE ADULT RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cgw	Chemical Concentration in Groundwater	mg/L	Maximum	U.S. EPA, December 2002	Maximum	U.S. EPA, December 2002	Ingestion CDI (mg/kg/day) =
	IRgw	Water Ingestion Rate	L/day	2	U.S. EPA, May 1993	1.4	U.S. EPA, May 1993	Cgw x IRgw x EF x ED
	EF	Exposure Frequency	days/year	350	U.S. EPA, May 1993	234	U.S. EPA, May 1993	BW x AT
	ED	Exposure Duration (Age 6-16) - RME	years	10	USEPA, May 1993, 2005	7	U.S. EPA, May 1993	CDI = Chronic Daily Intake
	ED	Exposure Duration (Age 17-30) - RME	years	14	USEPA, May 1993, 2005	NA	NA	
	BW	Body Weight	kg	70	U.S. EPA, May 1993	70	U.S. EPA, May 1993	USEPA, December 1989
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25,550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	U.S. EPA, December 1989	2,555	U.S. EPA, December 1989	
Dermal	Cgw	Chemical Concentration in Groundwater	mg/L	Maximum	U.S. EPA, December 2002	Maximum	U.S. EPA, December 2002	The equations and parameters for
	A	Skin Surface Area	cm^2	18,000	U.S. EPA, July 2004	18,000	U.S. EPA, July 2004	for estimating DAevent and the chemical-
	DAevent	Absorbed Dose per Event	mg/cm^2-event	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	specific dermally absorbed dose from
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	water (DAD) are provided in Section 6.2.4.4
	ED	Exposure Duration (Age 6-16) - RME	years	10	USEPA, May 1993, 2005	7	U.S. EPA, May 1993	of the text.
	ED	Exposure Duration (Age 17-30) - RME	years	14	USEPA, May 1993, 2005	NA	NA	
	EF	Exposure Frequency	days/year	350	U.S. EPA, May 1993	234	U.S. EPA, May 1993	
	t_{event}	Duration of Event	hour/event	0.33	Professional Judgement	0.25	Professional Judgement	USEPA, July 2004
	t*	Time to reach steady state	hour/event	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	T	Lag Time	hour/event	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	B	Bunge Model Constant	dimensionless	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	Kp	Permeability Coefficient from Water	cm/hour	chemical-specific	U.S. EPA, July 2004	chemical-specific	U.S. EPA, July 2004	
	BW	Body Weight	kg	70	U.S. EPA, May 1993	70	U.S. EPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25,550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	U.S. EPA, December 1989	2,555	U.S. EPA, December 1989	

Daily Intake Calculations

Ingestion Intake = (IRgw x EF x ED) / (BW x AT)
Dermal Intake = (A x EV x ED x EF) / (BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake(RME) = 9.39E-03
Cancer Dermal Intake(RME) = 8.45E+01

Cancer Ingestion Intake(CTE) = 1.28E-03
Cancer Dermal Intake(CTE) = 1.65E+01

Mutagenic Chemicals

Cancer Ingestion Intake (Ages 6-16) - RME = 3.91E-03
Cancer Ingestion Intake (Ages 17-30) - RME = 5.48E-03
Cancer Dermal Intake (Ages 6-16) - RME = 3.52E+01
Cancer Dermal Intake (Ages 17-30) - RME = 4.93E+01

Non-carcinogenic Chemicals

Noncancer Ingestion Intake(RME) = 2.74E-02
Noncancer Dermal Intake(RME) = 2.47E+02

Noncancer Ingestion Intake(CTE) = 1.28E-02
Noncancer Dermal Intake(CTE) = 1.65E+02

CALCULATION OF DAevent - EXPOSURES THROUGH DERMAL CONTACT WITH GROUNDWATER
REASONABLE MAXIMUM EXPOSURE (RME --- FUTURE ADULT RESIDENTS TO GROUNDWATER

SITE NAME: SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
LOCATION: NAVAL STATION GREAT LAKES, ILLINOIS
DATE: 07/15/10

REFERENCES: U.S. EPA, July 2004

DERMAL CONTACT:

DAD = (DAevent x EV x ED x EF x A)/(BW x AT)

WHERE: DAD = DERMALLY ABSORBED DOSE (MG/KG/DAY)
DAevent = ABSORBED DOSE PER EVENT (MG/CM^2/EVENT)
A = SKIN SURFACE AREA AVAILABLE FOR CONTACT(CM^2)
EV = EVENT FREQUENCY (EVENTS/DAY)
ED = EXPOSURE DURATION (YEARS)
EF = EXPOSURE FREQUENCY (DAYS/YEAR)
BW = BODY WEIGHT(KG)
AT = AVERAGING TIME (DAYS)

FOR INORGANICS: DAevent = Kp x C x tevent x CF

FOR ORGANICS:
IF tevent < t*, DAevent = 2FA x Kp x C x CF x (6T x tevent/3.1416)$^{0.5}$
IF tevent > t*, DAevent = FA x Kp x C x CF x ((tevent/(1 + B)) + (2T x ((1+3B+3B^2)/(1 + B)^2)))

WHERE:
FA = FRACTION ABSORBED (DIMENSIONLESS)
Kp = PERMEABILITY COEFFICIENT FROM WATER (CM/HR)
C = CONCENTRATION OF CHEMICAL IN WATER (MG/L)
tevent = DURATION OF EVENT (HR/EVENT)
CF = CONVERSION FACTOR (1L/1000 CM^3)
t* = TIME IT TAKES TO REACH STEADY-STATE (HOUR/EVENT)
T = LAG TIME (HOUR/EVENT)
B = BUNGE MODEL CONSTANT (DIMENSIONLESS)

CHEMICAL	GW CONC. (mg/L)		ORGANIC OR INORGANIC?		t* (HR)	tevent	T (HR)		Kp (CM/HR)		B	FA	DAevent
BAP EQUIVALENT (1/2 DL)	3.8E-05		o		1.17E+01	3.33E-01	2.69E+00		7.01E-01		4.27E+00	1	6.94E-08
ARSENIC	3.3E-03		i			3.33E-01			1.00E-03			1	1.10E-09

TABLE 7.12 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF ADULT RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	1.0E-06	mg/kg-day		mg/kg-day	NA	NA	
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	9.0E-05	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	3.0E-01
	(total)												**3.0E-01**
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	1.7E-05	mg/kg-day		mg/kg-day	NA	NA	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	2.7E-07	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	9.0E-04
	(total)												**9.0E-04**
												Total Hazard Index Across All Exposure Routes/Pathways	**3.0E-01**

TABLE 8.12 - REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF ADULT RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	6.5E-07	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	4.8E-06
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	3.1E-05	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	4.6E-05
	(total)										**5.1E-05**
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	1.1E-05	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	9.3E-08	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	1.4E-07
	(total)										**1.4E-07**
										Total Risk Across All Exposure Routes/Pathways	**5.1E-05**

CALCULATION OF DAevent - EXPOSURES THROUGH DERMAL CONTACT WITH GROUNDWATER
CENTRAL TENDENCY EXPOSURE (CTE) --- FUTURE ADULT RESIDENTS TO GROUNDWATER

SITE NAME: SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
LOCATION: NAVAL STATION GREAT LAKES, ILLINOIS
DATE: 07/15/10

REFERENCES: U.S. EPA, July 2004

DERMAL CONTACT:

DAD = (DAevent x EV x ED x EF x A)/(BW x AT)

WHERE: DAD = DERMALLY ABSORBED DOSE (MG/KG/DAY)
DAevent = ABSORBED DOSE PER EVENT (MG/CM^2/EVENT)
A = SKIN SURFACE AREA AVAILABLE FOR CONTACT(CM^2)
EV = EVENT FREQUENCY (EVENTS/DAY)
ED = EXPOSURE DURATION (YEARS)
EF = EXPOSURE FREQUENCY (DAYS/YEAR)
BW = BODY WEIGHT(KG)
AT = AVERAGING TIME (DAYS)

FOR INORGANICS: DAevent = Kp x C x tevent x CF

FOR ORGANICS:
IF tevent < t*, DAevent = 2FA x Kp x C x CF x (6T x tevent/3.1416)$^{0.5}$
IF tevent > t*, DAevent = FA x Kp x C x CF x ((tevent/(1 + B)) + (2T x ((1+3B+3B^2)/(1 + B)^2)))

WHERE:
FA = FRACTION ABSORBED (DIMENSIONLESS)
Kp = PERMEABILITY COEFFICIENT FROM WATER (CM/HR)
C = CONCENTRATION OF CHEMICAL IN WATER (MG/L)
tevent = DURATION OF EVENT (HR/EVENT)
CF = CONVERSION FACTOR (1L/1000 CM^3)
t* = TIME IT TAKES TO REACH STEADY-STATE (HOUR/EVENT)
T = LAG TIME (HOUR/EVENT)
B = BUNGE MODEL CONSTANT (DIMENSIONLESS)

CHEMICAL	GW CONC. (mg/L)		ORGANIC OR INORGANIC?		t* (HR)	tevent	T (HR)		Kp (CM/HR)		B	FA	DAevent
BAP EQUIVALENT (1/2 DL)	3.8E-05		o		1.17E+01	2.50E-01	2.69E+00		7.01E-01		4.27E+00	1	6.01E-08
ARSENIC	3.3E-03		i			2.50E-01			1.00E-03			1	8.25E-10

TABLE 7.12a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS FROM EXPOSURE OF ADULT RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	4.8E-07	mg/kg-day		mg/kg-day	NA	NA	
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	4.2E-05	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	1.4E-01
	(total)												**1.4E-01**
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	9.9E-06	mg/kg-day		mg/kg-day	NA	NA	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	1.4E-07	mg/kg-day	3.00E-04	mg/kg-day	NA	NA	4.5E-04
	(total)												**4.5E-04**
												Total Hazard Index Across All Exposure Routes/Pathways	**1.4E-01**

TABLE 8.12a - CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS FROM EXPOSURE OF ADULT RESIDENTS TO GROUNDWATER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	4.8E-08	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	3.5E-07
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	4.2E-06	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	6.3E-06
	(total)										**6.7E-06**
Dermal	BAP EQUIVALENT (1/2 DL	3.8E-05	mg/L	3.78E-05	mg/L	M	9.9E-07	mg/kg-day	7.30E+00	$(mg/kg\text{-}day)^{-1}$	NA
	ARSENIC	3.3E-03	mg/L	3.30E-03	mg/L	M	1.4E-08	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	2.0E-08
	(total)										**2.0E-08**
										Total Risk Across All Exposure Routes/Pathways	**6.7E-06**

TABLE 9.1. REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CONSTRUCTION WORKER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.0E-08		1.6E-08	5.6E-08	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	4.6E-02			4.6E-02
			ARSENIC	1.2E-07	1.9E-08	1.1E-08	1.5E-07	ARSENIC	Skin, CVS	1.6E-01	1.7E-01	1.5E-02	3.5E-01
			BARIUM					BARIUM	Kidney		3.7E-02		3.7E-02
			CHROMIUM		5.7E-07		5.7E-07	CHROMIUM	Fetotoxicity/GS/Bone	2.5E-02	4.2E-02		6.7E-02
			COBALT		3.1E-08		3.1E-08	COBALT	CVS, Immunological, Neurological	1.2E-01	3.4E-01		4.6E-01
			IRON					IRON	Gastrointestinal System	1.4E-01			1.4E-01
			MANGANESE					MANGANESE	CNS	2.5E-02	3.9E+00		4.0E+00
			NICKEL		2.3E-09		2.3E-09	NICKEL	Body Weight		6.0E-02		6.0E-02
Soil	Subsurface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	8.1E-10		3.2E-10	1.1E-09	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	3.2E-02	3.5E-01		3.9E-01
			ARSENIC	1.0E-07	1.6E-08	9.0E-09	1.2E-07	ARSENIC	Skin, CVS	1.3E-01	1.5E-01	1.2E-02	3.0E-01
			CHROMIUM		4.5E-07		4.5E-07	CHROMIUM	Fetotoxicity/GS/Bone	2.0E-02	3.3E-02		5.2E-02
			COBALT		3.1E-08		3.1E-08	COBALT	CVS, Immunological, Neurological	1.2E-01	3.4E-01		4.7E-01
			IRON					IRON	Gastrointestinal System	1.1E-01			1.1E-01
			NICKEL		2.2E-09		2.2E-09	NICKEL	Body Weight		5.8E-02		5.8E-02
			MANGANESE					MANGANESE	CNS	2.0E-02	3.2E+00		3.2E+00
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)					BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC			1.1E-09	1.1E-09	ARSENIC	Skin, CVS			1.5E-03	1.5E-03
			Total Risk for Surface Soil				8.1E-07		Total HI for Surface Soil				5.1E+00
			Total Risk for Subsurface Soil				6.1E-07		Total HI for Subsurface Soil				4.6E+00
			Total Risk for Groundwater				1.1E-09		Total HI for Groundwater				1.5E-03

Total Risk Across All Media and All Exposure Routes: 1.4E-06

Total HI Across All Media and All Exposure Routes: 9.7E+00

Total Immune System HI =	9.9E-01	Total Gastrointestinal HI =	3.8E-01
Total Skin HI =	6.5E-01	Total Kidney HI =	3.7E-02
Total CVS HI =	1.6E+00	Total Fetotoxicity & Bone HI =	1.2E-01
Total Neurological HI =	9.3E-01	CNS HI =	7.6E+00
Body Weight =	1.2E-01		

TABLE 9.2. REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - MAINTENANCE WORKER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	2.6E-06		2.2E-06	4.7E-06	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	1.4E-02			1.4E-02
			ARSENIC	7.5E-06		1.5E-06	9.0E-06	ARSENIC	Skin, CVS	4.7E-02		9.3E-03	5.6E-02
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	7.2E-03			7.2E-03
			COBALT					COBALT	CVS, Immunological, Neurological	3.5E-02			3.5E-02
			IRON					IRON	Gastrointestinal System	4.1E-02			4.1E-02
			MANGANESE					MANGANESE	CNS	7.3E-03			7.3E-03
			Total Risk for Surface Soil				1.4E-05		Total HI for Surface Soil				1.6E-01

Total Risk Across All Media and All Exposure Routes: 1.4E-05

Total HI Across All Media and All Exposure Routes: 1.6E-01

Total Immune System HI =	3.5E-02	Total Gastrointestinal HI =	4.9E-02
Total Skin HI =	5.6E-02		
Total CVS HI =	9.1E-02	Total Fetotoxicity & Bone HI =	7.2E-03
Total Neurological HI =	3.5E-02	CNS HI =	2.1E-02

TABLE 9.3. REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - OCCUPATIONAL WORKER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Occupational Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	2.6E-06		2.2E-06	4.7E-06	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	1.4E-02			1.4E-02
			ARSENIC	7.5E-06		1.5E-06	9.0E-06	ARSENIC	Skin, CVS	4.7E-02		9.3E-03	5.6E-02
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	7.2E-03			7.2E-03
			COBALT					COBALT	CVS, Immunological, Neurological	3.5E-02			3.5E-02
			IRON					IRON	Gastrointestinal System	4.1E-02			4.1E-02
			MANGANESE					MANGANESE	CNS	7.3E-03			7.3E-03
						Total Risk for Surface Soil	1.4E-05					Total HI for Surface Soil	1.6E-01

Total Risk Across All Media and All Exposure Routes: 1.4E-05

Total HI Across All Media and All Exposure Routes: 1.6E-01

Total Immune System HI =	3.5E-02	Total Gastrointestinal HI =	4.9E-02
Total Skin HI =	5.6E-02		
Total CVS HI =	9.1E-02	Total Fetotoxicity & Bone HI =	7.2E-03
Total Neurological HI =	3.5E-02	CNS HI =	2.1E-02

TABLE 9.4. REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADOLESCENT TRESPASSER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Trespasser
Receptor Age: Adolescent (7 - 16 years)

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	5.3E-07		4.5E-07	9.8E-07	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	2.3E-03			2.3E-03
			ARSENIC	5.2E-07		1.0E-07	6.3E-07	ARSENIC	Skin, CVS	8.1E-03		1.6E-03	9.7E-03
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	1.3E-03			1.3E-03
			COBALT					COBALT	CVS, Immunological, Neurological	6.1E-03			6.1E-03
			IRON					IRON	Gastrointestinal System	7.2E-03			7.2E-03
			MANGANESE					MANGANESE	CNS	1.3E-03			1.3E-03
						Total Risk for Surface Soil	1.6E-06					Total HI for Surface Soil	2.8E-02

Total Risk Across All Media and All Exposure Routes: 1.6E-06

Total HI Across All Media and All Exposure Routes: 2.8E-02

Total Immune System HI =	6.1E-03	Total Gastrointestinal HI =	8.4E-03
Total Skin HI =	9.7E-03		
Total CVS HI =	1.6E-02	Total Fetotoxicity & Bone HI =	1.3E-03
Total Neurological HI =	6.1E-03	CNS HI =	3.6E-03

TABLE 9.5. REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CHILD RESIDENT
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child (0 -6 years)

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.3E-05		1.6E-05	5.8E-05	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	1.8E-01			1.8E-01
			ARSENIC	2.4E-05		2.0E-06	2.6E-05	ARSENIC	Skin, CVS	6.1E-01		5.2E-02	6.7E-01
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	9.5E-02			9.5E-02
			COBALT					COBALT	CVS, immunological, Neurological	4.6E-01			4.6E-01
			IRON					IRON	Gastrointestinal System	5.4E-01			5.4E-01
			MANGANESE					MANGANESE	CNS	9.6E-02			9.6E-02
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)	1.2E-05			1.2E-05	BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC	4.1E-05		6.0E-08	4.1E-05	ARSENIC	Skin, CVS	1.1E+00		1.5E-03	1.1E+00
			Total Risk for Surface Soil				8.4E-05		Total HI for Surface Soil				2.0E+00
			Total Risk for Groundwater				5.3E-05		Total HI for Groundwater				1.1E+00

Total Risk Across All Media and All Exposure Routes: 1.4E-04

Total HI Across All Media and All Exposure Routes: 3.1E+00

Total Immune System HI =	4.6E-01	Total Gastrointestinal HI =	6.4E-01
Total Skin HI =	1.7E+00		
Total CVS HI =	2.2E+00	Total Fetotoxicity & Bone HI =	9.5E-02
Total Neurological HI =	4.6E-01	CNS HI =	2.7E-01

TABLE 9.6. REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE ADULT RESIDENT
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	6.3E-06		3.3E-06	1.E-05	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	1.9E-02			1.9E-02
			ARSENIC	1.0E-05		1.2E-06	1.E-05	ARSENIC	Skin, CVS	6.6E-02		7.9E-03	7.4E-02
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	1.0E-02			1.0E-02
			COBALT					COBALT	CVS, Immunological, Neurological	4.9E-02			4.9E-02
			IRON					IRON	Gastrointestinal System	5.8E-02			5.8E-02
			MANGANESE					MANGANESE	CNS	1.0E-02			1.0E-02
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)	4.8E-06			4.8E-06	BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC	4.6E-05		1.4E-07	4.7E-05	ARSENIC	Skin, CVS	3.0E-01		9.0E-04	3.0E-01
			Total Risk for Surface Soil				2.1E-05		Total HI for Surface Soil				2.2E-01
			Total Risk for Groundwater				5.1E-05		Total HI for Groundwater				3.0E-01

Total Risk Across All Media and All Exposure Routes: 7.2E-05

Total HI Across All Media and All Exposure Routes: 5.2E-01

Total Immune System HI =	4.9E-02	Total Gastrointestinal HI =	6.8E-02
Total Skin HI =	3.8E-01		
Total CVS HI =	4.3E-01	Total Fetotoxicity & Bone HI =	1.0E-02
Total Neurological HI =	4.9E-02	CNS HI =	2.9E-02

TABLE 9.7. REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - TOTAL RESIDENTIAL ILCRS
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child + Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.9E-05		1.9E-05	6.8E-05
			ALUMINUM				
			ARSENIC	3.4E-05		3.2E-06	3.7E-05
			CHROMIUM				
			COBALT				
			IRON				
			MANGANESE				
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)	1.7E-05			1.7E-05
			ARSENIC	8.7E-05		2.0E-07	8.7E-05
			Total Risk for Surface Soil				1.0E-04
			Total Risk for Groundwater				1.0E-04

Total Risk Across All Media and All Exposure Routes: 2.1E-04

TABLE 9.1a. CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CONSTRUCTION WORKER
SITE 19 - FOCTER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	2.0E-08		5.3E-09	2.5E-08	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	2.3E-02			2.3E-02
			ARSENIC	6.0E-08	9.3E-09	3.6E-09	7.3E-08	ARSENIC	Skin, CVS	8.1E-02	8.7E-02	4.8E-03	1.7E-01
			BARIUM					BARIUM	Kidney		1.8E-02		1.8E-02
			CHROMIUM		2.9E-07		2.9E-07	CHROMIUM	Fetotoxicity/GS/Bone	1.2E-02	2.1E-02		3.3E-02
			COBALT		1.5E-08		1.5E-08	COBALT	CVS, Immunological, Neurological	6.1E-02	1.7E-01		2.3E-01
			IRON					IRON	Gastrointestinal System	7.1E-02			7.1E-02
			MANGANESE					MANGANESE	CNS	1.3E-02	2.0E+00		2.0E+00
			NICKEL		1.2E-09		1.2E-09	NICKEL	Body Weight		3.0E-02		3.0E-02
Soil	Subsurface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.0E-10		1.1E-10	5.1E-10	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	1.6E-02	1.8E-01		1.9E-01
			ARSENIC	5.0E-08	7.9E-09	3.0E-09	6.1E-08	ARSENIC	Skin, CVS	6.7E-02	7.4E-02	4.0E-03	1.5E-01
			CHROMIUM		2.3E-07		2.3E-07	CHROMIUM	Fetotoxicity/GS/Bone	9.8E-03	1.6E-02		2.6E-02
			COBALT		1.5E-08		1.5E-08	COBALT	CVS, Immunological, Neurological	6.2E-02	1.7E-01		2.3E-01
			IRON					IRON	Gastrointestinal System	5.7E-02			5.7E-02
			NICKEL					NICKEL	Body Weight		2.9E-02		2.9E-02
			MANGANESE		1.1E-09		1.1E-09	MANGANESE	CNS	1.0E-02	1.6E+00		1.6E+00
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)					BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC			5.5E-10	5.5E-10	ARSENIC	Skin, CVS			7.4E-04	7.4E-04
			Total Risk for Surface Soil				4.0E-07		Total HI for Surface Soil				2.6E+00
			Total Risk for Subsurface Soil				3.0E-07		Total HI for Subsurface Soil				2.3E+00
			Total Risk for Groundwater				5.5E-10		Total HI for Groundwater				7.4E-04

Total Risk Across All Media and All Exposure Routes: 7.1E-07

Total HI Across All Media and All Exposure Routes: 4.8E+00

Total Immune System HI =	5.0E-01	Total Gastrointestinal HI =	1.9E-01
Total Skin HI =	3.2E-01	Total Kidney HI =	1.8E-02
Total CVS HI =	7.9E-01	Total Fetotoxicity & Bone HI =	5.9E-02
Total Neurological HI =	4.7E-01	CNS HI =	3.8E+00
Body Weight =	5.9E-02		

TABLE 9.2a. CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - MAINTENANCE WORKER
SITE 19 - FOCTER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.0E-07		6.9E-08	4.7E-07	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	5.9E-03			5.9E-03
			ARSENIC	1.2E-06		4.7E-08	1.2E-06	ARSENIC	Skin, CVS	2.1E-02		8.1E-04	2.1E-02
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	3.2E-03			3.2E-03
			COBALT					COBALT	CVS, Immunological, Neurological	1.5E-02			1.5E-02
			IRON					IRON	Gastrointestinal System	1.8E-02			1.8E-02
			MANGANESE					MANGANESE	CNS	3.2E-03			3.2E-03
						Total Risk for Surface Soil	1.7E-06					Total HI for Surface Soil	6.7E-02

Total Risk Across All Media and All Exposure Routes: 1.7E-06

Total HI Across All Media and All Exposure Routes: 6.7E-02

Total Immune System HI =	1.5E-02	Total Gastrointestinal HI =	2.1E-02
Total Skin HI =	2.1E-02		
Total CVS HI =	3.7E-02	Total Fetotoxicity & Bone HI =	3.2E-03
Total Neurological HI =	1.5E-02	CNS HI =	9.1E-03

TABLE 9.3a. CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - OCCUPATIONAL WORKER
SITE 19 - FOCTER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Occupational Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.0E-07		6.9E-08	4.7E-07	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	5.9E-03			5.9E-03
			ARSENIC	1.2E-06		4.7E-08	1.2E-06	ARSENIC	Skin, CVS	2.1E-02		8.1E-04	2.1E-02
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	3.2E-03			3.2E-03
			COBALT					COBALT	CVS, Immunological, Neurological	1.5E-02			1.5E-02
			IRON					IRON	Gastrointestinal System	1.8E-02			1.8E-02
			MANGANESE					MANGANESE	CNS	3.2E-03			3.2E-03
						Total Risk for Surface Soil	1.7E-06					Total HI for Surface Soil	6.7E-02

Total Risk Across All Media and All Exposure Routes: 1.7E-06

Total HI Across All Media and All Exposure Routes: 6.7E-02

Total Immune System HI =	1.5E-02	Total Gastrointestinal HI =	2.1E-02
Total Skin HI =	2.1E-02		
Total CVS HI =	3.7E-02	Total Fetotoxicity & Bone HI =	3.2E-03
Total Neurological HI =	1.5E-02	CNS HI =	9.1E-03

TABLE 9.4a. CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADOLESCENT TRESPASSER
SITE 19 - FOCTER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Trespasser
Receptor Age: Adolescent (7 - 16 years)

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.4E-08		1.4E-08	5.8E-08	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	5.9E-04			5.9E-04
			ARSENIC	1.3E-07		9.7E-09	1.4E-07	ARSENIC	Skin, CVS	2.0E-03		1.5E-04	2.2E-03
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	3.1E-04			3.1E-04
			COBALT					COBALT	CVS, Immunological, Neurological	1.5E-03			1.5E-03
			IRON					IRON	Gastrointestinal System	1.8E-03			1.8E-03
			MANGANESE					MANGANESE	CNS	3.2E-04			3.2E-04
						Total Risk for Surface Soil	2.0E-07					Total HI for Surface Soil	6.7E-03

Total Risk Across All Media and All Exposure Routes: 2.0E-07

Total HI Across All Media and All Exposure Routes: 6.7E-03

Total Immune System HI =	1.5E-03	Total Gastrointestinal HI =	2.1E-03
Total Skin HI =	2.2E-03		
Total CVS HI =	3.7E-03	Total Fetotoxicity & Bone HI =	3.1E-04
Total Neurological HI =	1.5E-03	CNS HI =	9.0E-04

TABLE 9.5a. CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CHILD RESIDENT
SITE 19 - FOCTER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child (0 -6 years)

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	8.9E-07		1.3E-07	1.0E-06	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	5.9E-02			5.9E-02
			ARSENIC	2.6E-06		8.9E-08	2.7E-06	ARSENIC	Skin, CVS	2.1E-01		6.9E-03	2.1E-01
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	3.2E-02			3.2E-02
			COBALT					COBALT	CVS, Immunological, Neurological	1.5E-01			1.5E-01
			IRON					IRON	Gastrointestinal System	1.8E-01			1.8E-01
			MANGANESE					MANGANESE	CNS	3.2E-02			3.2E-02
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)	2.2E-07			2.2E-07	BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC	4.0E-06		1.0E-08	4.0E-06	ARSENIC	Skin, CVS	8.9E-02		2.2E-04	8.9E-02
			Total Risk for Surface Soil				3.7E-06		Total HI for Surface Soil				6.7E-01
			Total Risk for Groundwater				4.2E-06		Total HI for Groundwater				8.9E-02

Total Risk Across All Media and All Exposure Routes: 8.0E-06

Total HI Across All Media and All Exposure Routes: 7.6E-01

Total Immune System HI =	1.5E-01	Total Gastrointestinal HI =	2.1E-01
Total Skin HI =	3.0E-01		
Total CVS HI =	4.5E-01	Total Fetotoxicity & Bone HI =	3.2E-02
Total Neurological HI =	1.5E-01	CNS HI =	9.1E-02

TABLE 9.6a. CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE ADULT RESIDENT
SITE 19 - FOCTER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	3.3E-07		5.0E-08	3.8E-07	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	6.3E-03			6.3E-03
			ARSENIC	9.9E-07		3.4E-08	1.0E-06	ARSENIC	Skin, CVS	2.2E-02		7.5E-04	2.3E-02
			CHROMIUM					CHROMIUM	Fetotoxicity/GS/Bone	3.4E-03			3.4E-03
			COBALT					COBALT	CVS, Immunological, Neurological	1.6E-02			1.6E-02
			IRON					IRON	Gastrointestinal System	1.9E-02			1.9E-02
			MANGANESE					MANGANESE	CNS	3.4E-03			3.4E-03
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)	3.5E-07			3.5E-07	BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC	6.3E-06		2.0E-08	6.4E-06	ARSENIC	Skin, CVS	1.4E-01		4.5E-04	1.4E-01
			Total Risk for Surface Soil				1.4E-06		Total HI for Surface Soil				7.2E-02
			Total Risk for Groundwater				6.7E-06		Total HI for Groundwater				1.4E-01

Total Risk Across All Media and All Exposure Routes: 8.1E-06

Total HI Across All Media and All Exposure Routes: 2.1E-01

Total Immune System HI =	1.6E-02	Total Gastrointestinal HI =	2.3E-02
Total Skin HI =	1.6E-01		
Total CVS HI =	1.8E-01	Total Fetotoxicity & Bone HI =	3.4E-03
Total Neurological HI =	1.6E-02	CNS HI =	9.8E-03

TABLE 9.7a. CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - TOTAL RESIDENTIAL ILCRS
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child + Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	1.2E-06		1.8E-07	1.4E-06
			ALUMINUM				
			ARSENIC	3.6E-06		1.2E-07	3.7E-06
			CHROMIUM				
			COBALT				
			IRON				
			MANGANESE				
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)	5.8E-07			5.8E-07
			ARSENIC	1.0E-05		3.0E-08	1.0E-05
						Total Risk for Surface Soil	5.2E-06
						Total Risk for Groundwater	1.1E-05

Total Risk Across All Media and All Exposure Routes: 1.6E-05

APPENDIX F.2

EXAMPLE RISK ASSESSMENT CALCULATIONS

CALCULATION WORKSHEET

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		**JOB NUMBER:** 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: T. JACKMAN	**CHECKED BY:**	**DATE:** 4/27/2009

PURPOSE: To estimate intake and cancer risks for mutagenic chemicals from incidental ingestion of surface soil at the exopsed area.

EQUATION:

$$IEX = \frac{CS \times IR \times EF \times ED \times FI \times CF}{BW \times AT} \times ADAF$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
IR	=	incidental ingestion rate (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
FI	=	fraction ingested from contaminated source (unitless)
CF	=	conversion factor (1.0E-6 kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cs	=	1	mg/kg	Chemical: Benzo(a)pyrene Equivalents
IR	=	200	mg/day	
EF	=	350	days/year	
ED_1	=	2	years	
ED_2	=	4	years	
FI	=	1		
CF	=	1.0E-06	kg/mg	
BW	=	15	kg	
AT	=	25550	days	
CSFo	=	7.3E+00	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	10		
$ADAF_2$	=	3		

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

EXAMPLE CARCINOGENIC CALCULATION

$$IEX_1 = \frac{1\ mg/kg \times 200\ mg/day \times 350\ days/year \times 2\ years \times 1 \times 1.0E\text{-}06\ kg/mg}{15\ kg \times 25550\ days} \times 10$$

IEX_1 = 3.65E-06 mg/kg/day

$$IEX_2 = \frac{1\ mg/kg \times 200\ mg/day \times 350\ days/year \times 4\ years \times 1 \times 1.0E\text{-}06\ kg/mg}{15\ kg \times 25550\ days} \times 3$$

IEX_2 = 2.19E-06 mg/kg/day

ILCR = (3.65E-06 mg/kg/day + 2.19E-06 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 4.3E-05

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FOR MUTAGENIC CHEMICALS HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

PURPOSE: To estimate intake and cancer risks for mutagenic chemicals from dermal contact with surface soil at the exopsed area.

EQUATION:

$$DEX = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

DEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
CF	=	conversion factor (1.0E-6 kg/mg)
SA	=	skin surface available for contact (cm^2/day)
ABS	=	absorption factor (unitless)
AF	=	adherence factor (mg/cm^2)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFd	=	dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFd (mg/kg/day)-1

ASSUMPTIONS:

Cs	=	1	mg/kg	Chemical: Benzo(a)pyrene Equivalents
CF	=	1.0E-06	kg/mg	
SA	=	2800	cm^2/day	
AF	=	0.2	mg/cm^2	
ABS	=	0.13		
EF	=	350	days/year	
ED_1	=	2	years	
ED_2	=	4	years	
BW	=	15	kg	
AT	=	25550	days	
CSFd	=	7.3E+00	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	10		
$ADAF_2$	=	3		

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FOR MUTAGENIC CHEMICALS HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

EXAMPLE CARCINOGENIC CALCULATION

$$DEXc = \frac{1\ mg/kg \times 1.0E\text{-}06\ kg/mg \times 2800\ cm2/day \times 0.2\ mg/cm2 \times 0.13 \times 350\ days/year \times 2\ years}{15\ kg \times 25550\ days} \times 10$$

DEXc = 1.33E-06 mg/kg/day

$$DEXc = \frac{1\ mg/kg \times 1.0E\text{-}06\ kg/mg \times 2800\ cm2/day \times 0.2\ mg/cm2 \times 0.13 \times 350\ days/year \times 4\ years}{15\ kg \times 25550\ days} \times 3$$

DEXc = 7.98E-07 mg/kg/day

ILCR = (1.33E-06 mg/kg/day + 7.98E-07 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 1.6E-05

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

PURPOSE: To estimate intake and cancer risks for mutagenic chemicals from incidental ingestion of surface soil at the exopsed area.

EQUATION:

$$IEX = \frac{CS \times IR \times EF \times ED \times FI \times CF}{BW \times AT} \times ADAF$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
IR	=	incidental ingestion rate (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
FI	=	fraction ingested from contaminated source (unitless)
CF	=	conversion factor (1.0E-6 kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cs	=	1	mg/kg	Chemical: Benzo(a)pyrene Equivalents
IR	=	100	mg/day	
EF	=	350	days/year	
ED_1	=	10	years	
ED_2	=	14	years	
FI	=	1		
CF	=	1.0E-06	kg/mg	
BW	=	70	kg	
AT	=	25550	days	
CSFo	=	7.3E+00	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	3		
$ADAF_2$	=	1		

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

EXAMPLE CARCINOGENIC CALCULATION

$$IEX_1 = \frac{1\ mg/kg \times 100\ mg/day \times 350\ days/year \times 10\ years \times 1 \times 1.0E\text{-}06\ kg/mg}{70\ kg \times 25550\ days} \times 3$$

IEX_1 = 5.87E-07 mg/kg/day

$$IEX_2 = \frac{1\ mg/kg \times 100\ mg/day \times 350\ days/year \times 14\ years \times 1 \times 1.0E\text{-}06\ kg/mg}{70\ kg \times 25550\ days} \times 1$$

IEX_2 = 2.74E-07 mg/kg/day

ILCR = (5.87E-07 mg/kg/day + 2.74E-07 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 6.3E-06

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FOR MUTAGENIC CHEMICALS HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

PURPOSE: To estimate intake and cancer risks for mutagenic chemicals from dermal contact with surface soil at the exopsed area.

EQUATION:

$$DEX = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

DEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
CF	=	conversion factor (1.0E-6 kg/mg)
SA	=	skin surface available for contact (cm^2/day)
ABS	=	absorption factor (unitless)
AF	=	adherence factor (mg/cm^2)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFd	=	dermal carcinogenic slope factor ((mg/kg/day)$^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFd (mg/kg/day)-1

ASSUMPTIONS:

Cs	=	1	mg/kg	Chemical: Benzo(a)pyrene Equivalents
CF	=	1.0E-06	kg/mg	
SA	=	5700	cm^2/day	
AF	=	0.07	mg/cm^2	
ABS	=	0.13		
EF	=	350	days/year	
ED_1	=	10	years	
ED_2	=	14	years	
BW	=	70	kg	
AT	=	25550	days	
CSFd	=	7.3E+00	(mg/kg/day)$^{-1}$	
$ADAF_1$	=	3		
$ADAF_2$	=	1		

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FOR MUTAGENIC CHEMICALS HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

EXAMPLE CARCINOGENIC CALCULATION

$$DEXc = \frac{1\ mg/kg \times 1.0E\text{-}06\ kg/mg \times 5700\ cm2/day \times 0.07\ mg/cm2 \times 0.13 \times 350\ days/year \times 10\ years}{70\ kg \times 25550\ days} \times 3$$

DEXc = 3.05E-07 mg/kg/day

$$DEXc = \frac{1\ mg/kg \times 1.0E\text{-}06\ kg/mg \times 5700\ cm2/day \times 0.07\ mg/cm2 \times 0.13 \times 350\ days/year \times 14\ years}{70\ kg \times 25550\ days} \times 1$$

DEXc = 1.42E-07 mg/kg/day

ILCR = (3.05E-07 mg/kg/day + 1.42E-07 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 3.3E-06

CALCULATION WORKSHEET

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		**JOB NUMBER:** 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: T. JACKMAN	**CHECKED BY:**	**DATE:** 4/27/2009

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from ingestion of groundwater from the Undeveloped Area.

EQUATION:

$$IEX = \frac{Cgw \times CF \times IF \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cgw	=	exposure point concentration in groundwater (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
IR	=	ingestion rate (L/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cgw	=	0.038	ug/L	Chemical: Benzo(a)pyrene equivalents
IR	=	1.5	L/day	
CF	=	1.0E-03	mg/ug	
EF	=	350	days/year	
ED_1	=	2	years	
ED_2	=	4	years	
BW	=	15	kg	
ATc	=	25550	days	
CSFo	=	7.3E+00	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	10		
$ADAF_2$	=	3		

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{0.038\ ug/L \times 0.001\ mg/ug \times 1.5\ L/day \times 350\ days/year \times 2\ years}{15\ kg \times 25550\ days} \times 10$$

IEXc = 1.04E-06 mg/kg/day

$$IEXc = \frac{0.038\ ug/L \times 0.001\ mg/ug \times 1.5\ L/day \times 350\ days/year \times 4\ years}{15\ kg \times 25550\ days} \times 3$$

IEXc = 6.25E-07 mg/kg/day

ILCR = (1.04E-06 mg/kg/day + 6.25E-07 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 1.2E-05

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENT		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from ingestion of groundwater from the Undeveloped Area.

EQUATION:

$$IEX = \frac{Cgw \times CF \times IF \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cgw	=	exposure point concentration in groundwater (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
IR	=	ingestion rate (L/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cgw	=	0.038	ug/L	Chemical: Benzo(a)pyrene equivalents
IR	=	2	L/day	
CF	=	1.0E-03	mg/ug	
EF	=	350	days/year	
ED_1	=	10	years	
ED_2	=	14	years	
BW	=	70	kg	
ATc	=	25550	days	
CSFo	=	7.3E+00	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	3		
$ADAF_2$	=	1		

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENT		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: T. JACKMAN	CHECKED BY:	DATE: 4/27/2009

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{0.038\ ug/L \times 0.001\ mg/ug \times 2\ L/day \times 350\ days/year \times 10\ years}{70\ kg \times 25550\ days} \times 3$$

IEXc = 4.46E-07 mg/kg/day

$$IEXc = \frac{0.038\ ug/L \times 0.001\ mg/ug \times 2\ L/day \times 350\ days/year \times 14\ years}{70\ kg \times 25550\ days} \times 1$$

IEXc = 2.08E-07 mg/kg/day

ILCR = (4.46E-07 mg/kg/day + 2.08E-07 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 4.8E-06

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENT		
BASED ON: USEPA, DEC. 1989, 2001		
BY: T. JACKMAN	CHECKED BY:	DATE: 04/27/2009

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with groundwater by an adult resident.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT}$$

Where:

DAD	=	dermally absorbed dose (mg/kg/day)
DAevent	=	absorbed does per event (mg/cm^2/event)
EV	=	event frequency (events/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
A	=	skin surface available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFd	=	dermal carcinogenic slope factor ((mg/kg/day)$^{-1}$)
RfDd	=	dermal noncarcinogenic reference dose (mg/kg/day)

RISKS:

ICLR (Carcinogens) = DAD (mg/kg/day) x CSFd (mg/kg/day)$^{-1}$
HQ (Noncarcinogens) = DAD (mg/kg/day) / RFDd (mg/kg/day)

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If } tevent \le t^*, \text{ then: } DAevent = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If } tevent > t^*, \text{ then: } DAevent = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENT		
BASED ON: USEPA, DEC. 1989, 2001		
BY: T. JACKMAN	CHECKED BY:	DATE: 04/27/2009

Where:

Kp	=	permeability coefficient from water (cm/hr)
Cgw	=	concentration of chemical in groundwater (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Cgw	=	0.0033	mg/L	Chemical: Arsenic
Kp	=	1.00E-03	cm/hr	
tevent	=	0.33	hr/event	
CF	=	0.001	L/cm^3	

DAevent = 0.001 cm/hr x 0.0033 mg/L x 0.001 L/cm3

DAevent = 1.09E-09 mg/cm2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	18000	cm^2/day
EV	=	1	event/day
ED	=	24	years
EF	=	350	days/year
BW	=	70	kg
ATc	=	25550	days
ATnc	=	8760	days
CSFd	=	1.5E+00	(mg/kg/day)$^{-1}$
RfDd	=	3.0E-04	(mg/kg/day)

CLIENT: NAVAL STATION GREAT LAKES, ILLINOIS		JOB NUMBER: 0936
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENT		
BASED ON: USEPA, DEC. 1989, 2001		
BY: T. JACKMAN	CHECKED BY:	DATE: 04/27/2009

EXAMPLE CARCINOGENIC CALCULATION

$$DADc = \frac{1.09E\text{-}09 mg/cm2\text{-}event \times 1\ event/day \times 24\ years \times 350\ days/year \times 18000\ cm2/day}{70\ kg \times 25550\ days}$$

DADc = 9.21E-08 mg/kg/day

ICLR = Not applicable, No CSF available.

EXAMPLE NONCARCINOGENIC CALCULATION

$$DADnc = \frac{1.09E\text{-}09 mg/cm2\text{-}event \times 1\ event/day \times 24\ years \times 350\ days/year \times 18000\ cm2/day}{70\ kg \times 8760\ days}$$

DADnc = 2.69E-07 mg/kg/day

HQ = 2.69E-07 mg/kg/day / 3.00E-04 (mg/kg/day) = Hazard Quotient

HQ = 0.0009

CALCULATION WORKSHEET

CLIENT:	JOB NUMBER:
NAVSTA, GREAT LAKES, ILLINOIS	00295

SUBJECT:
CALCULATION OF PARTICUALATE EMISSION FACTOR FOR CONSTRUCTION WORKERS

BASED ON:
Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA, Dec. 2002)

BY:	CHECKED BY:	DATE:
T. JACKMAN		03/11/09

Equation 5-5
Derivation of the Particulate Emission Factor
Construction Scenario - Construction Worker

$$PEF_{sc} = Q/C_{sr} \times \frac{1}{F_D} \times \left[\frac{T \times A_R}{556 \times \left(\frac{W}{3}\right)^{0.4} \times \frac{(365d/yr - p)}{365d/yr} \times VKT} \right]$$

Parameter/Definition (units)	Default
PEF_{sc}/subchronic road particulate emission factor (m^3/kg)	site-specific
Q/C_{sr}/ inverse of 1-h average air concentration along a straight road segment bisecting a 0.5-acre square site (g/m^2-s per kg/m^3)	23.02
F_D/dispersion correction factor (unitless)	0.185 (Appendix E)
T/total time over which construction occurs (s)	site-specific
A_R/surface area of contaminated road segment (m^2) L_R/length of road segment (ft) W_R/width of road segment (ft)	274.213 ($A_R = L_R \times W_R \times 0.092903 m^2/ft^2$)
W/mean vehicle weight (tons)	site-specific
p/number of days with at least 0.01 inches of precipitation (days/year) (see Figure 5-2)	site-specific
• VKT/sum of fleet vehicle kilometers traveled during the exposure duration (km)	site-specific

Calculation of PEF for Construction Workers

Q/C	23.02	(g/m2-s per kg/m3)	
Fd	0.185	dispersion correction factor (unitless)	
T	8.64E+05	sec	3600 sec/hr x 8hr/day x 30days/yr
Area (A)	274.213	m^2	
W	8	tons	
p	110	day/year	
VKT	40.5	km	

PEF = 1.27E+06 m^3/kg

APPENDIX F.3

CHILD (IEUBK) AND LEAD MODEL RESULTS

LEAD MODEL FOR WINDOWS Version 1.0

==========
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Model Version: 1.0 Build 264
User Name:
Date:
Site Name:
Operable Unit:
Run Mode: Research

==========
==

The time step used in this model run: 1 - Every 4 Hours (6 times a day).

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (ug Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(ug/day)
.5-1	5.530
1-2	5.780
2-3	6.490
3-4	6.240
4-5	6.010
5-6	6.340
6-7	7.000

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 ug Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 75.030 ug/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
.5-1	92.900	75.030
1-2	92.900	75.030
2-3	92.900	75.030
3-4	92.900	75.030
4-5	92.900	75.030
5-6	92.900	75.030
6-7	92.900	75.030

****** Alternate Intake ******

Age	Alternate (ug Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 2.500 ug Pb/dL

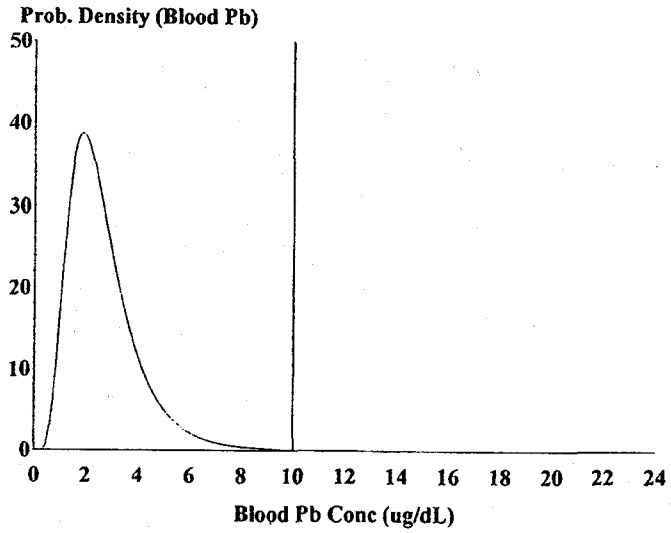
****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (ug/day)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
.5-1	0.021	2.612	0.000	0.378
1-2	0.034	2.722	0.000	0.942
2-3	0.062	3.075	0.000	0.985
3-4	0.067	2.981	0.000	1.013
4-5	0.067	2.902	0.000	1.062
5-6	0.093	3.074	0.000	1.125
6-7	0.093	3.399	0.000	1.146

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)

.5-1	2.001	5.013	2.7
1-2	3.169	6.867	2.9
2-3	3.188	7.310	2.7
3-4	3.214	7.274	2.6
4-5	2.407	6.438	2.2
5-6	2.175	6.466	2.0
6-7	2.057	6.695	1.9

IEUBK
929 mg/kg



Cutoff = 10.000 ug/dl
Geo Mean = 2.445
GSD = 1.600
% Above = 0.136
% Below = 99.864

Age Range = 0 to 84 months
Time Step = Every 4 Hours
Run Mode = Research

Calculations of Preliminary Remediation Goals (PRGs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/03

Exposure Variable	PRG Equation[1] 1*	PRG Equation[1] 2**	Description of Exposure Variable	Units	Values for Non-Residential Exposure Scenario: Using Equation 1, GSDi = Hom	Using Equation 1, GSDi = Het	Using Equation 2, GSDi = Hom	Using Equation 2, GSDi = Het
$PbB_{fetal,0.95}$	X	X	95th percentile PbB in fetus	ug/dL	10	10	10	10
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	2.1	2.3	2.1	2.3
PbB_0	X	X	Baseline PbB	ug/dL	1.5	1.7	1.5	1.7
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	--	--
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	0.050	0.050
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	1.0	1.0
K_{SD}		X	Mass fraction of soil in dust	--	--	--	0.7	0.7
$AF_{S,D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	219	219	219	219
$AT_{S,D}$	X	X	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PRG			**Preliminary Remediation Goal**	**ppm**	**1,235**	**780**	**1,235**	**780**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}). When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same PRG.

***Equation 1, based on Eq. 4 in USEPA (1996).**

$$PRG = \frac{([PbB_{95}fetal/(R*(GSD_i^{1.645})])-PbB_0)*AT_{S,D}}{BKSF*(IR_{S+D}*AF_{S,D}*EF_{S,D})}$$

****Equation 2, alternate approach based on Eq. 4 and Eq. A-19 in USEPA (1996).**

$$PRG = \frac{([PbB_{fetal,0.95}/(R*(GSD_i^{1.645})])-PbB_0)*AT_{S,D}}{BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])}$$

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Calculations of Blood Lead Concentrations (PbBs) - NAVSTA Great Lakes - Site 19, Surface Soil - Construction Worker

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/03

Exposure Variable	PbB Equation[1] 1*	PbB Equation[1] 2**	Description of Exposure Variable	Units	Values for Non-Residential Exposure Scenario: Using Equation 1, GSDi = Hom	Using Equation 1, GSDi = Het	Using Equation 2, GSDi = Hom	Using Equation 2, GSDi = Het
PbS	X	X	Soil lead concentration	ug/g or ppm	92.9	92.9	92.9	92.9
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	2.2	2.2	2.2	2.2
PbB_0	X	X	Baseline PbB	ug/dL	1.5	1.5	1.5	1.5
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	--	--
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	0.100	0.100
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	1.0	1.0
K_{SD}		X	Mass fraction of soil in dust	--	--	--	0.7	0.7
$AF_{S,D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	30	30	30	30
$AT_{S,D}$	X	X	Averaging time (same for soil and dust)	days/yr	42	42	42	42
PbB_{adult}	**PbB of adult worker, geometric mean**			**ug/dL**	**1.8**	**1.8**	**1.8**	**1.8**
$PbB_{fetal,0.95}$	**95th percentile PbB among fetuses of adult workers**			**ug/dL**	**6.0**	**6.0**	**6.0**	**6.0**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**			**ug/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**			**%**	**1.1%**	**1.1%**	**1.1%**	**1.1%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

***Equation 1, based on Eq. 1, 2 in USEPA (1996).**

PbB_{adult} =	$(PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_S/AT_{S,D}) + PbB_0$
$PbB_{fetal,0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

****Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).**

PbB_{adult} =	$PbS*BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])/365+PbB_0$
$PbB_{fetal,0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Defaults (DO NOT CHANGE THESE!!)

PRG for Lead

Values for Non-Residential Exposure Scenario			
Using Equation 1		Using Equation 2	
GSDi = Hom	GSDi = Het	GSDi = Hom	GSDi = Het
10	10	10	10
0.9	0.9	0.9	0.9
0.4	0.4	0.4	0.4
2.1	2.3	2.1	2.3
1.5	1.7	1.5	1.7
0.050	0.050	--	--
--	--	0.050	0.050
--	--	1.0	1.0
--	--	0.7	0.7
0.12	0.12	0.12	0.12
219	219	219	219
365	365	365	365
1,235	**780**	**1,235**	**780**

PbB Calculation

Values for Non-Residential Exposure Scenario			
Using Equation 1		Using Equation 2	
GSDi = Hom	GSDi = Het	GSDi = Hom	GSDi = Het
750	750	750	750
0.9	0.9	0.9	0.9
0.4	0.4	0.4	0.4
2.1	2.3	2.1	2.3
1.5	1.7	1.5	1.7
0.050	0.050	--	--
--	--	0.050	0.050
--	--	1.0	1.0
--	--	0.7	0.7
0.12	0.12	0.12	0.12
219	219	219	219
365	365	365	365
2.6	**2.8**	**2.6**	**2.8**
7.9	**9.8**	**7.9**	**9.8**
10.0	**10.0**	**10.0**	**10.0**
2.5%	**4.8%**	**2.5%**	**4.8%**

Calculations of Preliminary Remediation Goals (PRGs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/03

Exposure Variable	PRG Equation[1] 1*	PRG Equation[1] 2**	Description of Exposure Variable	Units	Values for Non-Residential Exposure Scenario: Using Equation 1, GSDi = Hom	Using Equation 1, GSDi = Het	Using Equation 2, GSDi = Hom	Using Equation 2, GSDi = Het
$PbB_{fetal,\ 0.95}$	X	X	95th percentile PbB in fetus	ug/dL	10	10	10	10
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	2.1	2.3	2.1	2.3
PbB_0	X	X	Baseline PbB	ug/dL	1.5	1.7	1.5	1.7
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	--	--
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	0.050	0.050
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	1.0	1.0
K_{SD}		X	Mass fraction of soil in dust	--	--	--	0.7	0.7
$AF_{S,D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	219	219	219	219
$AT_{S,D}$	X	X	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PRG			**Preliminary Remediation Goal**	**ppm**	**1,235**	**780**	**1,235**	**780**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same PRG.

***Equation 1, based on Eq. 4 in USEPA (1996).**

$$PRG = \frac{([PbB_{95}fetal/(R*(GSD_i^{1.645})])-PbB_0)*AT_{S,D}}{BKSF*(IR_{S+D}*AF_{S,D}*EF_{S,D})}$$

****Equation 2, alternate approach based on Eq. 4 and Eq. A-19 in USEPA (1996).**

$$PRG = \frac{([PbB_{fetal,0.95}/(R*(GSD_i^{1.645})])-PbB_0)*AT_{S,D}}{BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])}$$

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Calculations of Blood Lead Concentrations (PbBs) - NAVSTA Great Lakes - Site 19, Surface Soil - Maintenance/Occupational Worker

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/03

Exposure Variable	PbB Equation[1] 1*	2**	Description of Exposure Variable	Units	Values for Non-Residential Exposure Scenario: Using Equation 1, GSDi = Hom	Using Equation 1, GSDi = Het	Using Equation 2, GSDi = Hom	Using Equation 2, GSDi = Het
PbS	X	X	Soil lead concentration	ug/g or ppm	92.9	92.9	92.9	92.9
$R_{fetal/maternal}$	X	X	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	X	X	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD_i	X	X	Geometric standard deviation PbB	--	2.2	2.2	2.2	2.2
PbB_0	X	X	Baseline PbB	ug/dL	1.5	1.5	1.5	1.5
IR_S	X		Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	--	--
IR_{S+D}		X	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	0.100	0.100
W_S		X	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	1.0	1.0
K_{SD}		X	Mass fraction of soil in dust	--	--	--	0.7	0.7
$AF_{S,D}$	X	X	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,D}$	X	X	Exposure frequency (same for soil and dust)	days/yr	219	219	219	219
$AT_{S,D}$	X	X	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PbB_{adult}	**PbB of adult worker, geometric mean**			**ug/dL**	**1.8**	**1.8**	**1.8**	**1.8**
$PbB_{fetal,0.95}$	**95th percentile PbB among fetuses of adult workers**			**ug/dL**	**5.8**	**5.8**	**5.8**	**5.8**
PbB_t	**Target PbB level of concern (e.g., 10 ug/dL)**			**ug/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**			**%**	**1.0%**	**1.0%**	**1.0%**	**1.0%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

***Equation 1, based on Eq. 1, 2 in USEPA (1996).**

PbB_{adult} =	$(PbS*BKSF*IR_{S+D}*AF_{S,D}*EF_S/AT_{S,D}) + PbB_0$
$PbB_{fetal,0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

****Equation 2, alternate approach based on Eq. 1, 2, and A-19 in USEPA (1996).**

PbB_{adult} =	$PbS*BKSF*([(IR_{S+D})*AF_S*EF_S*W_S]+[K_{SD}*(IR_{S+D})*(1-W_S)*AF_D*EF_D])/365+PbB_0$
$PbB_{fetal,0.95}$ =	$PbB_{adult} * (GSD_i^{1.645} * R)$

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Defaults (DO NOT CHANGE THESE!!)

PRG for Lead

Values for Non-Residential Exposure Scenario			
Using Equation 1		Using Equation 2	
GSDi = Hom	GSDi = Het	GSDi = Hom	GSDi = Het
10	10	10	10
0.9	0.9	0.9	0.9
0.4	0.4	0.4	0.4
2.1	2.3	2.1	2.3
1.5	1.7	1.5	1.7
0.050	0.050	--	--
--	--	0.050	0.050
--	--	1.0	1.0
--	--	0.7	0.7
0.12	0.12	0.12	0.12
219	219	219	219
365	365	365	365
1,235	**780**	**1,235**	**780**

PbB Calculation

Values for Non-Residential Exposure Scenario			
Using Equation 1		Using Equation 2	
GSDi = Hom	GSDi = Het	GSDi = Hom	GSDi = Het
750	750	750	750
0.9	0.9	0.9	0.9
0.4	0.4	0.4	0.4
2.1	2.3	2.1	2.3
1.5	1.7	1.5	1.7
0.050	0.050	--	--
--	--	0.050	0.050
--	--	1.0	1.0
--	--	0.7	0.7
0.12	0.12	0.12	0.12
219	219	219	219
365	365	365	365
2.6	**2.8**	**2.6**	**2.8**
7.9	**9.8**	**7.9**	**9.8**
10.0	**10.0**	**10.0**	**10.0**
2.5%	**4.8%**	**2.5%**	**4.8%**

APPENDIX F.4

PROUCL STATISTICAL CALCULATIONS

TABLE 3.1
EXPOSURE POINT CONCENTRATION SUMMARY - GROUNDWATER
SITE 19 - GREAT LAKES, IL

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Entire Site

Chemical of Potential Concern	Units	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency Exposure		
					EPC Value	EPC Statistic	EPC Rationale	EPC Value	EPC Statistic	EPC Rationale
PAHs/Semivolatile Organic Compounds										
BENZO(A)ANTHRACENE	ug/L	0.036	J	ug/L	0.036	Maximum Concentration	Use maximum concentration for EPC for gw per work plan	0.036	Maximum Concentration	Use maximum concentration for EPC for gw per work plan
BENZO(A)PYRENE	ug/L	0.018		ug/L	0.018	Maximum Concentration	Use maximum concentration for EPC for gw per work plan	0.018	Maximum Concentration	Use maximum concentration for EPC for gw per work plan
DIBENZO(A,H)ANTHRACENE	ug/L	0.013		ug/L	0.013	Maximum Concentration	Use maximum concentration for EPC for gw per work plan	0.013	Maximum Concentration	Use maximum concentration for EPC for gw per work plan
Inorganics										
ARSENIC	ug/L	3.3		ug/L	3.3	Maximum Concentration	Use maximum concentration for EPC for gw per work plan	3.3	Maximum Concentration	Use maximum concentration for EPC for gw per work plan

Footnotes:

Per EPA and IL Guidance (USEPA, 1994a) the maximum concentration used as the EPC for both RME and CTE scenarios.

TABLE 3.2
EXPOSURE POINT CONCENTRATION SUMMARY - SURFACE SOIL
SITE 19 - GREAT LAKES, IL

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil
Exposure Point: Entire Site

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency Exposure		
							EPC Value	EPC Statistic	EPC Rationale	EPC Value	EPC Statistic	EPC Rationale
PAHs/Semivolatile Organic Compounds												
BENZO(A)ANTHRACENE	ug/kg	370	1461	1700		ug/kg	1461	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan	1461	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan
BENZO(A)PYRENE	ug/kg	262	966	1200		ug/kg	966	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan	966	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan
BENZO(B)FLUORANTHENE	ug/kg	322	1272	1700		ug/kg	1272	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan	1272	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan
CHRYSENE	ug/kg	342	1312	1900		ug/kg	1312	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan	1312	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan
DIBENZO(A,H)ANTHRACENE	ug/kg	29.5	205	160		ug/kg	205	99% Chebyshev(Mean, Std) UCL	Use 95% UCL for EPC for soil per work plan	205	99% Chebyshev(Mean, Std) UCL	Use 95% UCL for EPC for soil per work plan
INDENO(1,2,3-CD)PYRENE	ug/kg	140	506	730		ug/kg	506	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan	506	Adjusted Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan
NAPHTHALENE	ug/kg	10.3	61.4	62		ug/kg	61.4	99% Chebyshev(Mean, Std) UCL	Use 95% UCL for EPC for soil per work plan	61.4	99% Chebyshev(Mean, Std) UCL	Use 95% UCL for EPC for soil per work plan
Inorganics												
ALUMINUM	mg/kg	11968	13803	19300		mg/kg	13803	Student-t	Use 95% UCL for EPC for soil per work plan	13803	Student-t	Use 95% UCL for EPC for soil per work plan
ARSENIC	mg/kg	11.5	14.4	32.2		mg/kg	14.4	Approximate Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan	14.4	Approximate Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan
BARIUM	mg/kg	80.4	98.1	188		mg/kg	98.1	Student-t	Use 95% UCL for EPC for soil per work plan	98.1	Student-t	Use 95% UCL for EPC for soil per work plan
CADMIUM	mg/kg	0.464	0.542	0.92	J	mg/kg	0.542	Student-t	Use 95% UCL for EPC for soil per work plan	0.542	Student-t	Use 95% UCL for EPC for soil per work plan
COBALT	mg/kg	9.82	10.8	13.3		mg/kg	10.8	Student-t	Use 95% UCL for EPC for soil per work plan	10.8	Student-t	Use 95% UCL for EPC for soil per work plan
COPPER	mg/kg	28.1	31.3	53.6		mg/kg	31.3	Student-t	Use 95% UCL for EPC for soil per work plan	31.3	Student-t	Use 95% UCL for EPC for soil per work plan
IRON	mg/kg	26784	29571	36800		mg/kg	29571	Student-t	Use 95% UCL for EPC for soil per work plan	29571	Student-t	Use 95% UCL for EPC for soil per work plan
LEAD	mg/kg	92.9	146	480	J	mg/kg	93	Arithmetic Mean	Per IEUBK and Adult Lead Model guidance, the arithmetic average is used as the EPC for lead.	93	Arithmetic Mean	Per IEUBK and Adult Lead Model guidance, the arithmetic average is used as the EPC for lead.
MANGANESE	mg/kg	889	1052	1820	J	mg/kg	1052	Student-t	Use 95% UCL for EPC for soil per work plan	1052	Student-t	Use 95% UCL for EPC for soil per work plan
MERCURY	mg/kg	0.091	0.168	0.47		mg/kg	0.168	H-UCL	Use 95% UCL for EPC for soil per work plan	0.168	H-UCL	Use 95% UCL for EPC for soil per work plan
NICKLE	mg/kg	26.7	28.9	47.9	J	mg/kg	28.9	Student-t	Use 95% UCL for EPC for soil per work plan	28.9	Student-t	Use 95% UCL for EPC for soil per work plan

Footnotes:

Per EPA and IL Guidance (USEPA, 1994a) the 95% Upper Confidenct Limit on the mean is used as the EPC for both RME and CTE scenarios.
Per IEUBK and Adult Lead Model guidance, the arithmetic average is used as the EPC for lead.

TABLE 3.3
EXPOSURE POINT CONCENTRATION SUMMARY - SUBSURFACE SOIL
SITE 19 - GREAT LAKES, IL

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: SubSurface Soil
Exposure Point: Entire Site

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency Exposure		
							EPC Value	EPC Statistic	EPC Rationale	EPC Value	EPC Statistic	EPC Rationale
PAHs/Semivolatile Organic Compounds												
BENZO(A)ANTHRACENE	ug/kg	3.71	8.79	20		ug/kg	8.79	95% Chebyshev(Mean, Std) UCL	Use 95% UCL for EPC for soil per work plan	8.79	95% Chebyshev(Mean, Std) UCL	Use 95% UCL for EPC for soil per work plan
BENZO(A)PYRENE	ug/kg	4.77	19.3	22		ug/kg	19.3	99% Chebyshev(Mean, Std) UCL	Use 95% UCL for EPC for soil per work plan	19.3	99% Chebyshev(Mean, Std) UCL	Use 95% UCL for EPC for soil per work plan
Inorganics												
ALUMINUM	mg/kg	8309	9448	14700		mg/kg	9448	Student-t	Use 95% UCL for EPC for soil per work plan	9448	Student-t	Use 95% UCL for EPC for soil per work plan
ARSENIC	mg/kg	9.77	11.8	25.1		mg/kg	11.8	Student-t	Use 95% UCL for EPC for soil per work plan	11.8	Student-t	Use 95% UCL for EPC for soil per work plan
CADMIUM	mg/kg	0.272	0.297	0.43	J	mg/kg	0.297	Student-t	Use 95% UCL for EPC for soil per work plan	0.297	Student-t	Use 95% UCL for EPC for soil per work plan
COBALT	mg/kg	9.50	11	22.1		mg/kg	11	Student-t	Use 95% UCL for EPC for soil per work plan	11.0,	Student-t	Use 95% UCL for EPC for soil per work plan
IRON	mg/kg	21534	23772	34900		mg/kg	23772	Approximate Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan	23772	Approximate Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan
MANGANESE	mg/kg	736	845	1600		mg/kg	845	Approximate Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan	845	Approximate Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan
MERCURY	mg/kg	0.021	0.025	0.049		mg/kg	0.025	Student-t	Use 95% UCL for EPC for soil per work plan	0.025	Student-t	Use 95% UCL for EPC for soil per work plan
NICKLE	mg/kg	24.7	27.7	48.8		mg/kg	27.7	Approximate Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan	27.7	Approximate Gamma 95% UCL	Use 95% UCL for EPC for soil per work plan

Footnotes:

Per EPA and IL Guidance (USEPA, 1994a) the 95% Upper Confidenct Limit on the mean is used as the EPC for both RME and CTE scenarios.

Certificate of Publication

I, John Rung, do hereby certify that I am the publisher of the **Great Lakes Bulletin**, a secular newspaper of general circulation within the County of Lake regularly published in the County of Lake and State of Illinois, and which has been so published for more than 12 months prior to the first publication of hereunto annexed notice or advertisement relating to the matter of

PUBLIC COMMENT PERIOD OPEN FOR SITE 19
FORMER SMALL ARMS RANGE 910

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Given under my hand at Grayslake, Illinois
June 7, 2013

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PUBLIC NOTICES

PUBLIC NOTICE

Public Comment Period Open for Site 19 - Former Small Arms Range 910 Remedial Action From Naval Facilities Engineering Command Midwest Environmental Division Scheduled from June 21 to July 22, 2013

PUBLIC NOTICES

The Navy, as part of its responsibilities under the Department of Defense Installation Restoration (IR) Program, has completed a Proposed Plan for the Former Small Arms Range 910 (Site 19) at Naval Station Great Lakes. A public comment period for the Proposed Plan is scheduled from June 21 to July 22, 2013.

The primary intent of a Proposed Plan is to present a summary of the proposed remedy for this site to help the public understand and provide input on the proposed remedial alternative. The Proposed Plan for the site, as developed by the Navy, the lead agency, and the Illinois Environmental Protection Agency, the supporting agency, recommends land use controls. Elements of the plan also include the use of institutional controls to restrict property usage and intrusive activities, as well as a formal review of site conditions every 5 years. The Navy and Illinois EPA concur with the proposed remedial alternative for Site 19. In response to public comments or upon receipt of new information, the preferred alternative for the site may change. The Navy, with input from Illinois EPA, will make a final decision after reviewing and addressing the public's comments.

PUBLIC NOTICES

Site 19, which is 0.67 acre, was an indoor rifle range operated between 1942 and 1997; the building was demolished in 2000. As a result of past training activities, investigations encountered contaminants in surface and subsurface soil, that exceeded screening levels. Due to these contaminants, the Navy has determined that risks for the Illinois Environmental Protection Agency, without restrictions) at the site exceeds acceptable levels. These risks, along with the fact that soil remain in place, triggered the need for the remedial action. The Proposed Plan, presented in the Proposed Plan, concludes that risks were attributed to the site.

PUBLIC NOTICES

The public is encouraged to review and comment on the Navy's Proposed Plan, copies of which are available by contacting Ms. Terese Von Donsel at Naval Station Great Lakes, Building 1A, 201 Decatur Avenue, Great Lakes, IL 60088, telephone (847) 688-2600 extension 136 or by e-mail at terese.vondonsel@navy.mil. The Proposed Plan has been placed in the Administrative Record, along with other documents that provide project site and its contaminants. The Administrative Record is available online at http://go.usa.gov/RsJ. From that web site, just click on the "Administrative Records" tab, enter the Administrative Record, and search for "SITE 00019" documents. If you do not have a computer or internet access, hard copies of the Administrative Record can be viewed at NSGL. Please contact Ms. Von Donsel at (847) 688-2600 x136 to arrange a time and location for reviewing the information.

PUBLIC NOTICES

Comments should be in writing and should be directed to Ms. Von Donsel. Written comments must be postmarked no later than July 22, 2013. If significant interest is expressed and a formal written request is made, a public meeting will be held to discuss the findings and recommendations of the Proposed Plan.

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Focused
Feasibility Study
for
Site 19 – Small Arms Range 910

Naval Station Great Lakes
Great Lakes, Illinois

Naval Facilities Engineering Command
Midwest

Contract Number N62467-04-D-0055

Contract Task Order 468

October 2012

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FOCUSED FEASIBILITY STUDY

FOR

SITE 19 – SMALL ARMS RANGE 910

NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Midwest
201 Decatur Avenue, Building 1A
Great Lakes, Illinois 60088

Submitted by:
Tetra Tech
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 468

OCTOBER 2012

PREPARED UNDER THE SUPERVISION OF:

ROBERT DAVIS, PE
PROJECT MANAGER
TETRA TECH

TERESE VAN DONSEL
REMEDIAL PROJECT MANAGER
NAVFAC MIDWEST/NSGL

APPROVED FOR SUBMITTAL BY:

JOHN TREPANOWSKI, PE
PROGRAM MANAGER
TETRA TECH

BRIAN A. CONRATH
REMEDIAL PROJECT MANAGER
ILLINOIS EPA

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ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Chemical of concern
CSF	Cancer Slope Factors
CTE	Central Tendency Exposure
FFS	Focused Feasibility Study
GRA	General Response Action
HI	Hazard Index
HQ	Hazard Quotient
ICMP	Illinois Coastal Management Plan
ILCR	Incremental Lifetime Cancer Risk
Illinois EPA	Illinois Environmental Protection Agency
LUC	Land use control
MCL	Maximum Contaminant Level
mg/kg	Milligram per kilogram
MOA	Memorandum of Agreement
NAVFAC	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPW	Net Present Worth
PEF	Particulate Emissions Factor
PAH	Polynuclear aromatic hydrocarbon
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI/RA	Remedial Investigation/Risk Assessment
RME	Reasonable Maximum Exposure
SSL	Soil Screening Levels
TACO	Tiered Approach to Corrective Action
TBC	To be considered
µg/kg	Microgram per kilogram
USC	United States Code

USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound

1.0 INTRODUCTION

This Focused Feasibility Study (FFS) was prepared for Site 19, Small Arms Range 910, at the Department of the Navy's Naval Station Great Lakes, Great Lakes, Illinois, under Contract Task Order 468. Figure 1-1 shows the location of Site 19. The FFS Report was prepared in accordance with the United States Environmental Protection Agency's (USEPA's) Comprehensive Long-Term Environmental Action Navy IV Contract Number N62467-04-D-0055 and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Guidance for Conducting Remedial Investigations and Feasibility Studies (1988).

1.1 SITE CHARACTERIZATION

1.1.1 Location and Description

Site 19 is the location of the former Recruit Training Center Rifle Range housed within Building 910. The site is bounded on the north by 4th Avenue, on the east by Ohio Street, and on the south and west by grass and concrete associated with other buildings. Site 19 is currently an open, grassy area. Figure 1-2 shows aerial photographs of the site in 2000, when the building was still located at the site, and in 2008, as the site currently exists. Figure 1-3 is a recent site photograph from May 2012. A former dry cleaning operation was located approximately 50 feet southwest of Site 19.

1.1.2 History

Site 19 was an indoor rifle range that operated between 1942 and 1997 and was demolished in 2000. It is estimated that 19 million pounds of ammunition were generated by this facility, providing the potential for lead to have impacted site soil and groundwater. Chemicals used at the rifle range include CLP brand cleaner and standard issue bore cleaner #6850-00-224-6663. These chemicals are primarily composed of petroleum products and distillates [i.e., volatile organic compounds (VOCs) and polynuclear aromatic hydrocarbons (PAHs)]. The use of these chemicals provides the potential for VOCs and PAHs to have impacted site soil and groundwater.

A dry cleaning facility was located just southwest of former Building 910. A Resource Conservation and Recovery Act (RCRA) storage unit and tanks were located at the northern end of the dry cleaning facility, approximately 80 feet southwest of Site 19. Soil contamination associated with the dry cleaning operation has been documented, and these contaminants (i.e., chlorinated VOCs and their byproducts) may be present in soil and groundwater at Site 19.

1.2 ENVIRONMENTAL CONDITIONS

The following briefly reviews the Remedial Investigation/Risk Assessment (RI/RA), which characterized conditions at the site as of December 2008. More detailed information is available in Sections 4.0, 6.0, and 7.0 of the RI/RA (Tetra Tech NUS, Inc., 2010).

1.2.1 Nature and Extent of Contamination

The following summarizes the nature and extent of the current contamination in groundwater, surface soil, and subsurface soil at Site 19:

Groundwater – Two monitoring wells were installed and sampled at Site 19. No contaminant concentrations were identified at levels above federal or state drinking water standards. The limited nature of contaminant concentrations in groundwater indicate that potential leaching of contaminants from soil to groundwater is not a significant concern at the site.

- Low-concentration VOCs, specifically acetone and toluene, were detected in the groundwater below Site 19. Concentrations were observed at levels below risk-based screening concentrations, and did not exceed regulatory criteria based on the Illinois Environmental Protection Agency (Illinois EPA) Tiered Approach to Corrective Action Objectives (TACO) Tier 1 Groundwater Remediation Objectives and federal Maximum Contaminant Levels (MCLs).

- Low-concentration PAHs, including but not limited to benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene were detected in the shallow groundwater at Site 19. Several detections exceeded screening concentrations but did not exceed regulatory criteria based on Illinois EPA TACO Tier 1 Groundwater Remediation Objectives and federal MCLs.

- Arsenic was detected above a non-regulatory screening level in one of the two wells. However, the concentration detected was well below the Illinois EPA TACO Tier 1 Groundwater Remediation Objective and the federal MCL for arsenic.

Surface Soil - 16 surface soil samples (plus two duplicate samples) were collected from 15 surface soil sample locations. Two VOCs, 2-butanone and acetone, were detected in surface soil. No detections exceeded risk-based screening criteria or regulatory criteria based on Illinois EPA TACO Tier 1 Objectives. The presence of acetone in samples could be attributable to lab contamination.

- Multiple PAHs, including, but not limited to, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene, were observed consistently in surface soil across the site. PAH concentrations exceeded screening criteria and Illinois EPA TACO Tier 1 Remediation Objectives for Residential Incidental Ingestion. However, PAH concentrations in surface soil that exceeded TACO Tier 1 objectives were below background concentrations established by the Illinois EPA for soil in counties within the Metropolitan Statistical Area.

- Inorganic contaminants, including arsenic and manganese, were observed in surface soil at concentrations above risk-based screening levels and Illinois EPA TACO Tier 1 Remediation Objectives for Residential Incidental Ingestions. In addition, concentrations of manganese exceeded the Illinois EPA TACO Tier 1 Remediation Objective for Construction Worker Soil Inhalation.

Subsurface Soil - 22 subsurface soil samples (plus one duplicate sample) were collected from 18 soil borings.

- Three VOCs (4-methyl-2-pentanone, trichlorofluoromethane, and acetone) were detected in subsurface soil. No detections exceeded risk-based screening or regulatory criteria based on Illinois EPA TACO Tier 1 Objectives.

- Multiple PAHs, including, but not limited to, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, were observed consistently at low concentrations in subsurface soil across the site. Concentrations of benzo(a)pyrene and benzo(a)pyrene equivalents exceeded risk-based screening levels. However, no subsurface concentrations exceeded Illinois EPA TACO Tier 1 Remediation Objectives.

- Inorganic contaminants, including arsenic and manganese, were observed in subsurface soil at concentrations above risk-based screening levels and Illinois EPA TACO Tier 1 Remediation Objectives for Residential Incidental Ingestions. In addition, concentrations of manganese exceeded the Illinois EPA TACO Tier 1 Remediation Objective for Construction Worker Soil Inhalation.

1.2.2 Human Health Risk Assessment

The Human Health Risk Assessment identified contaminants as chemicals of concern (COCs) based on a non-cancer Hazard Index (HI) greater than 1.0, or Incremental Lifetime Cancer Risks (ILCR) greater than $1x10^{-6}$ in soil and in groundwater that may potentially be used as drinking water. The following contaminants were retained as COCs:

- arsenic
- manganese
- benzo(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- chrysene
- dibenzo(a,h)anthracene

These are the primary COC risk drivers for future residents. Groundwater at the site is not used and is not expected to be used in the future as drinking water. Naval Station Great Lakes is an active Navy facility and is expected to remain active for the foreseeable future. In accordance with Naval Station Great Lakes Instruction 11130.1 dated September 29, 2003, use of groundwater and surface water runoff within all geographical areas of the base, for any purpose, is strictly prohibited without prior written approval. Groundwater underlying Naval Station Great Lakes is not used for drinking water and is not expected to be used in the future.

No chemicals in soil were eliminated as COCs on the basis of comparisons to background concentrations. The PAHs selected as COCs in exposed surface soil had maximum detected concentrations that did not exceed surface soil background data, as shown in the Table 1-1 below. Based on this information and the Illinois EPA determination of urban PAH background concentrations, it is possible that these PAHs could be attributed to background conditions, and inclusion of these chemicals as COCs may result in an overestimation of total risks for this site.

The inorganic contaminants, arsenic and manganese, were also retained as COCs. The average arsenic concentration was below the Illinois EPA background level of 13 milligrams per kilogram (mg/kg) for both surface and subsurface soil, as shown in Table 1-1. The average concentration of manganese in surface soil exceeded the Illinois EPA background level (Table 1-1).

TABLE 1-1

SITE 19 CHEMICALS OF CONCERN

COCs	Surface Soil Average/ Maximum	Subsurface Soil Average/ Maximum	Illinois EPA Background Soil	Illinois EPA TACO Residential Direct Contact Criteria
Inorganics (mg/kg)				
Arsenic	11.5/32.2	9.77/25.1	13	---
Manganese	889/1820	736/1600	636	1600
PAHs (µg/kg)				
Benzo(a)anthracene	444/1700	17/20	1800(1)	900
Benzo(a)pyrene	314/1200	14.5/22	2100(1)	90
Benzo(b)fluoranthene	429/1700	16/18	2100(1)	900
Chrysene	372/1900	10.6/18	2700(1)	88000
Dibenzo(a,h)anthracene	68.3/160	N/A	420(1)	90

(1) Applies to surface soil only
mg/kg – milligram per kilogram
µg/kg – microgram per kilogram

Summary of Noncarcinogenic Risks

Pathway-specific Reasonable Maximum Exposure (RME) and Central Tendency Exposure (CTE) HIs were less than or equal to 1.0 for trespassers, maintenance workers, occupational workers, and future adult residents in the study area. For this reason, adverse noncarcinogenic health effects are not anticipated for these receptors at Site 19.

As per the Work Plan, the HIs were calculated using the USEPA Particulate Emissions Factor (PEF). For the construction worker pathway, this resulted in a total RME HI of 10 and a total CTE HI of 5, due to inhalation exposure to manganese in soil. However, it was collectively determined by the Navy, Illinois EPA, and Tetra Tech that the USEPA PEF was overly conservative for this site and not a realistic representation of Site 19. Therefore, a site-specific determination, based on the size and location of Site 19, was made to use the Illinois EPA TACO PEF to calculate the HIs for the inhalation construction worker pathway. The Illinois EPA TACO PEF is less conservative than the USEPA PEF; however, it is still considered conservative and protective by the regulatory agency.

This recalculation resulted in a construction worker total RME HI of 1 and a total CTE HI of 0.5, which are less than or equal to 1.0. Therefore, adverse noncarcinogenic health effects are not anticipated for the construction worker receptor at Site 19. These calculations and risk summaries of the construction worker pathway are presented in Appendix B and a summary in presented below in Table 1-2.

TABLE 1-2

SITE 19 SUMMARY OF CONSTRUCTION WORKER HI CALCULATIONS

	Total RME HI for Construction Worker Pathway	Total CTE HI for Construction Worker Pathway
Previous HI using USEPA PEF	5	4
New HI using Illinois EPA TACO PEF	1	0.5

The RME HIs were greater than 1.0 for future child residents in the study area. The CTE HIs are less than or equal to 1.0 for future child residents and construction worker receptors.

For future child residents, ingestion of soil and groundwater is the primary pathway of concern in the RME scenario. Further examination of these results reveals that the organ-specific HIs for skin and cardiovascular system, and individual Hazard Quotients (HQs) for arsenic, were the risk drivers.

The exceedances of 1.0 by organ-specific HIs and individual contaminants indicate that adverse noncarcinogenic health effects are possible under the conditions established in the exposure assessment for future child residents.

Summary of Carcinogenic Risks

RME and CTE cancer risk estimates for construction workers, maintenance workers, occupational workers, trespassers, future child residents, and future adults residents and the CTE cancer risk estimate for total future residential risk (child + adult) for Site 19 do not exceed the target USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$). However, RME and CTE cancer risk estimates for future child residents and future adult residents and the CTE cancer risk estimate for total future residents (child + adult) exceed the Illinois EPA risk goal ($1x10^{-6}$).

The total (soil + groundwater) site RME cancer risk estimates for total future residents (adult + child), exceed the USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$) and Illinois EPA risk goal ($1x10^{-6}$). The major contributors to cancer risk at Site 19 are arsenic and PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and dibenzo(a,h)anthracene).

While independent of the development of the Site 19 Human Health Baseline Risk Assessment, it is interesting to note that, from a regulatory perspective, PAHs in site soil do not exceed allowable

concentrations under the Illinois EPA TACO Tier 1 Objectives. Concentrations of PAHs were higher in surface soil than subsurface and maximum concentrations of PAHs that were found to exceed Tier 1 risk-based objectives were below background concentrations identified under TACO for counties within the Metropolitan Statistical Area.

The levels of contamination found in the soil at Site 19 are acceptable for commercial/industrial use and are safe for worker exposure. Under the current land use within Naval Station Great Lakes, no action would be necessary to protect those who work at or near the property. However, because levels of contamination in soil do not currently meet Illinois' standards for residential properties, the Navy is considering remedial alternatives to address this hypothetical future risk.

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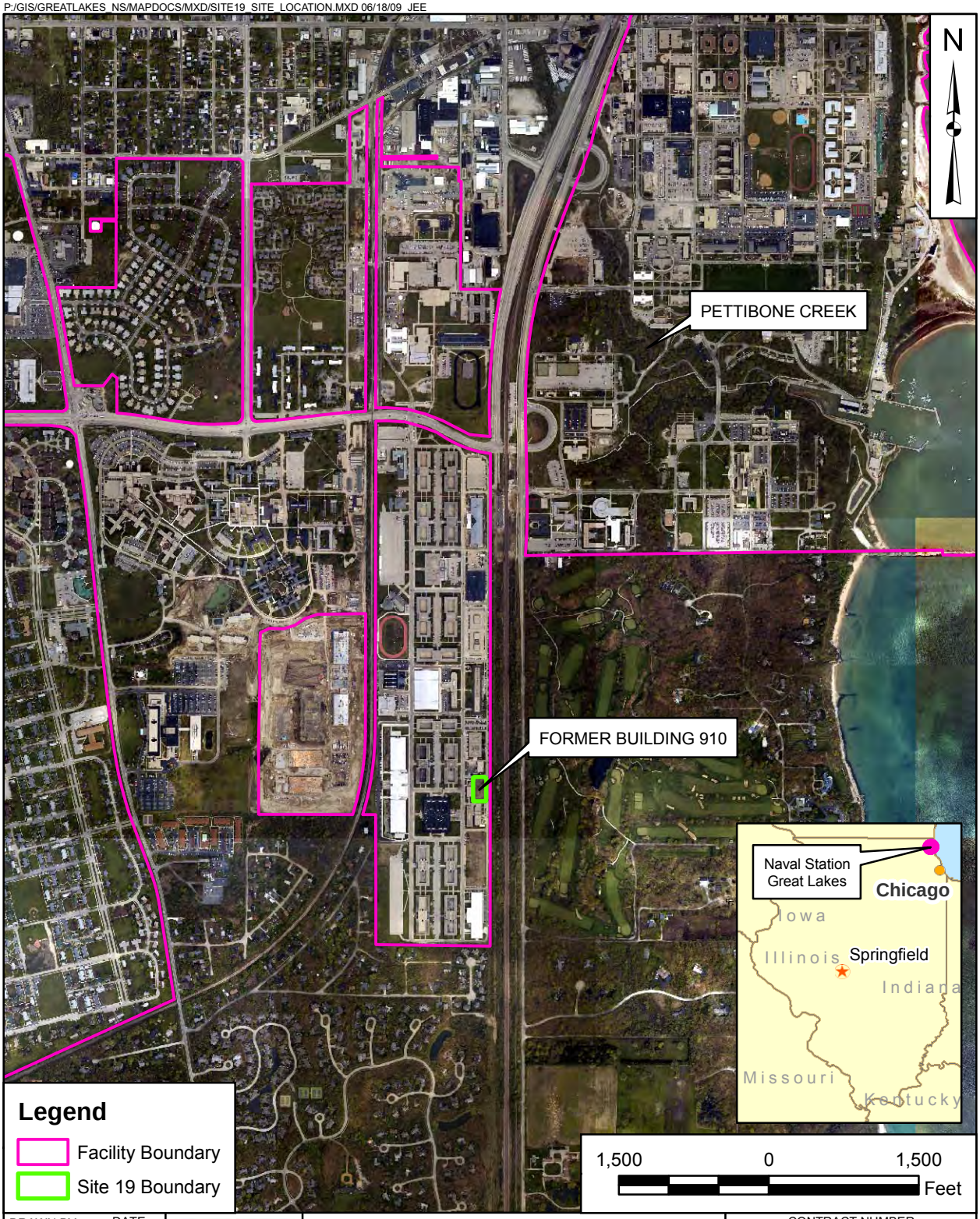

DRAWN BY K. MOORE	DATE 06/18/09	LOCATION MAP SITE 19 - FORMER BUILDING 910 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER CTO 0468
CHECKED BY RFD	DATE 03/23/12		APPROVED BY RFD — DATE 06/19/09
REVISED BY AS NOTED	DATE		APPROVED BY — DATE —
SCALE			FIGURE NO. FIGURE 1-1 — REV 0

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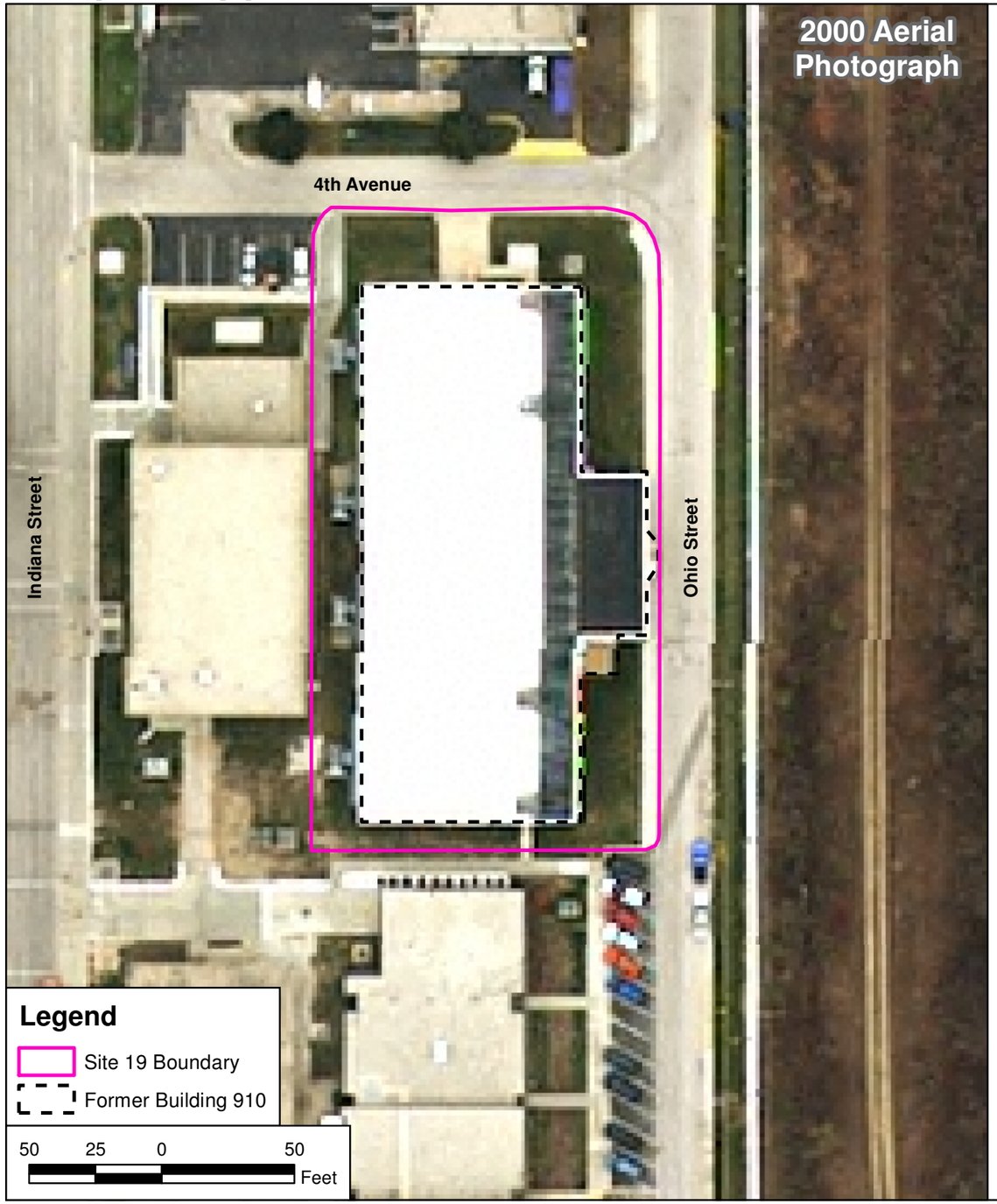

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K. MOORE	08/15/07
CHECKED BY	DATE
C. GALAND	05/09/12
REVISED BY	DATE
S. PAXTON	05/09/12
SCALE AS NOTED	

NAVFAC

SITE MAP
SITE 19 - FORMER BUILDING 910
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	
CTO 0468	
APPROVED BY	DATE
RFD	06/19/09
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FIGURE NO.	REV
FIGURE 1-2	0

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DRAWN BY S. PAXTON	DATE 05/09/12	NAVFAC	SITE PHOTOGRAPH SITE 19 - FORMER BUILDING 910 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER CTO 0468
CHECKED BY C. GALAND	DATE 05/09/12			APPROVED BY RFD — DATE 06/19/09
REVISED BY —	DATE —			APPROVED BY — — DATE — —
SCALE AS NOTED				FIGURE NO. FIGURE 1-3 — REV 0

2.0 REMEDIAL ACTION OBJECTIVE AND GENERAL RESPONSE ACTIONS

This section presents the Remedial Action Objective (RAO) for the site. The objectives and goals for the remedial action at the site provide the basis for selecting RAOs and identifying remedy technologies to address unacceptable exposure scenarios that may be encountered. This section also presents General Response Actions (GRAs) for contaminated media at the site. GRAs are categories of actions that could be implemented to satisfy or address a component of the RAOs for the site. Lastly, this section provides an estimate of the area and volume of contaminated media to be addressed at the site.

2.1 REMEDIAL ACTION OBJECTIVES

RAOs are medium-specific goals that define the objectives of conducting remedial actions to protect human health and the environment. The RAOs specify the COCs, potential exposure routes and receptors, and acceptable ranges of contaminant concentrations [i.e., preliminary remediation goals (PRGs)] for the site. Section 2.1.1 presents the RAO developed for the Site.

The development of PRGs takes into consideration Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) criteria. Section 2.1.2 identifies the ARARs and TBCs.

2.1.1 Statement of Remedial Action Objectives

Site-specific RAOs specify COCs, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. The RAOs for this FFS were developed based on the current land use as industrial/commercial property and future potential land use as residential property, with the goals of protecting the public from potential current and future health risks.

The following RAO was developed for Site 19:

RAO 1: Prevent unacceptable human health risk to hypothetical future residents associated with exposure to soil containing arsenic at concentrations greater than background levels.

2.1.2 Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria

Applicable requirements are cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility

siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.

If a requirement is not applicable, it still may be relevant and appropriate. Relevant and appropriate requirements are those cleanup standards that address problems or situations sufficiently similar to those encountered at the CERCLA site. A requirement that is relevant and appropriate may not meet one or more jurisdictional prerequisites for applicability but still make sense at the site, given the circumstances of the site and the release.

When a requirement is deemed relevant and appropriate, it must be complied with as if it were applicable. However, there are significant differences between the identification and analysis of the two types of requirements. Applicability is a legal and jurisdictional determination, while the determination of relevant and appropriate relies on professional judgment, considering environmental and technical factors at the site. Also, there is more flexibility when determining relevant and appropriate. A requirement may be relevant in that it covers situations similar to those at the site, but may not be appropriate; therefore, may not be well suited to the site. In some situations, only portions of a requirement or regulation may be judged relevant and appropriate; however, if a requirement is applicable, all substantive parts must be followed.

2.1.2.1 Chemical-Specific ARARs and TBCs

Federal and state chemical-specific ARARs and TBCs are listed in Table 2-1.

The Illinois EPA TACO Tier 1 Soil Remediation Objectives were retained as TBCs. The Tier 1 TACO for residential and industrial/commercial properties does not regulate activities at a site or mandate fixed cleanup standards, rather, TACO provides methodologies for meeting the requirements of programs to which it is applied [Illinois Pollution Control Board No. R97-12 (A), p.1 (Illinois EPA, 2007)]. The applicability section of TACO provides that a person "may elect to proceed under this Part" (35 IAC 742.105(a). This language is permissive, not a requirement. Therefore, TACO is not enforceable by its own terms, but relies upon the language of the governing program for its enforceability. Because TACO is not enforceable unto itself, TACO cannot be an ARAR as defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and must be treated as TBC guidance.

2.1.2.2 Location-Specific ARARs and TBCs

Federal and state location-specific ARARs and TBCs are listed in Table 2-2.

The Illinois Coastal Management Program (ICMP) was retained as a location-specific TBC. In January 2012, National Oceanic and Atmospheric Administration approved the ICMP, which was prepared according to the federal Coastal Zone Management Act.

The ICMP identifies a framework of existing programs, laws, and policies that bring state agencies into a comprehensive network. The ICMP does not provide any additional rules or regulations. The CERCLA process, which identifies ARARs and TBCs through input from both USEPA and state agencies, will identify the enforceable policies that would be identified using the ICMP process. Because the ICMP process would be duplicative, administrative, and provide no additional substantive requirements, the ICMP could be excluded from the ARAR/TBC list.

2.1.2.3 Action-Specific ARARs

Action-specific ARARs and TBCs are those regulations, criteria, and guidance that must be complied with or taken into consideration during on-site implementation of GRAs. Action-specific ARARs and TBC criteria are technology- or activity-based controls or restrictions on activities related to management of hazardous substances. Action-specific ARARs pertain to implementing a given remedy. Action-specific ARARs and TBCs are listed along with appropriate actions in Table 2-3.

2.2 GENERAL RESPONSE ACTIONS

GRAs are broadly defined remedial approaches that may be used (by themselves or in combination with others) to attain the RAOs. Because the Human Health Risk Assessment identified potential noncarcinogenic risks at a concentration in excess of the HI of 1 and carcinogenic risks in excess of 1×10^{-4}, Naval Facilities Engineering Command (NAVFAC) has developed the following GRAs for Site 19:

- No Action – no direct action to be conducted to remediate the site.
- Limited Action [i.e. Land Use Controls (LUCs)].
- Excavation and Disposal of Contaminated Soil.

The most conservative of the Illinois EPA TACO Tier 1 Remediation Objectives for residential, industrial/commercial, and construction worker exposure via incidental ingestion and inhalation were used to identify target concentrations for consideration of unrestricted use of the property. Target concentrations of PAHs and inorganics also took background concentrations, as defined in the TACO Appendix A Table G for Inorganics and Appendix A Table H for PAHs, into consideration.

2.3 ESTIMATED VOLUMES OF CONTAMINATED SOIL

Based on the evaluation of contaminant concentrations in Site 19 soil, it was concluded that concentrations of PAHs are acceptable based on a comparison with the most conservative TACO Tier 1 criteria and the TACO Appendix A Table H background values identified for surface soil. Therefore, no remedial actions are proposed to address PAHs in Site 19 soil.

Under CERCLA, once a potentially unacceptable risk has been demonstrated, chemical-specific ARARs can be applied to a site. While the TACO Tier 1 Remedial Objectives are considered TBCs, NAVFAC has elected to use the most conservative of the residential, industrial/commercial, and construction worker criteria to identify a baseline that would be acceptable for unrestricted use of the property. Based on maximum detections observed in both surface and subsurface soil, contaminant concentrations exceed residential criteria for incidental ingestion for arsenic.

For remedial action purposes, the volume of inorganic contaminated soil at Site 19 was estimated based on the locations of samples where arsenic concentrations exceeded 13 mg/kg (background).

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 1 OF 3

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
Cancer Slope Factors (CSFs)	-	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants. Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Risks due to carcinogens as assessed with slope factors will be addressed excavation and off-site disposal and/or land use controls (LUCs).
Reference Doses (RfDs)	-	To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants. Hazards due to noncarcinogens with EPA RfDs will be addressed excavation and off-site disposal and/or LUCs.
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Hazards due to carcinogens assessed through this guidance will be addressed excavation and off-site disposal and/or LUCs.

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 2 OF 3

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (continued)				
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Carcinogenic risks to children assessed through this guidance will be addressed excavation and off-site disposal and/or LUCs.
Regional Screening Levels for Chemical Contaminants at Superfund Sites for Residential and Industrial receptors	USEPA Oak Ridge National Laboratory (2008)	To Be Considered	Chemical contaminant screening level guidance.	RSLs are used when a potential site is initially investigated to determine if potentially significant levels of contamination are present to warrant further investigation. Screening levels may be used during the initial scoping of remediation goals, but remediation goals are ultimately selected based on site-specific information. The RSL tables were not generated to represent action levels or cleanup levels.

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 3 OF 3

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State				
Illinois EPA Tiered Approach to Corrective Action Objectives (TACO) - Tier 1 Soil Remediation Objectives	35 IAC 742.505 (a)(1) and (a)(2) - (Tier 1 Soil Remediation Objectives); 742.1012 - (Institutional Controls, Federally Owned Property); Section 742.Table G and Table H – Background Soil Concentrations	To Be Considered	This part sets forth procedures for evaluating the risk to human health posed by environmental conditions and developing remediation objectives that achieve acceptable risk levels, and to provide for the adequate protection of human health and the environment based on the risks to human health posed by environmental conditions while incorporating site related information. A Tier 1 evaluation compares the concentration of contaminants detected at a site to the corresponding tabulated remediation objectives for residential and industrial/commercial properties.	These values were used to develop Preliminary Remediation Goals (PRGs). Facility is in Metropolitan area where background values apply.

TABLE 2-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

REQUIREMENT	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
There are no federal location-specific ARARs.				
State				
Coastal Zone Management	Illinois Coastal Management Program (ICMP) – Chapter 11, Federal Consistency and the National Interest	To Be Considered	On January 31, 2012, the ICMP received federal approval under the Coastal Zone Management Act (CZMA). The ICMP will work to preserve, protect, restore, and where possible, enhance coastal resources. The ICMP document identifies a framework of existing programs, laws, and policies that brings state agencies into a comprehensive network. The coastal zone is defined in the ICMP.	Per the CZMA, the ICMP excludes lands that are owned by the federal government. The exclusion of federally owned does not exempt activities occurring on those lands from CZMA federal consistency requirements. As federally owned land, Naval Station Great Lakes is excluded from the CZMA.

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 1 OF 2

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
There are no federal action-specific ARARs.				
State				
Identification and Listing of Hazardous Waste	35 IAC 721 Subparts C and D	Applicable	Identifies those solid wastes that are subject to regulation as hazardous wastes.	These regulations would apply when determining whether or not a solid waste, such as contaminated soil is hazardous, either by being listed or exhibiting a hazardous characteristic.
Standards Applicable to Generators of Hazardous Waste	35 IAC 722.111 and 722 Subpart C	Applicable	Characterization of waste is required to determine if it is a hazardous waste. Subpart C Establishes manifesting, pre-transport, and accumulation requirements for hazardous waste.	If contaminated soil is determined to be hazardous, these regulations would apply.
Fugitive Particulate Dust	35 IAC 212 Subpart K	Applicable	No person shall cause or allow the emission of fugitive particulate matter from any process, including any material handling or storage activity that is visible by an observer looking generally toward the zenith at a point beyond the property line of the source.	Control of dust during excavation and handling of soil would be implemented to prevent material from becoming airborne.

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS
PAGE 2 OF 2

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (continued)				
Illinois Urban Manual (2010)	None	To be considered	The standards and associated materials describe best management practices for controlling non-point source pollution impacts that affect ecosystems in existing communities and developing areas. The manual includes BMPs for soil erosion and sediment control; stormwater management; and special area protection.	Soil excavation activities would need to meet these requirements.
Illinois Solid Waste and Special Waste Hauling	35 IAC 809	Potentially Applicable	These regulations would apply if waste is transported to a disposal facility.	This regulation would apply if excavation and hauling was performed.

3.0 SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential remediation technologies and process options that may be applicable to Site 19 at Naval Station Great Lakes. The primary objective of this phase of the FFS is to develop an appropriate range of remediation technologies and process options that will be used for developing remedial alternatives.

3.1 PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

The preliminary screening of remediation technologies and process options is based on overall applicability to the medium of concern, COCs, and specific conditions present at the Site. Table 3-1 summarizes the preliminary screening of remediation technologies and process options for both GRAs.

TABLE 3-1
REMEDIATION TECHNOLOGIES

GRA	Remediation Technology	Process Option
No Action	None	Not applicable
Limited Action	Institutional Controls	LUCs
Removal	Excavation/Disposal	Off-base landfill disposal

3.2 DETAILED SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

3.2.1 No Action

No Action would consist of “walking away” from the site without implementing any remedial action or performing any monitoring and/or maintenance. As required under CERCLA regulations, the No Action alternative is carried through the FFS to provide a baseline for comparison to other alternatives and their effectiveness in mitigating risks posed by site COCs.

3.2.1.1 Effectiveness

The No Action alternative would not be effective in reducing risks or meeting the RAO and PRGs because no exposure control or treatment would be performed. Because no monitoring or maintenance would be performed, the No Action alternative would not be effective in evaluating the potential migration of COCs, or the potential reduction of COC concentrations.

3.2.1.2 Implementability

There would be no implementability concerns because no actions would be implemented.

3.2.1.3 Cost

There would be no costs associated with the No Action alternative.

3.2.1.4 Conclusion

Although it would not be effective, the No Action alternative will be retained for comparison to other options.

3.2.2 LUCs

Based on other LUCs implemented at Naval Station Great Lakes and site conditions, the LUCs would include only property use restrictions. While the contaminants in soil at Site 19 are at concentrations that are acceptable for commercial/industrial use, the concentrations do not meet Illinois' more restrictive standards for residential properties. Therefore, the area in question may be restricted to industrial/commercial (nonsensitive) use.

The Illinois EPA and the Navy have signed a LUC Memorandum of Agreement (MOA) that includes a Naval Station Policy Letter restricting use of groundwater on the Naval Station Great Lakes property. Because there are no identified exceedances of risk-based standards in groundwater, no additional groundwater use restrictions would be included in this action to address groundwater below Site 19.

3.2.2.1 Effectiveness

LUCs alone would not effectively reduce concentrations of COCs. However, LUCs would be an effective tool to prevent future exposure to the COCs.

3.2.2.2 Implementability

LUCs have been implemented throughout Naval Station Great Lakes and could be readily implemented at this site.

3.2.2.3 Cost

Costs to implement and maintain the LUCs would be low. A detailed cost estimate is provided in Appendix A.

3.2.2.4 Conclusion

LUCs are retained for the development of remedial alternatives.

3.2.3 Removal

The only technology considered for removal is mechanical excavation. Mechanical excavation of the impacted soil would be performed using excavators. After excavation is completed, the location would be filled and graded with clean fill material. Excavated materials would be transported offsite for disposal in a non-hazardous landfill.

3.2.3.1 Effectiveness

Mechanical excavation would not reduce concentrations of COCs in the impacted soil, but would be an effective means for addressing soil with COC concentrations greater than PRGs from the site in order to open the property to unrestricted use.

3.2.3.2 Implementability

Mechanical excavation of soil would be implementable, and the necessary resources, equipment, and materials would be readily available. It is anticipated that, based on results from the RI, excavated material could be disposed in a non-hazardous waste landfill.

3.2.3.3 Cost

The cost of mechanical excavation would be moderate and is estimated to be approximately $385,000 for inorganic contaminated soil removal. A detailed cost estimate is provided in Appendix A.

3.2.3.4 Conclusion

Mechanical excavation is retained for the development of remedial alternatives.

4.0 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 INTRODUCTION

In this section, the remediation technologies retained from the components selected in Section 3.0 are assembled into remediation alternatives. This section presents an evaluation of each remedial alternative with respect to the criteria of the NCP of 40 Code of Federal Regulations (CFR) Part 300, as revised in 1990. The criteria required by the NCP and the relative importance of these criteria are described in the following subsections.

4.1.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

4.1.2 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs (excluding those that may be waived)

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

The balancing criteria are used to weigh the relative merits of alternatives.

The remaining two (state and community acceptance) are considered to be modifying criteria that must be considered during remedy selection. The last criterion, community acceptance, cannot be completely evaluated until comments on the Proposed Plan are received from the public.

4.1.3 Selection of Remedy

The selection of a remedy is a two-step process. The first step consists of identification of a preferred alternative and presentation of the alternative in a Proposed Plan to the community for review and comment.

The second step consists of the Navy's review of the public comments and a determination of whether or not the preferred alternative continues to be the most appropriate remedial action for the site, in consultation with Illinois EPA.

4.2 ASSEMBLY OF REMEDIAL ALTERNATIVES

This section develops the remedial alternatives for the Site. Additional site-specific information and assumptions are provided in this section to further explain the alternative development process.

Based on the technology screening presented in Section 3.0, the following three remedial alternatives were developed for the Site:

- Alternative 1: No Action
- Alternative 2: LUCs
- Alternative 3: Excavation and Off-Site Disposal

Alternative 1 was developed and analyzed to serve as a baseline for other alternatives, as required by CERCLA and the NCP. Alternative 2 was developed and analyzed to evaluate restricting usage of the

site, while Alternative 3 was formulated and analyzed to evaluate a removal remedy and its components. A description and detailed analysis of these alternatives is presented in the following sections.

4.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.3.1 Alternative 1: No Action

4.3.1.1 Description

This alternative is a "walk-away" alternative required under CERCLA to establish a basis for comparison with other alternatives. Under this alternative, the property would be released for unrestricted use. In addition, there would be no Five-Year Review required to assess contamination at the site over time. This alternative could only be chosen if it is determined that taking no action would be protective of human health and the environment.

4.3.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 1 would not provide protection of human health and the environment. The potential for exposure of human receptors to contaminated soil via incidental ingestion and inhalation would remain unchanged.

Compliance with ARARs and TBCs

Alternative 1 would not comply with chemical- or location-specific ARARs and TBCs because no action would be taken to reduce COC concentrations. No action-specific ARARs are associated with this alternative.

Long-Term Effectiveness and Permanence

Alternative 1 would have no long-term effectiveness or permanence because nothing would be done to reduce concentrations of soil COCs or to reduce human exposure to site contaminants

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative 1 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment.

Alternative 1 would not achieve the RAOs or the PRGs and would also have no life cycle sustainability impacts.

Implementability

Because no action would occur, Alternative 1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. The remedy would be implementable if ultimately selected in the Record of Decision.

Cost

There would be no costs associated with Alternative 1.

State Acceptance

Since contaminants remain on site at concentrations above background and TACO screening criteria, Alternative 1 is not an acceptable alternative.

Community Acceptance

This assessment will be performed after comments on the Proposed Plan are received from the public.

4.3.2 Alternative 2: LUCs

4.3.2.1 Description

LUCs would be established at the site to make sure the property is not developed for residential use or for non-residential special use (such as for a park, day care, or school) by a population that would require special protections. Additionally, LUCs would require review of construction activities and intrusive work in the area to protect workers and confirm proper management of contaminated materials. Five-Year Reviews would be required since concentrations of contaminants will remain in soil above levels acceptable for unrestricted use at the site.

4.3.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 2 would provide protection to human health by minimizing exposure to contaminated soil but would not provide protection to the environment.

Compliance with ARARs and TBCs

Although no action would be taken to reduce COC concentrations, Alternative 2 would comply with location- and chemical-specific ARARs and TBCs by restricting access to the site and controlling exposure to contaminant concentrations in excess of those acceptable for residential use. In addition, this alternative would require that Five-Year Reviews be conducted to assess the protectiveness and effectiveness of the controls that would be placed on the property. No action-specific ARARs are associated with this alternative.

Long-Term Effectiveness and Permanence

Alternative 2 would be an effective means of minimizing exposure to contaminants in site soil over the long term. The permanence of Alternative 2 would depend on the maintenance of the controls and verification that the land use is being properly controlled.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Implementation of Alternative 2 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. Alternative 2 would not achieve the PRGs, but would achieve the RAO by restricting exposure to soil at the site. Life cycle sustainability impacts of this alternative are energy consumption and greenhouse gas (CO_2) emissions associated with travel to the site for annual inspections.

Implementability

Alternative 2 would be easily implemented since LUCs are already in place at Naval Station Great Lakes.

Cost

The estimated costs for Alternative 2 are shown below and a detailed cost estimate is provided in Appendix A. These costs have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates:

- Capital Cost: $23,000
- Annual Cost: $2,000
- 5 Year Cost: $25,000
- 30-Year Net Present Worth (NPW): $190,000

State Acceptance

The Illinois EPA has indicated that Alternative 2 could be an acceptable alternative because LUCs are frequently used to manage properties impacted by low-level soil contamination where concentrations exceed residential criteria but are otherwise acceptable for commercial/industrial development.

Community Acceptance

This assessment will be performed after comments on the Proposed Plan are received from the public.

4.3.3 Alternative 3: Excavation and Off-Site Disposal

4.3.3.1 Description

Alternative 3 would consist of soil excavation at the area shown on Figure 4-1, as necessary, to meet the TACO Tier 1 Remedial Objectives for arsenic and manganese. The excavated area abuts the neighboring building to the west and it is assumed that the contaminated soil is not under the building. Excavated material would be transported off-base to a non-hazardous landfill for disposal. No Five-Year Review would be required for this alternative since the contaminated soil would be removed from the site. After completion of remedial action, the property could be developed with no restrictions on land use.

4.3.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 3 would be protective of human health and the environment, as contaminants would be permanently removed from the site.

Compliance with ARARs and TBCs

Alternative 3 would comply with chemical- and location-specific ARARs and TBCs. Alternative 3 would also comply with all action-specific ARARs relevant to the excavation, transportation, and off-site disposal of contaminated soil.

Long-Term Effectiveness and Permanence

Alternative 3 would provide long-term effectiveness and permanence. Although no treatment would be used to reduce COC concentrations, the contaminated soil would be removed from the site, thereby limiting exposure to human receptors.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 3 contains no treatment component; therefore, no reduction in contaminant toxicity, mobility, or volume would be realized through treatment.

Short-Term Effectiveness

Implementation of Alternative 3 could result in short-term risk to remediation workers because of exposure to contaminated soil during excavation, staging, transportation, and off-base landfill disposal. However, potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression and appropriate site monitoring. The potential for worker exposure would be further reduced by compliance with site-specific health and safety procedures, including wearing appropriate personal protective equipment. Appropriate site monitoring would also be implemented for this alternative to measure emissions from the excavation activities.

Life cycle impacts associated with mechanical excavation include greenhouse gas emissions, criteria pollutant emissions, water consumption, and energy consumption. This alternative can be optimized to

reduce greenhouse gas and criteria pollutant emissions by using biodiesel fuel instead of petroleum based diesel.

Implementability

Alternative 3 would be easily implemented. The area of excavation is developed and there are utilities and utility corridors around and through the site. Implementation of Alternative 3 would involve the completion of numerous administrative procedures such as obtaining a construction permit for excavation and the off-site transportation and disposal of the excavated material, including determining the requirements for non-hazardous waste transport and disposal. While constituting a significant effort, these procedures could readily be accomplished.

Cost

The estimated capital cost for removal of inorganic contaminated soil is $385,000. A detailed cost estimate is provided in Appendix A. These costs are rounded to the nearest $1,000 to reflect the preliminary nature of the estimates.

State Acceptance

The state has indicated that soil excavation to meet TACO Tier 1 Remediation Objectives for inorganics would be acceptable.

Community Acceptance

This assessment will be performed after comments on the Proposed Plan are received from the public.

4.4 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Table 4-1 compares the analyses of the remedial alternatives that were described above. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives. The Navy has the option of selecting any alternative or combination of alternatives.

TABLE 4-1

NINE EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Threshold Criteria

1	Overall Protection of Human Health and the Environment	Will it protect you and the plant and animal life on and near the site? EPA and the Navy will not choose a plan that does not meet this basic criterion.
2	Compliance with ARARs	Does the alternative meet all federal environmental, state environmental, and facility siting statues, regulations and requirements? The chosen cleanup plan must meet this criterion.

Primary Balancing Criteria

3	Long-Term Effectiveness and Permanence	Will the effects of the cleanup plan last or could contamination cause future risk?
4	Reduction of Toxicity, Mobility or Volume through Treatment	Using treatment, does the alternative reduce the harmful effects of the contaminants, the spread of contaminants, and the amount of contaminated material?
5	Short-Term Effectiveness	How soon will site risks be adequately reduced? Could the cleanup cause short-term hazards to workers, residents, or the environment?
6	Implementability	Is the alternative technically feasible? Are the right goods and services available for the plan?
7	Cost	What is the total cost of an alternative over time? EPA and the Navy must find a plan that gives necessary protection for a reasonable cost

Modifying Criteria

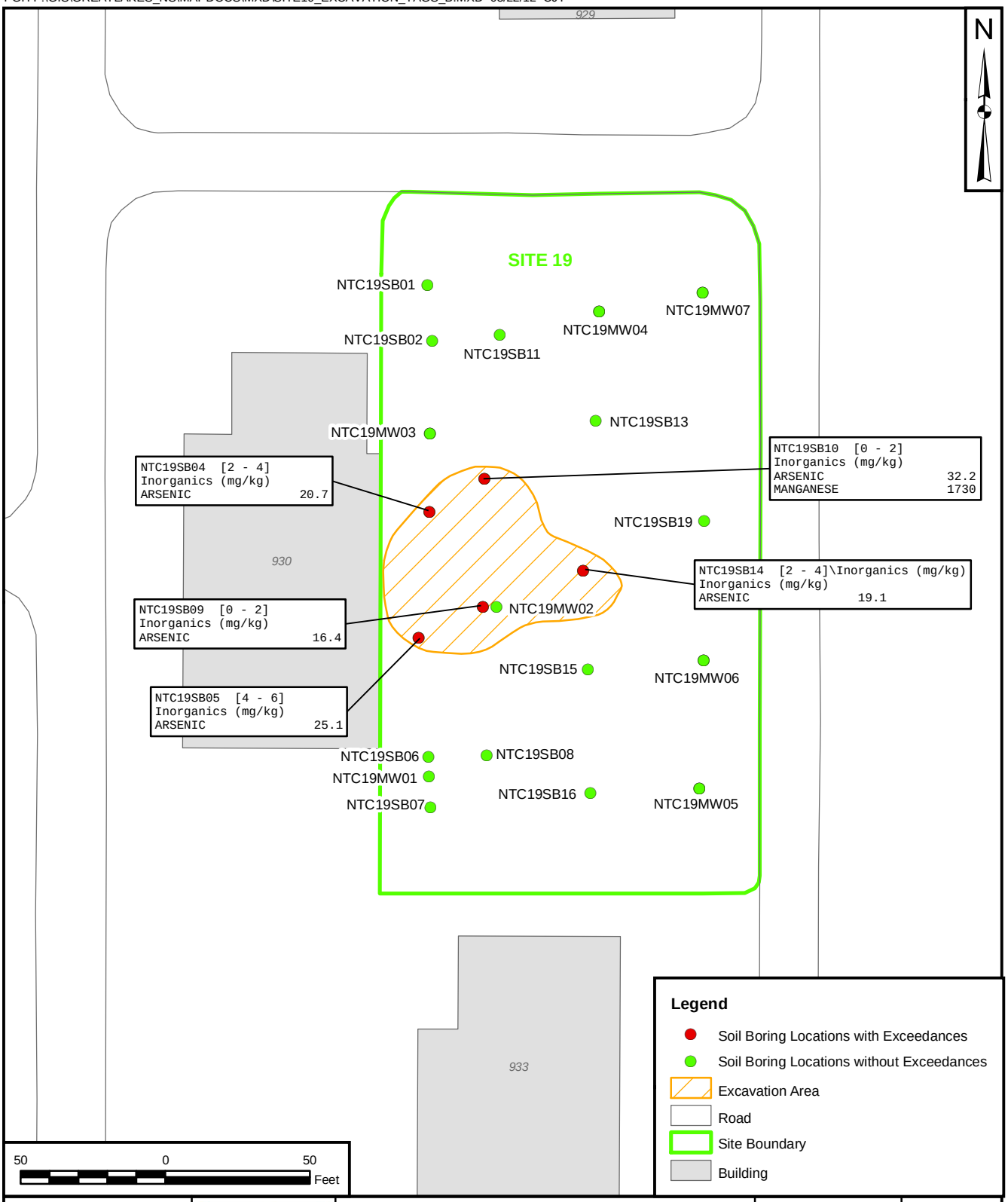
8	State Acceptance	Does the state agree with the proposal?
9	Community Acceptance	What objections, suggestions, or modifications do the public offer during the comment period?

TABLE 4-2

**SUMMARY OF COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES
SITE 19 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS**

EVALUATION CRITERION	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LUCs	ALTERNATIVE 3: EXCAVATION AND OFF-BASE DISPOSAL
Overall Protection of Human Health and Environment	Not protective. The potential for exposure of human receptors to contaminated soil would remain unchanged.	Protective of human health by minimizing exposure to contaminated soil.	Protective of human health as contaminants would be permanently removed from the site.
Compliance with ARARs & TBCs: Chemical-Specific Location-Specific Action-Specific	 *Would not comply *Not applicable *Not applicable	 *Would comply via control of exposure pathways. *Would comply *Not Applicable	 *Would comply *Would comply *Would comply
Long-Term Effectiveness and Permanence	Neither effective nor permanent.	Provides long-term effectiveness and permanence.	Provides long-term effectiveness and permanence.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None.	None.	None.
Short-Term Effectiveness	Would not result in risks to on-site workers or result in short-term adverse impact to the local community and the environment. Would not achieve RAO or PRGs.	Would not result in risks to on-site workers or result in short-term adverse impact to the local community and the environment. Would achieve RAO and PRGs via control of exposure pathways.	Would not result in risks to on-site workers or result in short-term adverse impacts to local community and the environment. Would achieve RAO and PRGs by removal of the contaminated soil. Life cycle impacts resulting from excavation activities include greenhouse gas and criteria pollutant emissions, water and energy consumption. This alternative can be optimized to reduce greenhouse gas and criteria pollutant emissions by using biodiesel.
Implementability	Readily implementable.	Readily implementable.	Readily implementable.
Costs:	$0	Capital Cost: $23,000 Annual Cost $3,000 5 Year Cost: $25,000 30-Year NPW: $190,000	$385,000
State Acceptance	Illinois EPA has indicated that Alternatives 2 or 3 would be acceptable alternatives.		
Community Acceptance	Assessment will be performed after comments on the Proposed Plan are received from the public.		

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE19_EXCAVATION_TAGS_B.MXD 05/22/12 CJT



DRAWN BY	DATE
S. PAXTON	05/11/12
CHECKED BY	DATE
C. GALAND	05/11/12
REVISED BY	DATE
C. TULLEY	05/22/12
SCALE AS NOTED	

APPROXIMATE LIMITS OF EXCAVATION
SITE 19 - FORMER BUILDING 910
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
0936	468
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
FIGURE NO.	REV
FIGURE 4 - 1	0

REFERENCES

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APPENDIX A

COST ESTIMATE

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 19 - Formal Building 910
Alternative 2: LUCs with 5-Year Reviews
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$2,350	$23,000	
Contingency @ 10%	$235	$2,300	
TOTAL	**$2,585**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 19 - Formal Building 910
Alternative 2: LUCs with 5-Year Reviews
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$23,423		$23,423	1.000	$23,423
1		$2,585	$2,585	0.980	$2,534
2		$2,585	$2,585	0.961	$2,485
3		$2,585	$2,585	0.942	$2,436
4		$2,585	$2,585	0.924	$2,388
5		$27,885	$27,885	0.906	$25,256
6		$2,585	$2,585	0.888	$2,295
7		$2,585	$2,585	0.871	$2,250
8		$2,585	$2,585	0.853	$2,206
9		$2,585	$2,585	0.837	$2,163
10		$27,885	$27,885	0.820	$22,875
11		$2,585	$2,585	0.804	$2,079
12		$2,585	$2,585	0.788	$2,038
13		$2,585	$2,585	0.773	$1,998
14		$2,585	$2,585	0.758	$1,959
15		$27,885	$27,885	0.743	$20,719
16		$2,585	$2,585	0.728	$1,883
17		$2,585	$2,585	0.714	$1,846
18		$2,585	$2,585	0.700	$1,810
19		$2,585	$2,585	0.686	$1,774
20		$27,885	$27,885	0.673	$18,766
21		$2,585	$2,585	0.660	$1,706
22		$2,585	$2,585	0.647	$1,672
23		$2,585	$2,585	0.634	$1,639
24		$2,585	$2,585	0.622	$1,607
25		$27,885	$27,885	0.610	$16,997
26		$2,585	$2,585	0.598	$1,545
27		$2,585	$2,585	0.586	$1,514
28		$2,585	$2,585	0.574	$1,485
29		$2,585	$2,585	0.563	$1,456
30		$27,885	$27,885	0.552	$15,394
				TOTAL PRESENT WORTH	**$190,201**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 19 - Formal Building 910
Alternative 2: LUCs with 5-Year Reviews
Capital Cost

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Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare LUC Documents	300	hr			$39.00		$0	$0	$11,700	$0	$11,700
Subtotal							$0	$0	$11,700	$0	$11,700
Overhead on Labor Cost @	30%								$3,510		$3,510
G & A Cost @	10%						$0	$0	$1,170	$0	$1,170
Tax on Materials and Equipment Cost @	6.25%							$0		$0	$0
Total Direct Cost							$0	$0	$16,380	$0	$16,380
Indirects on Total Direct Cost @	20%										$3,276
Profit on Total Direct Cost @	10%										$1,638
Subtotal											$21,294
Health & Safety Monitoring @	0%										$0
Total Field Cost											$21,294
Contingency on Total Field Costs @	10%										$2,129
Engineering on Total Field Cost @	0%										$0
TOTAL CAPITAL COST											**$23,423**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 19 - Formal Building 910

Alternative 3: Excavation and Off-Site Disposal
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	250	hr			$39.00		$0	$0	$9,750	$0	$9,750
1.2 Prepare Permits	200	hr			$39.00		$0	$0	$7,800	$0	$7,800
1.3 Prepare Shoring Design	150	hr			$39.00		$0	$0	$5,850	$0	$5,850
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	4	ea			$188.00	$566.00	$0	$0	$752	$2,264	$3,016
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	1	mo				$94.00	$0	$0	$0	$94	$94
3.2 Survey Support	1	day	$1,150.00				$1,150	$0	$0	$0	$1,150
3.3 Site Superintendent	12	day		$242.00	$384.24		$0	$2,904	$4,611	$0	$7,515
3.4 Underground Utility Clearance	1	ls	$7,350.00				$7,350	$0	$0	$0	$7,350
4 DECONTAMINATION											
4.1 Decontamination Services	0.5	mo		$1,220.00	$2,245.00	$1,550.00	$0	$610	$1,123	$775	$2,508
4.2 Equipment Decon Pad	1	ls		$4,500.00	$3,000.00	$725.00	$0	$4,500	$3,000	$725	$8,225
4.3 Decon Water	500	gal		$0.20			$0	$100	$0	$0	$100
4.4 Decon Water Storage Tank, 6,000 gallon	0.5	mo				$813.00	$0	$0	$0	$407	$407
4.5 Clean Water Storage Tank, 4,000 gallon	0.5	mo				$731.00	$0	$0	$0	$366	$366
4.6 Disposal of Decon Waste (liquid & solid)	0.5	mo	$985.00				$493	$0	$0	$0	$493
5 EXCAVATION, DISPOSAL, AND RESTORATION											
5.1 Foundation Shoring	200	sf	$9.30				$1,860	$0	$0	$0	$1,860
5.2 Excavator, 2.5 cy	8	day			$372.40	$1,652.00	$0	$0	$2,979	$13,216	$16,195
5.3 Dozer, 140 hp	8	day			$358.00	$817.40	$0	$0	$2,864	$6,539	$9,403
5.4 Site Labor, (3 laborers)	24	day			$280.80		$0	$0	$6,739	$0	$6,739
5.5 Transport & Dispose Excavated Soil, nonhazardous	795	ton	$85.00				$67,575	$0	$0	$0	$67,575
5.6 Waste Disposal Characterization / Analytical	1	ea	$850.00	$30.00	$50.00	$30.00	$850	$30	$50	$30	$960
5.7 Backfill, common fill	265	cy		$24.65			$0	$6,532	$0	$0	$6,532
5.8 Backfill, gravel	265	cy		$31.50			$0	$8,348	$0	$0	$8,348
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	150	hr			$39.00		$0	$0	$5,850	$0	$5,850
6.2 Remedial Action Closeout Report	200	hr			$39.00		$0	$0	$7,800	$0	$7,800
Subtotal							$79,278	$23,024	$59,168	$24,415	$185,884
Overhead on Labor Cost @ 30%									$17,750		$17,750
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$7,928	$2,302	$5,917	$2,442	$18,588
Tax on Materials and Equipment Cost @ 6.25%								$1,439		$1,526	$2,965
Total Direct Cost							$87,205	$26,765	$82,835	$28,383	$225,188
Indirects on Total Direct Cost @ 25%		(excluding transportation and disposal cost)									$39,280
Profit on Total Direct Cost @ 10%											$22,519
Subtotal											$286,987

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Health & Safety Monitoring @ 3%											$8,610
Total Field Cost											$295,596
Engineering on Total Field Cost @ 10%											$29,560
Contingency on Total Field Cost @ 20%											$59,119
TOTAL CAPITAL COST											**$384,275**

APPENDIX B

CONSTRUCTION WORKER PATHWAY CALCULATIONS AND RISK SUMMARY

TABLE 4.8

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) =
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	$\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04 Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(RME) = 2.38E-01 Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

TABLE 7.8. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-07	mg/m^3	R	2.7E-08	mg/m^3	1.5E-05	mg/m^3	1.8E-03
	BARIUM	9.8E+01	mg/kg	7.9E-07	mg/m^3	R	1.9E-07	mg/m^3	5.0E-04	mg/m^3	3.8E-04
	CHROMIUM	2.2E+01	mg/kg	1.8E-07	mg/m^3	R	4.3E-08	mg/m^3	1.0E-04	mg/m^3	4.3E-04
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	2.1E-08	mg/m^3	6.0E-06	mg/m^3	3.5E-03
	MANGANESE	1.1E+03	mg/kg	8.5E-06	mg/m^3	R	2.0E-06	mg/m^3	5.0E-05	mg/m^3	4.0E-02
	NICKEL	2.9E+01	mg/kg	2.3E-07	mg/m^3	R	5.6E-08	mg/m^3	9.0E-05	mg/m^3	6.2E-04
	(total)										4.7E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**0.05**

8.8. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-07	mg/m^3	R	4.4E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.9E-10
	BARIUM	9.8E+01	mg/kg	7.9E-07	mg/m^3	R	3.1E-10	mg/m^3			
	CHROMIUM	2.2E+01	mg/kg	1.8E-07	mg/m^3	R	7.0E-11	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	5.9E-09
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	3.5E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	3.1E-10
	MANGANESE	1.1E+03	mg/kg	8.5E-06	mg/m^3	R	3.3E-09	mg/m^3			
	NICKEL	2.9E+01	mg/kg	2.3E-07	mg/m^3	R	9.2E-11	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	2.4E-11
	(total)										6.4E-09
										Total Risk Across All Exposure Routes/Pathways	**6.4E-09**

TABLE 4.2

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) =
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	$\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04
Noncancer Inhalation Intake(RME) = 2.38E-01

Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(CTE) = 1.19E-01

TABLE 7.8a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-07	mg/m^3	R	1.3E-08	mg/m^3	1.5E-05	mg/m^3	9.0E-04
	BARIUM	9.8E+01	mg/kg	7.9E-07	mg/m^3	R	9.4E-08	mg/m^3	5.0E-04	mg/m^3	1.9E-04
	CHROMIUM	2.2E+01	mg/kg	1.8E-07	mg/m^3	R	2.1E-08	mg/m^3	1.0E-04	mg/m^3	2.1E-04
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	1.1E-08	mg/m^3	6.0E-06	mg/m^3	1.8E-03
	MANGANESE	1.1E+03	mg/kg	8.5E-06	mg/m^3	R	1.0E-06	mg/m^3	5.0E-05	mg/m^3	2.0E-02
	NICKEL	2.9E+01	mg/kg	2.3E-07	mg/m^3	R	2.8E-08	mg/m^3	9.0E-05	mg/m^3	3.1E-04
	(total)										2.4E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**0.02**

8.8a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ARSENIC	1.4E+01	mg/kg	1.1E-07	mg/m^3	R	2.2E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	9.5E-11
	BARIUM	9.8E+01	mg/kg	7.9E-07	mg/m^3	R	1.5E-10	mg/m^3			
	CHROMIUM	2.2E+01	mg/kg	1.8E-07	mg/m^3	R	3.5E-11	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	2.9E-09
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	1.7E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	1.6E-10
	MANGANESE	1.1E+03	mg/kg	8.5E-06	mg/m^3	R	1.7E-09	mg/m^3		$(mg/m^3)^{-1}$	
	NICKEL	2.9E+01	mg/kg	2.3E-07	mg/m^3	R	4.6E-11	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	1.2E-11
	(total)										3.2E-09
										Total Risk Across All Exposure Routes/Pathways	**3.2E-09**

TABLE 4.9

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) =
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	$\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04 Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(RME) = 2.38E-01 Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

TABLE 7.9. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.6E-05	mg/m^3	R	1.8E-05	mg/m^3	5.0E-03	mg/m^3	3.6E-03
	ARSENIC	1.2E+01	mg/kg	9.6E-08	mg/m^3	R	2.3E-08	mg/m^3	1.5E-05	mg/m^3	1.5E-03
	CHROMIUM	1.8E+01	mg/kg	1.4E-07	mg/m^3	R	3.4E-08	mg/m^3	1.0E-04	mg/m^3	3.4E-04
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	2.1E-08	mg/m^3	6.0E-06	mg/m^3	3.5E-03
	MANGANESE	8.5E+02	mg/kg	6.8E-06	mg/m^3	R	1.6E-06	mg/m^3	5.0E-05	mg/m^3	3.2E-02
	NICKEL	2.8E+01	mg/kg	2.2E-07	mg/m^3	R	5.3E-08	mg/m^3	9.0E-05	mg/m^3	5.9E-04
	(total)										4.2E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**0.04**

8.9. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.6E-05	mg/m^3	R	3.0E-08	mg/m^3			
	ARSENIC	1.2E+01	mg/kg	9.6E-08	mg/m^3	R	3.8E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.6E-10
	CHROMIUM	1.8E+01	mg/kg	1.4E-07	mg/m^3	R	5.5E-11	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	4.6E-09
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	3.5E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	3.1E-10
	MANGANESE	8.5E+02	mg/kg	6.8E-06	mg/m^3	R	2.7E-09	mg/m^3			
	NICKEL	2.8E+01	mg/kg	2.2E-07	mg/m^3	R	8.7E-11	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	2.3E-11
	(total)										5.1E-09
										Total Risk Across All Exposure Routes/Pathways	**5.1E-09**

TABLE 4.9

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) =
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	$\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04 Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(RME) = 2.38E-01 Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

TABLE 7.9a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.6E-05	mg/m^3	R	9.1E-06	mg/m^3	5.0E-03	mg/m^3	1.8E-03
	ARSENIC	1.2E+01	mg/kg	9.6E-08	mg/m^3	R	1.1E-08	mg/m^3	1.5E-05	mg/m^3	7.6E-04
	CHROMIUM	1.8E+01	mg/kg	1.4E-07	mg/m^3	R	1.7E-08	mg/m^3	1.0E-04	mg/m^3	1.7E-04
	COBALT	1.1E+01	mg/kg	8.9E-08	mg/m^3	R	1.1E-08	mg/m^3	6.0E-06	mg/m^3	1.8E-03
	MANGANESE	8.5E+02	mg/kg	6.8E-06	mg/m^3	R	8.1E-07	mg/m^3	5.0E-05	mg/m^3	1.6E-02
	NICKEL	2.8E+01	mg/kg	2.2E-07	mg/m^3	R	2.7E-08	mg/m^3	9.0E-05	mg/m^3	3.0E-04
	(total)										2.1E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**2.1E-02**

8.9a. CENTRAL TENDENCY EXPOSURE (CTE)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ALUMINUM	9.4E+03	mg/kg	7.6E-05	mg/m^3	R	1.5E-08	mg/m^3			
	ARSENIC	1.2E+01	mg/kg	9.6E-08	mg/m^3	R	1.9E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	8.1E-11
	CHROMIUM	1.8E+01	mg/kg	1.4E-07	mg/m^3	R	2.8E-11	mg/m^3	8.4E+01	$(mg/m^3)^{-1}$	2.3E-09
	COBALT	8.5E+02	mg/kg	8.9E-08	mg/m^3	R	1.7E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	1.6E-10
	MANGANESE	8.5E+02	mg/kg	6.8E-06	mg/m^3	R	1.3E-09	mg/m^3			
	NICKEL	2.8E+01	mg/kg	2.2E-07	mg/m^3	R	4.4E-11	mg/m^3	2.6E-01	$(mg/m^3)^{-1}$	1.1E-11
	(total)										2.6E-09
										Total Risk Across All Exposure Routes/Pathways	**2.6E-09**

TABLE 6-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Construction/Excavation Worker	Surface Soil	Ingestion	2.E-07	- -	- -	- -	0.5	- -
		Dermal Contact	3.E-08	- -	- -	- -	0.01	- -
		Inhalation	6.E-09	- -	- -	- -	0.05	- -
		Total	2.E-07	- -	- -	- -	0.6	- -
	Subsurface Soil	Ingestion	1.E-07	- -	- -	- -	0.4	- -
		Dermal Contact	9.E-09	- -	- -	- -	0.01	- -
		Inhalation	5.E-09	- -	- -	- -	0.04	- -
		Total	1.E-07	- -	- -	- -	0.5	- -
	Groundwater	Ingestion	NA	- -	- -	- -	NA	- -
		Dermal Contact	1.E-09	- -	- -	- -	0.001	- -
		Total	1.E-09	- -	- -	- -	0.001	- -
		Total Surface Soil	2.E-07	- -	- -	- -	0.6	- -
		Total Subsurface Soil	1.E-07	- -	- -	- -	0.5	- -
		Total Groundwater	1.E-09	- -	- -	- -	0.001	- -
		Total Across the Entire Site	**3.E-07**	- -	- -	- -	**1**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Maintenance Worker	Surface Soil	Ingestion	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Dermal Contact	4.E-06	- -	- -	cPAHs	0.009	- -
		Total	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Total Surface Soil	1.E-05	- -	- -	- -	0.2	- -
		Total Across the Entire Site	**1.E-05**	- -	- -	- -	**0.2**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Occupational Worker	Surface Soil	Ingestion	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Dermal Contact	4.E-06	- -	- -	cPAHs	0.009	- -
		Total	1.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Total Surface Soil	1.E-05	- -	- -	- -	0.2	- -
		Total Across the Entire Site	**1.E-05**	- -	- -	- -	**0.2**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Adolescent Trespasser	Surface Soil	Ingestion	1.E-06	- -	- -	- -	0.03	- -
		Dermal Contact	6.E-07	- -	- -	- -	0.002	- -
		Total	2.E-06	- -	- -	- -	0.03	- -
		Total Surface Soil	2.E-06	- -	- -	- -	0.03	- -
		Total Across the Entire Site	**2.E-06**	- -	- -	- -	**0.03**	- -

TABLE 6-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME)
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Child Resident	Surface Soil	Ingestion	7.E-05	- -	cPAHs, Arsenic	- -	2	- -
		Dermal Contact	2.E-05	- -	cPAHs	Arsenic	0.05	- -
		Total	8.E-05	- -	cPAHs, Arsenic	- -	2	- -
	Groundwater	Ingestion	5.E-05	- -	Arsenic	cPAHs	1.1	- -
		Dermal Contact	6.E-08	- -	- -	- -	0.002	- -
		Total	5.E-05	- -	Arsenic	cPAHs	1.1	- -
		Total Surface Soil	8.E-05	- -	- -	- -	2	- -
		Total Groundwater	5.E-05	- -	- -	- -	1.1	- -
		Total Across the Entire Site	**1.E-04**	- -	- -	- -	**3**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Adult Resident	Surface Soil	Ingestion	2.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
		Dermal Contact	4.E-06	- -	- -	cPAHs	0.008	- -
		Total	2.E-05	- -	- -	cPAHs, Arsenic	0.2	- -
	Groundwater	Ingestion	5.E-05	- -	Arsenic	cPAHs	0.3	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.0009	- -
		Total	5.E-05	- -	Arsenic	cPAHs	0.3	- -
		Total Surface Soil	2.E-05	- -	- -	- -	0.2	- -
		Total Groundwater	5.E-05	- -	- -	- -	0.3	- -
		Total Across the Entire Site	**7.E-05**	- -	- -	- -	**0.5**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Total Residential Risks	Surface Soil	Ingestion	8.E-05	- -	cPAHs, Arsenic	- -	NA	- -
		Dermal Contact	2.E-05	- -	cPAHs	Arsenic	NA	- -
		Total	1.E-04	- -	cPAHs, Arsenic	- -	NA	- -
	Groundwater	Ingestion	1.E-04	- -	cPAHs, Arsenic	- -	NA	- -
		Dermal Contact	2.E-07	- -	- -	- -	NA	- -
		Total	1.E-04	- -	cPAHs, Arsenic	- -	NA	- -
		Total Surface Soil	1.E-04	- -	- -	- -	NA	- -
		Total Groundwater	1.E-04	- -	- -	- -	NA	- -
		Total Across the Entire Site	**2.E-04**	- -	- -	- -	NA	- -

cPAHs = Carcinogenic PAHs
NA = Not applicable

TABLE 6-14

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURE (CTE)
SITE 19 - SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Construction/Excavation Worker	Surface Soil	Ingestion	8.E-08	- -	- -	- -	0.3	- -
		Dermal Contact	9.E-09	- -	- -	- -	0.005	- -
		Inhalation	3.E-09	- -	- -	- -	0.02	- -
		Total	9.E-08	- -	- -	- -	0.3	- -
	Subsurface Soil	Ingestion	5.E-08	- -	- -	- -	0.2	- -
		Dermal Contact	3.E-09	- -	- -	- -	0.004	- -
		Inhalation	3.E-09	- -	- -	- -	0.02	- -
		Total	6.E-08	- -	- -	- -	0.2	- -
	Groundwater	Ingestion	NA	- -	- -	- -	NA	- -
		Dermal Contact	5.E-10	- -	- -	- -	0.0007	- -
		Total	5.E-10	- -	- -	- -	0.0007	- -
		Total Surface Soil	9.E-08	- -	- -	- -	0.3	- -
		Total Subsurface Soil	6.E-08	- -	- -	- -	0.2	- -
		Total Groundwater	5.E-10	- -	- -	- -	0.0007	- -
		Total Across the Entire Site	**1.E-07**	- -	- -	- -	**0.5**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Maintenance Worker	Surface Soil	Ingestion	2.E-06	- -	- -	- -	0.07	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.0008	- -
		Total	2.E-06	- -	- -	- -	0.07	- -
		Total Surface Soil	2.E-06	- -	- -	- -	0.07	- -
		Total Across the Entire Site	**2.E-06**	- -	- -	- -	**0.07**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Occupational Worker	Surface Soil	Ingestion	2.E-06	- -	- -	- -	0.07	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.0008	- -
		Total	2.E-06	- -	- -	- -	0.07	- -
		Total Surface Soil	2.E-06	- -	- -	- -	0.07	- -
		Total Across the Entire Site	**2.E-06**	- -	- -	- -	**0.07**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Adolescent Trespasser	Surface Soil	Ingestion	2.E-07	- -	- -	- -	0.007	- -
		Dermal Contact	2.E-08	- -	- -	- -	0.0002	- -
		Total	2.E-07	- -	- -	- -	0.007	- -
		Total Surface Soil	2.E-07	- -	- -	- -	0.007	- -
		Total Across the Entire Site	**2.E-07**	- -	- -	- -	**0.007**	- -

TABLE 6-14

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CENTRAL TENDENCY EXPOSURE (CTE)
SITE 19 - SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Child Resident	Surface Soil	Ingestion	4.E-06	- -	- -	Arsenic	0.7	- -
		Dermal Contact	2.E-07	- -	- -	- -	0.007	- -
		Total	4.E-06	- -	- -	Arsenic	0.7	- -
	Groundwater	Ingestion	4.E-06	- -	- -	Arsenic	0.09	- -
		Dermal Contact	1.E-08	- -	- -	- -	0.0002	- -
		Total	4.E-06	- -	- -	Arsenic	0.09	- -
		Total Surface Soil	4.E-06	- -	- -	- -	0.7	- -
		Total Groundwater	4.E-06	- -	- -	- -	0.09	- -
		Total Across the Entire Site	**8.E-06**	- -	- -	- -	**0.8**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Adult Resident	Surface Soil	Ingestion	1.E-06	- -	- -	- -	0.07	- -
		Dermal Contact	8.E-08	- -	- -	- -	0.0008	- -
		Total	1.E-06	- -	- -	- -	0.07	- -
	Groundwater	Ingestion	7.E-06	- -	- -	Arsenic	0.14	- -
		Dermal Contact	2.E-08	- -	- -	- -	0.0005	- -
		Total	7.E-06	- -	- -	Arsenic	0.14	- -
		Total Surface Soil	1.E-06	- -	- -	- -	0.07	- -
		Total Groundwater	7.E-06	- -	- -	- -	0.14	- -
		Total Across the Entire Site	**8.E-06**	- -	- -	- -	**0.2**	- -

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Total Residential Risks	Surface Soil	Ingestion	5.E-06	- -	- -	cPAHs, Arsenic	NA	- -
		Dermal Contact	3.E-07	- -	- -	- -	NA	- -
		Total	5.E-06	- -	- -	cPAHs, Arsenic	NA	- -
	Groundwater	Ingestion	1.E-05	- -	- -	Arsenic	NA	- -
		Dermal Contact	3.E-08	- -	- -	- -	NA	- -
		Total	1.E-05	- -	- -	Arsenic	NA	- -
		Total Surface Soil	5.E-06	- -	- -	- -	NA	- -
		Total Groundwater	1.E-05	- -	- -	- -	NA	- -
		Total Across the Entire Site	**2.E-05**	- -	- -	- -	NA	- -

cPAHs = Carcinogenic PAHs

TABLE 9.1. REASONABLE MAXIMUM EXPOSURE (RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CONSTRUCTION WORKER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.0E-08		1.6E-08	5.6E-08	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	4.6E-02			4.6E-02
			ARSENIC	1.2E-07	1.9E-10	1.1E-08	1.3E-07	ARSENIC	Skin, CVS	1.6E-01	1.8E-03	1.5E-02	1.8E-01
			BARIUM					BARIUM	Kidney		3.8E-04		3.8E-04
			CHROMIUM		5.9E-09		5.9E-09	CHROMIUM	Fetotoxicity/GS/Bone	2.5E-02	4.3E-04		2.5E-02
			COBALT		3.1E-10		3.1E-10	COBALT	CVS, Immunological, Neurological	1.2E-01	3.5E-03		1.2E-01
			IRON					IRON	Gastrointestinal System	1.4E-01			1.4E-01
			MANGANESE					MANGANESE	CNS	2.5E-02	4.0E-02		6.6E-02
			NICKEL		2.4E-11		2.4E-11	NICKEL	Body Weight		6.2E-04		6.2E-04
Soil	Subsurface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	8.1E-10		3.2E-10	1.1E-09	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	3.2E-02	3.6E-03		3.5E-02
			ARSENIC	1.0E-07	1.6E-10	9.0E-09	1.1E-07	ARSENIC	Skin, CVS	1.3E-01	1.5E-03	1.2E-02	1.5E-01
			CHROMIUM		4.6E-09		4.6E-09	CHROMIUM	Fetotoxicity/GS/Bone	2.0E-02	3.4E-04		2.0E-02
			COBALT		3.1E-10		3.1E-10	COBALT	CVS, Immunological, Neurological	1.2E-01	3.5E-03		1.3E-01
			IRON					IRON	Gastrointestinal System	1.1E-01			1.1E-01
			NICKEL		2.4E-11		2.4E-11	NICKEL	Body Weight		5.9E-04		5.9E-04
			MANGANESE					MANGANESE	CNS	2.0E-02	3.2E-02		5.3E-02
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)					BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC			1.1E-09	1.1E-09	ARSENIC	Skin, CVS			1.5E-03	1.5E-03
			Total Risk for Surface Soil				1.9E-07		Total HI for Surface Soil				0.6
			Total Risk for Subsurface Soil				1.1E-07		Total HI for Subsurface Soil				0.5
			Total Risk for Groundwater				1.1E-09		Total HI for Groundwater				0.0015

Total Risk Across All Media and All Exposure Routes: 3.E-07

Total HI Across All Media and All Exposure Routes: 1.E+00

Total Immune System HI =	0.3	Total Gastrointestinal HI =	0.3
Total Skin HI =	0.3	Total Kidney HI =	0.0004
Total CVS HI =	0.6	Total Fetotoxicity & Bone HI =	0.05
Total Neurological HI =	0.3	CNS HI =	0.2
Body Weight =	0.001		

TABLE 9.1a. CENTRAL TENDENCY EXPOSURE (CTE)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - FUTURE CONSTRUCTION WORKER
SITE 19 - FORMER SMALL ARMS RANGE BUILDING 910
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Surface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	2.0E-08		5.3E-09	2.5E-08	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	2.3E-02			2.3E-02
			ARSENIC	6.0E-08	9.5E-11	3.6E-09	6.3E-08	ARSENIC	Skin, CVS	8.1E-02	9.0E-04	4.8E-03	8.7E-02
			BARIUM					BARIUM	Kidney		1.9E-04		1.9E-04
			CHROMIUM		2.9E-09		2.9E-09	CHROMIUM	Fetotoxicity/GS/Bone	1.2E-02	2.1E-04		1.3E-02
			COBALT		1.6E-10		1.6E-10	COBALT	CVS, Immunological, Neurological	6.1E-02	1.8E-03		6.2E-02
			IRON					IRON	Gastrointestinal System	7.1E-02			7.1E-02
			MANGANESE					MANGANESE	CNS	1.3E-02	2.0E-02		3.3E-02
			NICKEL		1.2E-11		1.2E-11	NICKEL	Body Weight		3.1E-04		3.1E-04
Soil	Subsurface Soil	Entire Site	BAP EQUIVALENT (1/2 DL)	4.0E-10		1.1E-10	5.1E-10	BAP EQUIVALENT (1/2 DL)	NA				
			ALUMINUM					ALUMINUM	CNS	1.6E-02	1.8E-03		1.8E-02
			ARSENIC	5.0E-08	8.1E-11	3.0E-09	5.3E-08	ARSENIC	Skin, CVS	6.7E-02	7.6E-04	4.0E-03	7.2E-02
			CHROMIUM		2.3E-09		2.3E-09	CHROMIUM	Fetotoxicity/GS/Bone	9.8E-03	1.7E-04		1.0E-02
			COBALT		1.6E-10		1.6E-10	COBALT	CVS, Immunological, Neurological	6.2E-02	1.8E-03		6.4E-02
			IRON					IRON	Gastrointestinal System	5.7E-02			5.7E-02
			NICKEL					NICKEL	Body Weight		3.0E-04		3.0E-04
			MANGANESE		1.1E-11		1.1E-11	MANGANESE	CNS	1.0E-02	1.6E-02		2.6E-02
Groundwater	Groundwater	Entire Site	BAP EQUIVALENT (1/2 DL)					BAP EQUIVALENT (1/2 DL)	NA				
			ARSENIC			5.5E-10	5.5E-10	ARSENIC	Skin, CVS			7.4E-04	7.4E-04
			Total Risk for Surface Soil				9.2E-08		Total HI for Surface Soil				0.3
			Total Risk for Subsurface Soil				5.6E-08		Total HI for Subsurface Soil				0.2
			Total Risk for Groundwater				5.5E-10		Total HI for Groundwater				0.0007

Total Risk Across All Media and All Exposure Routes: 1.E-07

Total HI Across All Media and All Exposure Routes: 0.5

Total Immune System HI =	0.1	Total Gastrointestinal HI =	0.2
Total Skin HI =	0.2	Total Kidney HI =	0.0002
Total CVS HI =	0.3	Total Fetotoxicity & Bone HI =	0.02
Total Neurological HI =	0.1	CNS HI =	0.1
Body Weight =	0.0006		

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Superfund Publication: 9380.3-06FS November 1991

EPA

A Guide to Principal Threat and Low Level Threat Wastes

Office of Emergency and Remedial Response
Hazardous Site Control Division OS-220W

Quick Reference Fact Sheet

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) promulgated on March 8, 1990 states that EPA expects to use "treatment to address the principal threats posed by a site, wherever practicable" and "engineering controls, such as containment, for waste that poses a relatively low long-term threat." (40 CFR Section 300.430(a)(1)(iii).) These expectations, derived from the mandates of CERCLA §121 and based on previous Superfund experience, were developed as guidelines to communicate the types of remedies that the EPA generally anticipates to find appropriate for specific types of wastes. Although remedy selection decisions are ultimately site-specific determinations based on an analysis of remedial alternatives using the nine evaluation criteria, these expectations help to streamline and focus the remedial investigation/feasibility study (RI/FS) on appropriate waste management options. **This guide explains considerations that should be taken into account in categorizing waste for which treatment or containment generally will be suitable and provides definitions, examples, and ROD documentation requirements related to waste that constitute a principal or low level threat.** EPA makes this categorization of waste as principal or low level threat waste after deciding whether to take remedial action at a site. The "Interim Final Guidance on Preparing Superfund Decision Documents," (EPA/624/1-87/90, October 1990) and "A Guide to Developing Superfund Records of Decision" (Publication 9335.3-02FS-1, May 1990) provide additional information on ROD documentation.

NCP Expectations

EPA established general expectations in the NCP (40 CFR 300.430(a)(1)(iii)) to inform the public of the types of remedies that EPA has found to be appropriate for certain types of waste in the past and anticipates selecting in the future. These expectations (see Highlight 1) provide a means of sharing collected experience to guide the development of cleanup options. They reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur. Conversely, these expectations also reflect the fact that other source materials can be safely contained and that treatment for all waste will not be appropriate or necessary to ensure protection of human health and the environment, nor cost effective.

Identifying Principal and Low Level Threat Wastes

The concept of principal threat waste and low level threat waste as developed by EPA in the NCP is to be applied on a site-specific basis when characterizing source material. "Source material" is defined as material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, to surface water, to air, or acts as a source for direct exposure.

HIGHLIGHT 1: NCP Expectations Involving Principal and Low Level Threat Wastes

EPA expects to:

1. Use treatment to address the principal threats posed by a site, wherever practicable.
2. Use engineering controls, such as containment, for wastes that pose a relatively low long-term threat or where treatment is impracticable.
3. Use a combination of methods, as appropriate, to achieve protection of human health and the environment. In appropriate site situations, treatment of principal threats posed by a site, with priority placed on treating waste that is liquid, highly toxic or highly mobile, will be combined with engineering controls (such as containment) and institutional controls, as appropriate, for treatment residuals and untreated waste.
4. Use institutional controls such as water use and deed restrictions to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances.

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Contaminated ground water generally is not considered to be a source material although non-aqueous phase liquids (NAPLs) may be viewed as source materials. The NCP establishes a different expectation for remediating contaminated ground water (i.e., to return usable ground waters to their beneficial uses in a time frame that is reasonable given the particular circumstances of the site). Examples of source and non-source materials are provided in Highlight 2.

HIGHLIGHT 2: Examples of Source and Non-Source Materials

Source Materials

- Drummed wastes
- Contaminated soil and debris
- "Pools" of dense non-aqueous phase liquids (NAPLs) submerged beneath ground water or in fractured bedrock
- NAPLs floating on ground water
- Contaminated sediments and sludges

Non-Source Materials

- Ground water
- Surface water
- Residuals resulting from treatment of site materials

Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. They include liquids and other highly mobile materials (e.g., solvents) or materials having high concentrations of toxic compounds. No "threshold level" of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} or greater, generally treatment alternatives should be evaluated.

Low level threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of release. They include source materials that exhibit low toxicity, low mobility in the environment, or are near health-based levels.

Determinations as to whether a source material is a principal or low level threat waste should be based on the inherent toxicity as well as a consideration of the physical state of the material (e.g., liquid), the potential mobility of the wastes in the particular environmental setting, and the lability and degradation products of the material. However, this concept of principal and low level threat waste should not necessarily be equated with the risks posed by site contaminants via various exposure pathways. Although the characterization of some material as principal or low level threats takes into account toxicity (and is thus related to degree of risk posed assuming exposure occurs), characterizing a waste as a principal threat does not mean that the waste poses the primary risk at the site. For example, buried drums leaking solvents into ground water would be considered a principal threat waste, yet the primary risk at the site (assuming little or no direct contact threat) could be ingestion of contaminated ground water, which as discussed above is not considered to be a source material, and thus would not be categorized as a principal threat.

The identification of principal and low level threats is made on a site-specific basis. In some situations site wastes will not be readily classifiable as either a principal or low level threat waste, and thus no general expectations on how best to manage these source materials of moderate toxicity and mobility will necessarily apply. [NOTE: In these situations wastes do not have to be characterized as either one or the other. The principal threat/low level threat waste concept and the NCP expectations were established to help streamline and focus the remedy selection process, not as a mandatory waste classification requirement.]

HIGHLIGHT 3: Examples of Principal and Low Level Threat Wastes

Wastes that generally will be considered to constitute principal threats include, but are not limited to:

- Liquids - waste contained in drums, lagoons or tanks, free product (NAPLs) floating on or under ground water (generally excluding ground water) containing contaminants of concern.
- Mobile source material - surface soil or subsurface soil containing high concentrations of contaminants of concern that are (or potentially are) mobile due to wind entrainment, volatilization (e.g., VOCs), surface runoff, or sub-surface transport.
- Highly-toxic source material - buried drummed non-liquid wastes, buried tanks containing non-liquid wastes, or soils containing significant concentrations of highly toxic materials.

Waste that generally will be considered to constitute low level threat wastes include, but are not limited to:

- Non-mobile contaminated source material of low to moderate toxicity - Surface soil containing contaminants of concern that generally are relatively immobile in air or ground water (i.e., non-liquid, low volatility, low leachability contaminants such as high molecular weight compounds) in the specific environmental setting.
- Low toxicity source material - soil and subsurface soil concentrations not greatly above reference dose levels or that present an excess cancer risk near the acceptable risk range.

Examples of principal and low level threat wastes are provided in Highlight 3.

Risk Management Decisions fo. Principal and Low Level Threat Wastes

The categorization of source material as a principal threat or low level threat waste, and the expectations regarding the use of treatment and containment technologies follows the fundamental decision as to whether any remedial action is required at a site. These determinations, and the application of the expectations, serve as general guidelines and do not dictate the selection of a particular remedial alternative. For example, EPA's experience has demonstrated that highly mobile wastes (e.g., liquids) are difficult to reliably contain and thus generally need to be treated. As such, EPA expects alternatives developed to address highly mobile material to focus on treatment options rather that containment approaches.

However, as stated in the preamble to the NCP (55 FR at 8703, March 8, 1990), there may be situations where wastes identified as constituting a principal threat may be contained rather than treated due to difficulties in treating the wastes. Specific situations that may limit the use of treatment include:

- Treatment technologies are not technically feasible or are not available within a reasonable time frame;
- The extraordinary volume of materials or complexity of the site make implementation of treatment technologies impracticable;
- Implementation of a treatment-based remedy would result in greater overall risk to human health and the environment due to risks posed to workers or the surrounding community during implementation; or
- Severe effects across environmental media resulting from implementation would occur.

Conversely, there may be situations where treatment will be selected for both principal threat wastes and low level threat wastes. For example, once a decision has been made to treat some wastes (e.g., in an onsite incinerator) economies of scale may make it cost effective to treat all materials including low level threat wastes to alleviate or minimize the need for engineering/institutional controls.

While these expectations may guide the development of appropriate alternatives, the fact that a remedy is consistent with the expectations does not constitute sufficient grounds for the selection of that remedial alternative. The selection of an appropriate waste management strategy is determined solely through the remedy selection process outlined in the NCP (i.e., all remedy selection decisions are site-specific and must be based on a comparative analysis of the alternatives using the nine criteria in accordance with the NCP). Independent of the expectations, selected remedies must be protective, ARAR-compliant, cost-effective, and use permanent solutions or treatment to the maximum extent practicable. Once the final remedy is selected, consistency with the NCP expectations should be discussed as part of the documented rationale for the decision.

ROD Documentation

Declaration

The "Description of the Selected Remedy" section should note whether the remedy is addressing any source materials that constitute "principal" or "low level" threat wastes, or both.

The "Statutory Determinations" section should discuss how the selected remedy satisfies the statutory preference stated in CERCLA §121 to select remedial actions "in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal element." In evaluating this statutory preference, the site manager needs to decide whether treatment selected in the ROD constitutes treatment as a major component of the remedy for that site. Remedies which involve treatment of principal threat wastes likely will satisfy the statutory preference for treatment as a principal element, although this will not necessarily be true in all cases (e.g., when principal threat wastes that are treated represent only a small fraction of the wastes managed through containment). Ground water treatment remedies also may satisfy the statutory preference, even though contaminated ground water is not considered a principal threat waste and even though principal threat source material may not be treated.

Decision Summary

The "Decision Summary" of the ROD should identify those source materials that have been identified as principal threat and/or low level threat wastes, and the basis for these designations. These designations should be provided in the "Summary of Site Characteristics" section as part of the discussion focusing on these source materials that pose or potentially pose a risk to human health and the environment. In addition, the "Description of Alternatives" and the "Selection of Remedy" sections should briefly note how principal and/or low level threat wastes that may have been identified are being managed.

The "Statutory Determinations" section of the ROD should include a discussion of how the statutory preference for treatment as a principal element is satisfied or explain why it is not satisfied, stating reasons in terms of the nine evaluation criteria.

NOTICE: The policies set out in this memorandum are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance at any time without public notice.

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Proposed Plan for Site 19
Former Small Arms Range 910
Naval Station Great Lakes
Installation Restoration Program
Great Lakes, Illinois

About This Document

This Proposed Plan is being presented to satisfy the statutory and regulatory requirements for public participation under the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**. Its primary intent is to help the public understand and provide input on the proposed remedial alternatives to address impacted surface and subsurface soil at Site 19 – Former Small Arms Range 910, which was located in Building 910**.** The Department of the Navy, with the concurrence of Illinois Environmental Protection Agency (Illinois EPA), developed this plan to summarize the proposed remedy for this site. The Navy, as the lead agency, is accepting formal public comments on this Proposed Plan from May 3 to June 3, 2013 and, with input from Illinois EPA, will make a final remedy selection after reviewing and addressing the public comments received. Therefore, the public is encouraged to review and comment on the information presented in this Proposed Plan.

The Proposed Plan

To address contaminated surface and subsurface soil at Site 19, the Navy, with the concurrence of Illinois EPA, proposes Alternative 2 (**land use controls [LUCs]** and **Five Year Reviews**) as the recommended remedial action for the site. **LUCs** will be incorporated into the Base Master Plan to make sure restrictions are applied and enforced at the site.

Based on other **LUCs** implemented at Naval Station Great Lakes and site conditions, the **LUCs** at Site 19 would include property restrictions. While the contaminant concentrations in the soil at Site 19 are acceptable for commercial/industrial use and are safe for worker exposure, the concentrations do not meet Illinois' more restrictive standards for residential properties. Therefore, the area in question would be restricted to industrial/commercial (nonsensitive) use. In addition, Illinois EPA and the Navy have signed a **LUC Memorandum of Agreement (MOA)** that includes a Naval Station Policy Letter restricting use of groundwater on the Naval Station Great Lakes property.

CERCLA requires periodic re-evaluation when contaminants remain on site. Therefore, Five Year Reviews will be conducted to evaluate the protectiveness of the **LUCs** in order to determine if the remedy is or will remain protective of human health. Evaluation and determination of protectiveness should be based on and sufficiently supported by data and observations collected during the review process.

LUCs alone would not effectively reduce concentrations of **chemicals of concern** (**COCs);** however, they would be an effective tool to prevent future exposure to the **COCs,** especially since property use is not expected to change in the foreseeable future.

What do you think?

You don't have to be a technical expert to comment. If you have a concern, question, suggestion, or preference, the Navy and Illinois EPA want to hear it before making a final decision on how to protect our community. The Navy, as the lead agency, is accepting formal public comments on this Proposed Plan for a 30-day period from May 3 to June 3, 2013. To comment formally, send written comments postmarked no later than June 3, 2013 to:

Department of the Navy
Naval Station Great Lakes
NAVFAC Midwest
Attn: Terese Van Donsel
201 Decatur Avenue
Building 1A, Code EV
Great Lakes, IL 60088

Or e-mail comments by the end of the comment period to terese.vandonsel@navy.mil.

The Navy will provide opportunity for a public meeting during the public comment period if significant interest is expressed and a formal written request is made. The public will be notified of the date, time, and location. At the meeting, the proposed action will be discussed and questions about the action will be received. Written responses to the formal comments and questions will be prepared and included in the final **Record of Decision (ROD)**.

This document summarizes the Proposed Plan for Site 19 at Naval Station Great Lakes. For detailed information on the investigation and Focused Feasibility Study of Site 19, consult the documents available for review at Naval Station Great Lakes. Call the Naval Station Great Lakes Environmental Department at (847) 688-2600, Extension 136 to review the information.

Bold terms throughout this Proposed Plan are explained in the Glossary of Terms presented on page 10.

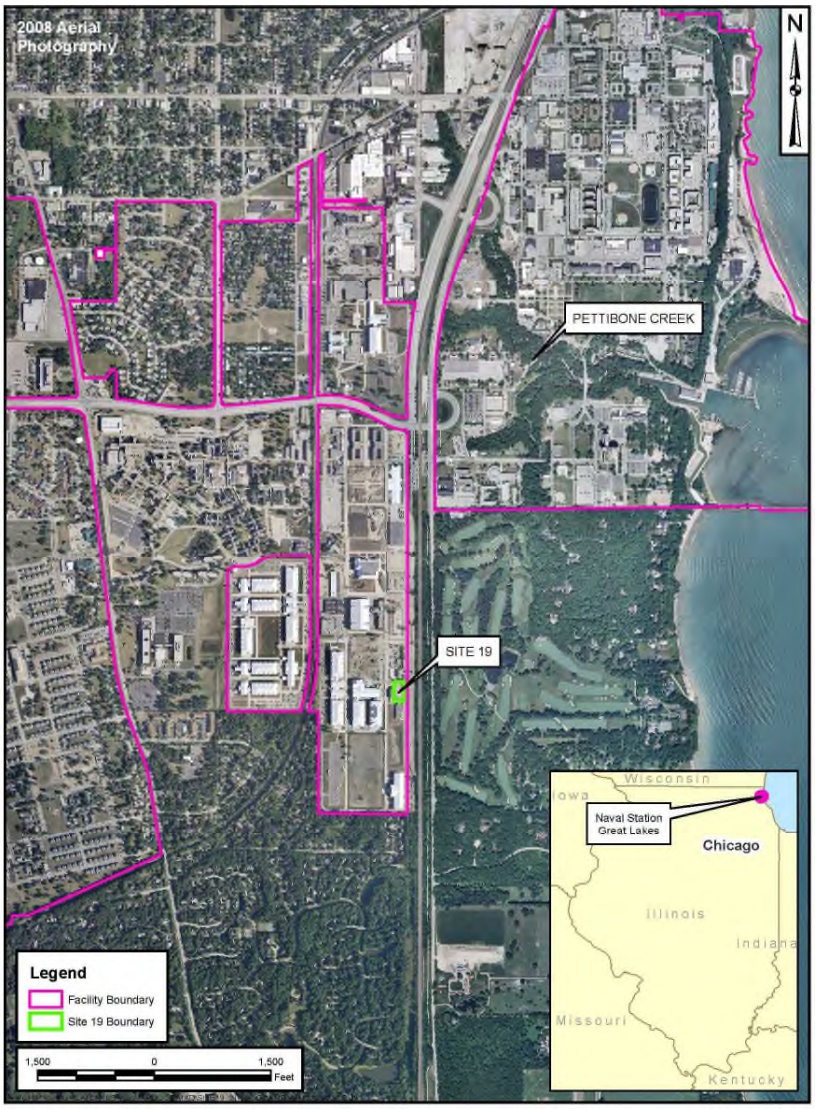

Figure 1: General Location

This Proposed Plan highlights key information from the **Remedial Investigation/Risk Assessment (RI/RA)** and **Focused Feasibility Study (FFS)** reports. More complete information can be found in the **Administrative Record,** available at Naval Station Great Lakes, 201 Decatur Avenue, Building 1A, Environmental Department, Great Lakes, Illinois 60088 or online at http://go.usa.gov/RsJ. From this website, just click on the "Administrative Record" tab, enter the Administrative Record, and search for "SITE 00019."

Facility Description

Naval Station Great Lakes is located in Lake County, Illinois, north of the City of Chicago, and encompasses 1.5 miles of Lake Michigan shoreline (see Figure 1). Naval Station Great Lakes is used to support naval training and consists of the Recruit Training Command, Training Support Center, and Naval Facilities Engineering Command Midwest. In 1986, an **Initial Assessment Study** conducted at Naval Station Great Lakes identified 14 potentially contaminated sites. Each site was evaluated with respect to contamination characteristics, migration pathways, and pollutant receptors. The study concluded that seven of these sites warranted further investigation to assess potential long-term impacts. Although it was not one of the seven sites identified, Site 19 was named as a waste generation operation because of the Recruit Training Center Rifle Range in Building 910. In addition, investigations conducted prior to the demolition of Building 910 identified soil contamination that warranted further investigation to assess potential long-term impacts resulting from historical site activities.

Summary of Site History
> 1942 to 1997 — Site 19, Building 910, was an indoor rifle range.
> 1998 - Limited sampling occurred. Two soil samples were collected adjacent to the building and analyzed for **Toxicity Characteristic Leaching Procedure (TCLP)** lead. Lead was detected and the concentration exceeded the **Resource Conservation and Recovery Act (RCRA)** toxicity characteristic criteria.
> 2000 — Building 910 was demolished
> 2001 — Soil samples were collected on Lake County property located east of Building 910, two of which were near Site 19. A sample collected slightly northeast of Site 19 had a lead detection below residential soil criteria and also had several **polynuclear aromatic hydrocarbons (PAHs)** detections that exceeded residential and commercial criteria based on Illinois EPA **Tiered Approach to Corrective Action Objectives (TACO) limits**. A sample collected southeast of Site 19 had a lead detection below residential soil criteria and no **TACO** exceedances for **PAHs**.
> 2008 — Surface and subsurface soil and groundwater sampling was conducted. There were few **volatile organic compound (VOC)** detections and none exceeded screening criteria. **PAHs** were detected in soil and groundwater but were still below screening criteria and Illinois EPA **TACO** background criteria for the area and the detections were widespread with no discernible source. Inorganics, particularly arsenic and manganese, exceeded the screening criteria in surface and subsurface soil.
> 2010 — The **RI/RA** was published recommending no further investigation of Site 19.
> 2012 — The **FFS** was prepared to evaluate remedial alternatives for the sites since contaminants remain on site at concentrations above what is acceptable for unrestricted use.

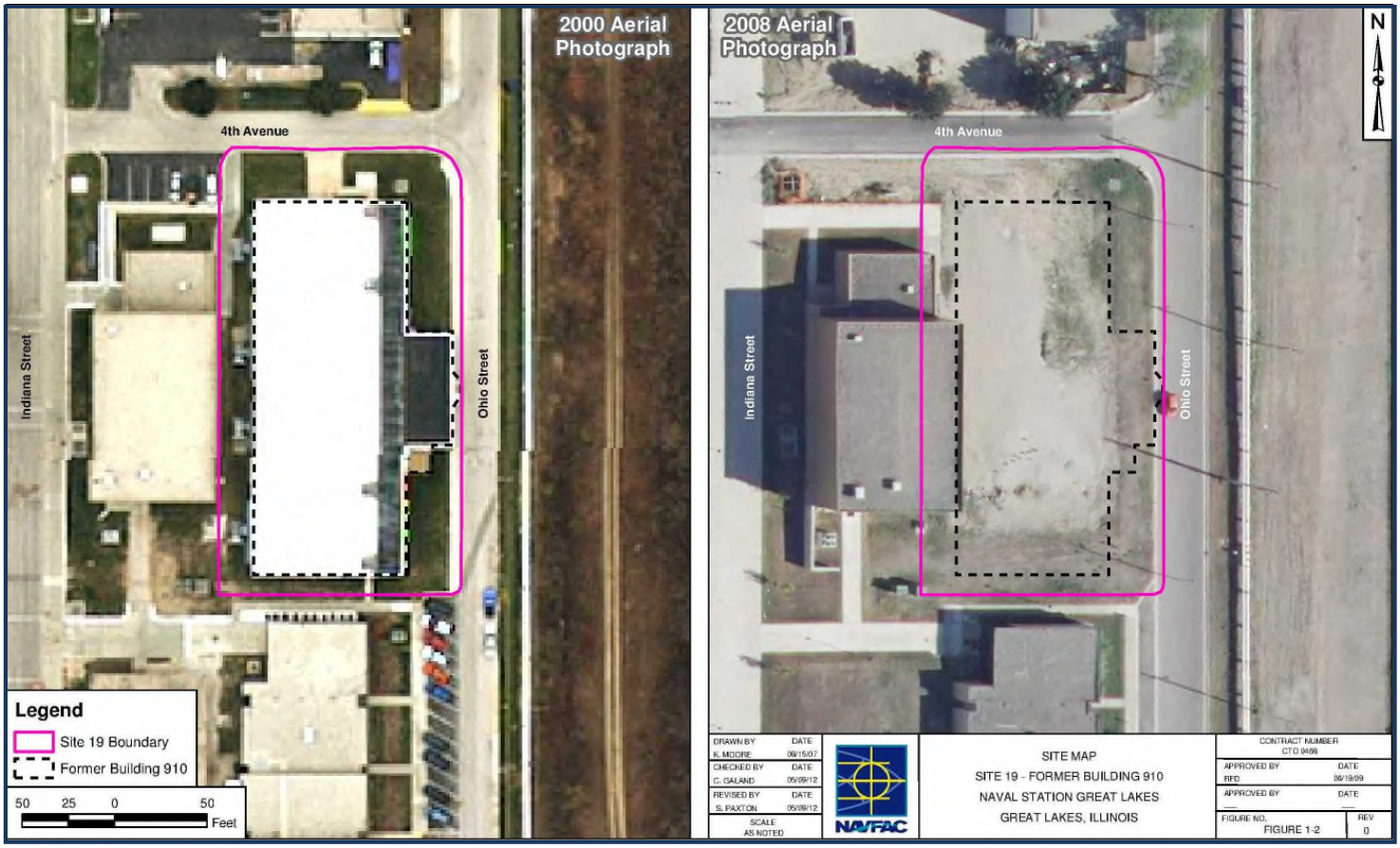

Figure 2: Site Plan

Figure 3: Current Site Conditions

Site Description

Site 19 was an indoor rifle range operated between 1942 and 1997; the building was demolished in 2000 (see Figure 2). It is estimated that, during its 55 years of operation, 19 million pounds of spent ammunition were generated by this facility, providing the potential for lead to have impacted site soil and groundwater. Chemicals used at the rifle range include CLP brand cleaner and standard issue bore cleaner #6850-00-224-6663. These chemicals are primarily composed of petroleum products and distillates (i.e., **volatile organic compounds [VOCs]** and **PAHs**). The use of these chemicals provides the potential for **VOCs** and **PAHs** to have impacted site soil and groundwater.

Site 19 covers approximately 0.67 acre and is an open, grassy area (see Figure 3).

Soil and groundwater sampling have been conducted during several investigations at the site over the past 10 years. The investigations have included collection of soil samples and installation of temporary monitoring wells for monitoring groundwater. While lead was retained as a **contaminant of potential concern (COPC)** during these investigations, detections remained below soil screening criteria.

Naval Station Great Lakes is an active Navy facility and is expected to remain active for the foreseeable future. In accordance with Naval Station Great Lakes Instruction 11130.1 dated September 29, 2003, use of groundwater and surface water runoff within all geographical areas of the base, for any purpose, is strictly prohibited without prior written approval. Groundwater underlying Naval Station Great Lakes is not used for drinking water and is not expected to be used in the future.

Nature and Extent of Contamination

For the 2008 **RI/RA**, no contaminants in soil were eliminated as **COCs** on the basis of comparison to background concentrations. However, the **PAHs** selected as **COCs** in exposed surface soil had maximum detected concentrations that did not exceed Illinois EPA **Tiered Approach to Corrective Action Objectives (TACO)** surface soil background criteria, as shown in Table 1. PAHs did not appear to be confined to any particular area of the site. Based on this information and the Illinois EPA determination of urban **PAH** background concentrations, it is possible that these **PAHs** could be attributed to background conditions, and inclusion of these chemicals as **COCs** may result in an overestimation of total risks for this site. Background chemical levels do not signify a release of a hazardous substance according to the definition of a release as stated in the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP),** and it is Navy policy to not clean up contaminants below background levels.

The inorganics arsenic and manganese were also retained as **COCs**. The average arsenic concentration was

How are Human Health Risks Evaluated?

A **human health risk assessment (HHRA)** estimates "baseline risk," which is an estimate of the likelihood of health problems occurring if no cleanup action occurs at a site. To estimate baseline risk at a site, the Navy undertakes a four-step process in accordance with EPA guidance:

Step 1: Analyze Contamination

Step 2: Estimate Exposure

Step 3: Assess Potential Health Dangers

Step 4: Characterize Site Risk

In Step 1, the Navy looks at the concentrations of chemicals found at a site as well as past scientific studies on the effects these chemicals have had on people (or animals when human studies are unavailable). Comparisons between site-specific concentrations and concentrations reported in past studies help determine which chemicals are most likely to pose the greatest threat to human health.

In Step 2, the Navy considers the different ways that people might be exposed to the chemicals identified in Step 1, the concentrations to which people might be exposed, and the potential frequency and duration of exposure. Using this information, the Navy calculates a "reasonable maximum exposure" (RME) and the central tendency exposure (CTE) scenarios, which represents the highest level and average level of human exposure, respectively, that could reasonably be expected to occur.

In Step 3, the Navy uses the information from Step 2 combined with information on the toxicity of each chemical to assess potential health risks. The likelihood of any kind of cancer resulting from exposure to a site is generally expressed as an upper bound probability, for example, a "1 in 10,000 chance." In other words, for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure to site chemicals. An extra cancer case means that one more person could get cancer than would normally be expected from other causes. For non-cancer health effects, the Navy calculated an **HI**, where a "threshold level" (measured usually as a hazard index of less than 1) exists, below which non-cancer health effects are no longer predicted.

In Step 4, the Navy determines whether site risks are great enough to cause health problems for people at or near the site. The results of the three previous steps are combined, evaluated, and summarized. The Navy adds the potential risks from the individual chemicals to determine the total risk resulting from the site.

TABLE 1

MAXIMUM AND AVERAGE SOIL CONCENTRATIONS FOR INORGANICS AND PAHS COMPARED TO ILLINOIS EPA TACO BACKGROUND CRITERIA

COCs	Surface Soil Average/ Maximum	Subsurface Soil Average/ Maximum	Illinois EPA Background Soil	Illinois EPA TACO Residential Direct Contact Criteria
Inorganics (mg/kg)				
Arsenic	11.5/32.2	9.77/25.1	13	---
Manganese	889/1820	736/1600	636	1600
PAHs (µg/kg)				
Benzo(a)anthracene	444/1700	17/20	1800(1)	900
Benzo(a)pyrene	314/1200	14.5/22	2100(1)	90
Benzo(b)fluoranthene	429/1700	16/18	2100(1)	900
Chrysene	372/1900	10.6/18	2700(1)	88000
Dibenzo(a,h)anthracene	68.3/160	N/A	420(1)	90

(1) Applies to surface soil only

mg/kg – milligram per kilogram

µg/kg – microgram per kilogram

below the Illinois EPA background level of 13 milligram per kilogram (mg/kg) for both surface and subsurface soil, as shown in Table 1. Average concentrations of manganese in both surface and subsurface soil exceeded the Illinois EPA background level (see Table 1). Figure 4 illustrates the horizontal extent of arsenic and manganese contamination and exceedances with respective depths.

Summary of Site Risks

The investigation at this site included evaluating potential **human health risk** from inorganics in surface and subsurface soil. Under current land use scenarios, the potential exposed population included maintenance workers, occupational workers, construction workers, and adolescent trespassers. Future use scenarios considered the same population but also considered site residents under the unlikely premise that the site would be developed for residential use.

Under current and future use scenarios, risks to **ecological receptors** were not evaluated because the site is an open grassy lot surrounded by a light industrial area. Additionally, because contaminant concentrations are low and there is a lack of suitable ecological habitat, the overall **ecological risk** from site contaminants is low.

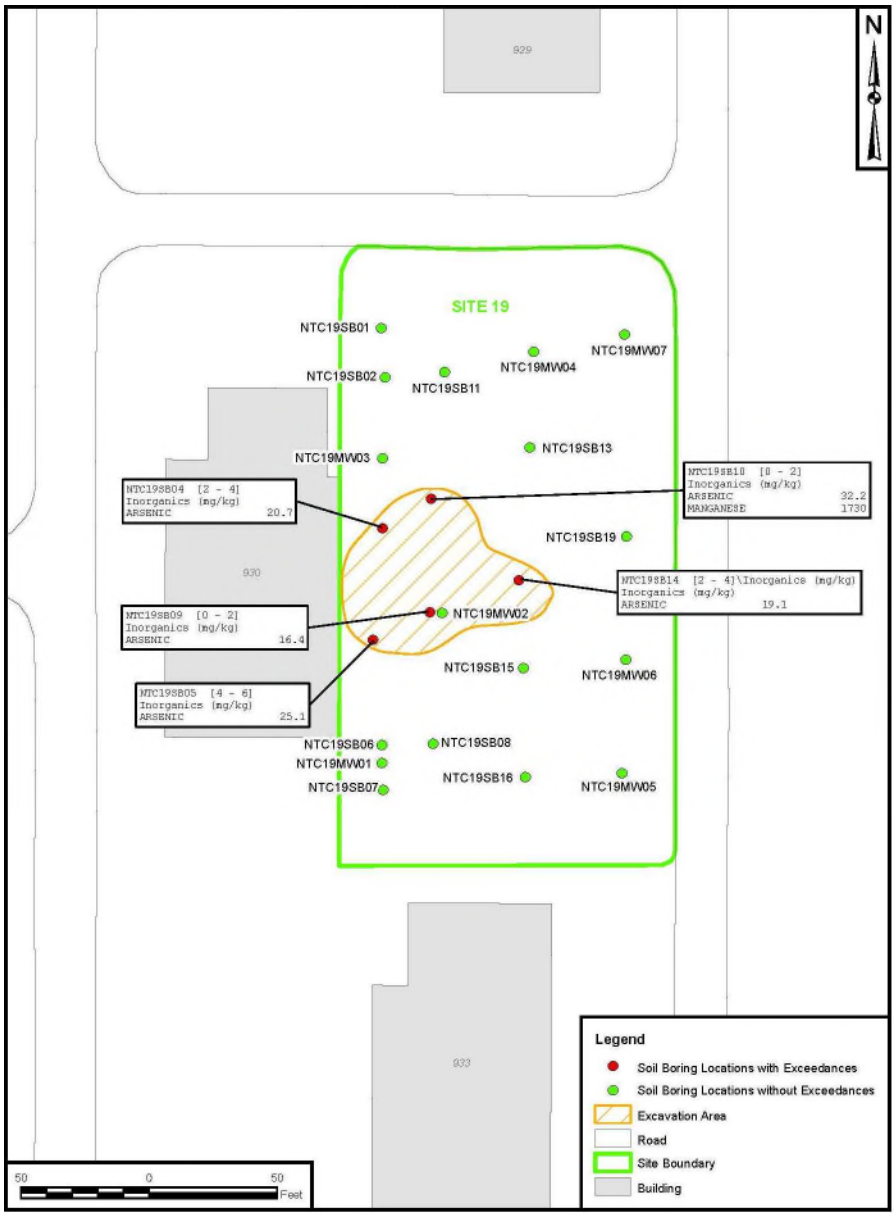

Figure 4 (right): Approximate Limits of Excavation

Non-carcinogenic risks (represented by **Hazard Indices [HIs]**) for surface and subsurface soil were less than United States Environmental Protection Agency (U.S. EPA) and Illinois EPA benchmarks for the potential receptors evaluated at the sites. A **HI** greater than 1 indicates non-carcinogenic risk. **HIs** were less than or equal to 1.0 for trespassers, maintenance workers, occupational workers, construction workers, and future adult residents in the study area. For this reason, adverse non-carcinogenic health effects are not anticipated for these receptors at Site 19.

For future child residents, ingestion of soil and groundwater containing arsenic presents a primary pathway of concern for non-carcinogenic risk. The **HI** was greater than 1 for future child residents, indicating that adverse non-carcinogenic health effects are possible under the conditions established in the exposure assessment for this receptor.

Carcinogenic risk estimates for construction workers, maintenance workers, occupational workers, trespassers, future child residents, and future adults residents and the cancer risk estimate for total future residential risk (child + adult) for Site 19 do not exceed the target USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$). However, cancer risk estimates for maintenance workers, occupational workers, future child residents, and future adult residents and the cancer risk estimate for total future residents (child + adult) do exceed the Illinois EPA risk goal ($1x10^{-6}$).

The total (soil + groundwater) site cancer risk estimates for total future residents (adult + child), exceed the USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$) and Illinois EPA risk goal ($1x10^{-6}$). The major contributors to cancer risk at Site 19 are arsenic and **PAHs** (benzo(a)anthracene, benzo(a) pyrene, benzo(b)fluoranthene, chrysene, and dibenzo(a,h) anthracene). However **PAHs** in the site soil do not exceed the Illinois EPA **TACO** background criteria. Concentrations of **PAHs** were higher in the surface soil then the subsurface soil. Inclusion of **PAHs** exposure in the carcinogenic risk estimate results in an overestimation of total risk.

Why is remedial action needed?

The Navy's environmental studies of Site 19 resulted in the following conclusion:

- As a result of past activities, several chemicals are present in surface and subsurface soil, at the site that may result in unacceptable human health risk.
- The concentrations of contamination found in the soil at Site 19 are acceptable for commercial/industrial use and are safe for worker exposure. Under the current land use within Naval Station Great Lakes, no action would be necessary to protect those who work at or near the property. However, because concentrations of contamination in soil do not currently meet Illinois' standards for residential properties, the Navy is considering remedial alternatives to address this hypothetical future risk.

Preliminary Remediation Goals (PRGs) were developed to identify the concentrations of chemicals that, when exceeded, cause potentially unacceptable risk to human health and the environment. This Proposed Plan recommends no further action in zones or media with concentrations below the established **PRGs**. Recommended actions for zones exceeding **PRGs** were either removal of the soil or **LUCs** (engineering controls, institutional controls, and inspections) and monitoring.

For an alternative in which concentrations of **COCs** greater than residential **PRGs** remain, **LUC** implementation establishes institutional controls to restrict unauthorized disturbance of soil and prevent residential development. **CERCLA** risk-based engineering controls, including regular inspections and maintenance, are required when concentrations of **COCs** greater than the residential **PRGs** remain.

It is proposed by the Navy and Illinois EPA that Alternative 2, identified in this Proposed Plan, be implemented to protect public health and welfare from actual or threatened releases of hazardous substances, and to meet the applicable or relevant and appropriate requirements (ARARs) necessary to achieve that goal.

What is the remedial action objective?

Remedial Action Objectives (RAOs) provide a general description of what the cleanup will accomplish. RAOs are medium-specific goals that define the objectives of conducting cleanups or implementing measures to protect receptors at risk from contaminated media. Site-specific RAOs specify **COCs**, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. The RAO for this **FFS** was developed based on current land use as industrial/commercial property and future potential land use as residential property, with the goal of protecting the public from potential current and future health risks.

The following RAO was developed for Site 19:

RAO1: Prevent unacceptable human health risk to hypothetical residents associated with exposure to soil containing arsenic and manganese at concentrations greater than **PRGs**.

Site 19 Remedial Action Alternatives

The **FFS** report presents the options that the Navy and Illinois EPA developed for remedial action at the site. Based on the evaluation of various technologies documented in the **FFS**, the following three remedial alternatives were developed:

Alternative 1: No Action

This alternative is a "walk-away" alternative that maintains the site as is and is required for consideration under **CERCLA** to establish a basis for comparison with other alternatives. No restriction would be imposed to prevent access to the site and the alternative does not address the site contamination. Under this alternative, the property would be released for unrestricted use. In addition, there would be no Five-Year Review required to assess contamination at the site over time. This alternative could only be chosen if it is determined that taking no action would be protective of human health and the environment.

Alternative 2: **LUCs**

While the contaminants in the soil at Site 19 are at concentrations that are acceptable for commercial/industrial use and are safe for worker exposure, the concentrations do not meet Illinois' more restrictive standards for residential properties. Therefore, **LUCs** would be established at the site to make sure the property is not developed for residential or non-residential special use (such as for a park, day care, or school). Five-Year Reviews would be required since concentrations of contaminants will remain in soil above those acceptable for unrestricted use at the site.

A draft **LUC Remedial Design (RD)** would be developed after the signing of the **ROD** to document the **LUC** requirements. Five-Year Reviews to evaluate the continued protectiveness of the remedy would be required for the alternative since contamination would remain in excess of concentrations that allow for unrestricted use and unlimited exposure.

Alternative 3: Excavation and Off-Site Disposal

Alternative 3 would consist of excavating approximately 795 tons of soil at the area shown on Figure 4, as necessary, to meet the **TACO** Tier 1 Remedial Objectives for arsenic and manganese. Excavated material would be transported off-base to a non-hazardous landfill for disposal. Excavation, disposal, and restoration is expected to take approximately 1 month. No Five-Year Review would be required for this alternative since the contaminated soil would be removed from the site. After completion of remedial action, the property could be developed with no restrictions on land use.

Evaluation Criteria for Superfund Remedial Alternatives

Threshold Criteria

The primary threshold criterion in the selection of an alternative is the overall protection of human health and the environment. The Navy and Illinois EPA will not choose a plan that does not meet this basic criterion. The second threshold criterion that must be met is compliance with ARARs. The alternative must meet federal and state environmental and facility siting statutes, regulations, and requirements in order to be selected.

These two criteria must be satisfied for an alternative to be eligible for selection.

Primary Balancing Criteria

The five balancing criteria considered in the alternative selection are:

- Long-Term Effectiveness and Permanence: The effects of the cleanup plan should be permanent or prevent future risk to human health and the environment.
- Reduction of Toxicity, Mobility or Volume through Treatment: The alternative should reduce the harmful effects of the contaminants, the spread of contaminants, or the amount of contaminated material.
- Short-Term Effectiveness: An alternative that reduces site risk sooner rather than later and one that causes fewer short-term hazards to workers, residents, or the environment is preferred.
- Implementability: This criterion considers whether the alternative is technically feasible and if the right goods and services (e.g., treatment machinery) are available for the plan.
- Cost: Navy and Illinois EPA must find a plan that gives necessary protection for a reasonable cost over the life of the alternative.

Modifying Criteria

The final two criteria are the modifiers. They are state and community acceptance. The state considers the objections, suggestions, and modifications offered by the community during the public comment period. If the state agrees with the proposal once the criteria are considered, the alternative is presented in the **ROD**.

Use of ARARs and To Be Considered (TBC) Guidelines in the Evaluation Process

Applicable requirements are cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a **CERCLA** site.

If a requirement is not applicable, it still may be relevant and appropriate. Relevant and appropriate requirements mean those cleanup standards that address problems or situations sufficiently similar to those encountered at the **CERCLA** site so that their use is suited to the site. A requirement that is relevant and appropriate may not meet one or more jurisdictional prerequisites for applicability but still make sense, given the circumstances of the site and the release.

When a requirement is deemed relevant and appropriate, it must be complied with as if it were applicable. However, there are significant differences between the identification and analysis of the two types of requirements. Applicability is a legal and jurisdictional determination, while the determination of relevant and appropriate relies on professional judgment, considering environmental and technical factors at the site. Also, there is more flexibility when determining relevant and appropriate. A requirement may be relevant in that it covers situations similar to those at the site, but may not be appropriate; therefore, may not be well suited to the site. In some situations, only portions of a requirement or regulation may be judged relevant and appropriate; however, if a requirement is applicable, all substantive parts must be followed.

Potential chemical-, location-, and action-specific ARARs that apply to the sites are presented in Section 2.0 of the **FFS** Report. Each alternative was evaluated to determine its compliance with ARARs. TBC criteria are non-enforceable guidelines or criteria that may be useful for developing a remedial action or that are necessary for determining what is protective to human health and/or the environment.

TABLE 2

SUMMARY OF COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES

EVALUATION CRITERION	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LUCs	ALTERNATIVE 3: EXCAVATION AND OFF-BASE DISPOSAL
Overall Protection of Human Health and Environment	Not protective. The potential for exposure of human receptors to contaminated soil would remain unchanged.	Protective of human health by minimizing exposure to contaminated soil.	Protective of human health as contaminants would be permanently removed from the site.
Compliance with ARARs & TBCs: Chemical-Specific Location-Specific Action-Specific	 *Would not comply *Not applicable *Not applicable	 *Would comply via control of exposure pathways. *Would comply *Not Applicable	 *Would comply *Would comply *Would comply
Long-Term Effectiveness and Permanence	Neither effective nor permanent.	Provides long-term effectiveness and permanence.	Provides long-term effectiveness and permanence.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None.	None.	None.
Short-Term Effectiveness	Would not result in risks to on-site workers or result in short-term adverse impact to the local community and the environment. Would not achieve **RAOs** or **PRGs**.	Would not result in risks to on-site workers or result in short-term adverse impact to the local community and the environment. Would achieve **RAOs** and **PRGs** via control of exposure pathways.	Would result in minimal risks to on-site workers or in short-term adverse impacts to local community and the environment.; however, this potential for exposure would be minimized by the implementation of engineering controls and compliance with site-specific health and safety procedures. Would achieve **RAOs** and **PRGs** by removal of the contaminated soil. Life cycle impacts resulting from excavation activities include greenhouse gas and criteria pollutant emissions, water and energy consumption. This alternative can be optimized to reduce greenhouse gas and criteria pollutant emissions by using biodiesel fuel.
Implementability	Readily implementable.	Readily implementable.	Readily implementable.
Costs:	$0	Capital Cost: $23,000 Annual Cost $3,000 5 Year Cost: $25,000 30-Year NPW: $190,000	$385,000
State Acceptance	Illinois EPA has indicated that Alternative 2 would be acceptable.		
Community Acceptance	Assessment will be performed after comments on the Proposed Plan are received from the public.		

ARAR - Applicable or Relevant and Appropriate Requirement
LUC - Land use control
PRG - Preliminary Remediation Goal
RAO - Remedial Action Objective
TBC - To Be Considered
NPW - Net Present Worth

The Illinois EPA **TACO** Tier 1 Soil Remediation Objectives were retained as chemical TBC guidance. The Tier 1 **TACO** for residential and industrial/commercial properties does not regulate activities at a site or mandate fixed cleanup standards, rather, **TACO** provides methodologies for meeting the requirements of programs to which it is applied. **TACO** language is permissive and is not a requirement. Therefore, **TACO** is not enforceable by its own terms, but relies upon the language of the governing program for its enforceability. Because **TACO** is not enforceable unto itself, **TACO** cannot be an ARAR as defined in the **NCP** and must be treated as TBC guidance.

Based on the evaluation of contaminant concentrations in Site 19 soil, it was concluded that concentrations of **PAHs** are acceptable based on a comparison with the most conservative **TACO** Tier 1 criteria and the **TACO** Appendix A Table H background values identified for surface soil. Therefore, no remedial actions are proposed to address **PAHs** in Site 19 soil.

The **Illinois Coastal Management Program (ICMP)** was retained as a location-specific TBC. In January 2012, National Oceanic and Atmospheric Administration approved the **ICMP**, which was prepared according to the federal Coastal Zone Management Act.

Analysis of Alternatives

In accordance with **CERCLA**, a detailed analysis of the alternatives must be conducted with respect to the nine **CERCLA** evaluation criteria. These include the two threshold, five balancing, and two modifying criteria described above. An analysis of these criteria was performed for each remedial alternative, and summary comparisons of these analyses are presented in Table 2. Consult the Site 19 **FFS** Report for more detailed information.

State (Illinois EPA) acceptance of the proposed alternative was secured during the development of this Proposed Plan. During the upcoming comment period, the Navy and Illinois EPA also welcome your comments on the proposed remedial action.

Alternative 1 - The No Action alternative would not be effective in reducing risks or meeting the RAO and **PRGs** because no exposure control or treatment would be performed. Because no monitoring or maintenance would be performed, the No Action alternative would not be effective in evaluating the potential migration of **COCs**, or the potential reduction of **COC** concentrations.

Alternative 2 - Based on other **LUCs** implemented at Naval Station Great Lakes and site conditions, the **LUCs** would be limited to property use restrictions allowing only industrial/commercial (nonsensitive) use. The Illinois EPA and the Navy have signed a **LUC MOA** that includes a Naval Station Policy Letter restricting use of groundwater on the Naval Station Great Lakes property.

Alternative 3 - The only technology considered for removal is mechanical excavation. Mechanical excavation of the impacted soil would be performed using excavators. After excavation is completed, the location would be filled and graded with clean fill material. Excavated material would be transported offsite for disposal in a non-hazardous landfill.

Mechanical excavation would not reduce concentrations of **COCs** in the impacted soil, but it would be an effective means for addressing soil with **COC** concentrations greater than **PRGs** from the site in order to open the property to unrestricted use.

A Closer Look at the Proposed Remedial Action

Alternative 2, **LUCs,** would be established at the site to make sure the property is not developed for residential or non-residential special use (such as for a park, day care, or school) and would be incorporated into the Base Master Plan. Five-Year Reviews would be required since concentrations of contaminants will remain in soil above concentrations acceptable for unrestricted use at the site.

Alternative 2 would provide protection to human health by prohibiting residential exposure to contaminated soil.

Although no action would be taken to reduce **COC** concentrations, Alternative 2 would comply with chemical-specific ARARs and TBCs by restricting access to the site and controlling exposure to contaminant concentrations in excess of those acceptable for residential use. In addition, this alternative would require that a site review be conducted every 5 years to assess the protectiveness and effectiveness of the controls that would be placed on the property. No location-specific ARARs have been identified for the property. No action-specific ARARs are associated with this alternative.

Alternative 2 would be an effective means of minimizing exposure to contaminants in site soil over the long term. The permanence of Alternative 2 would depend on the maintenance of the controls and verification that the land use is being properly controlled and maintained.

While Alternative 2 would not reduce the toxicity, mobility, or volume of **COCs** through treatment because no treatment would occur, neither would it pose risk to on-site workers or result in short-term adverse impact to the local community and the environment.

Alternative 2 would not achieve the **PRGs**, but would achieve the RAO by restricting exposure to soil at the site. Alternative 2 would be easily implemented since groundwater **LUCs** are already in place at Naval Station Great Lakes and only property use restrictions are necessary.

Based on information currently available, the lead agency believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The Navy expects the Preferred Alternative to satisfy the following statutory requirements of **CERCLA** §121(b): 1) be protective of human health and the environment; 2) comply with ARARs; 3) be cost-effective; 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent possible; and 5) satisfy the preference for treatment as a principal element.

Why Does the Navy Recommend this Proposed Alternative?

The proposed alternative (Alternative 2) is recommended

because it would meet the RAO for the following reasons:

- This alternative would effectively prevent exposure to surface and subsurface soil contamination through **LUCs** until concentrations have naturally decreased to less than the USEPA and Illinois EPA criteria.
- It would protect human health and the environment.
- **LUCs** at the sites are in accordance with the Naval Station Great Lakes Base Master Plan and are not overly burdensome.
- Five-Year Reviews would be conducted to make sure the **LUCs** are in place and maintained for continued protection of human health and the environment.
- It is deemed to be cost effective and represents a reasonable value for the money to be spent.
- Land use is not expected to change in the foreseeable future.

This recommended alternative can change in response to public comments or based on receipt of new information. The Illinois EPA has indicated that Alternative 2 would be acceptable.

Next Steps:

The Navy will receive comments during the 30-day public comment period. A public meeting will be conducted if there is significant public interest. In response to public comments or upon receipt of new information, the preferred alternative for the site may change. By September 2013, the Navy expects to have reviewed comments and signed the **ROD** describing the chosen remedial action. The **ROD**, which includes a summary of responses to public comments, will then be made available to the public at Naval Station Great Lakes, 201 Decatur Avenue, Building 1A, Environmental Department, Great Lakes, IL 60088. The Navy will also announce its decision through the local news media.

For More Detailed Information

To help the public understand and comment on the proposal for this site, this publication summarized a number of reports and studies. The technical and public information prepared to date for the site is available online at http://go.usa.gov/RsJ. From this website, just click on the "Administrative Record" tab, enter the Administrative Record, and search for "SITE 00019."

If you do not have a computer or internet access, hard copies of the Administrative Record can be viewed at Naval Station Great Lakes as noted above. Please contact Ms. Van Donsel at (847) 688-2600 x136 to arrange a time and location for viewing the information.

Glossary of Terms

This glossary defines the terms used in this Proposed Plan. The definitions in this glossary apply specifically to this Proposed Plan and may have other meanings when used in different circumstances.

Administrative Record: The complete body of documents pertaining to the investigation and restoration of an environmental site. This body of documents is kept at a location where it can be accessed by the general public.

Chemical of concern (COC): A substance detected at a concentration and/or in a location where it will have an adverse effect on human health and the environment.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law also known as "Superfund." This law was passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA). This law created a special tax that goes into a trust fund to investigate and cleanup abandoned or uncontrolled hazardous waste sites.

Ecological receptor: A plant or animal that could be exposed to a chemical in the environment by direct contact or through the food chain.

Ecological Risk: Defined as a process that evaluates the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to one or more stressors.

Focused Feasibility Study (FFS): A report that presents the development, analysis, and comparison of cleanup alternatives.

Hazard Index (HI): The ratio of the daily intake of chemicals from onsite exposure divided by the reference dose for those chemicals. The reference dose represents the daily intake of a chemical that is not expected to cause adverse health effects.

Human Health Baseline Risk Assessment: A baseline risk assessment is an assessment conducted before cleanup activities begin at a site to identify and evaluate the threat to human health and the environment. After remediation has been completed, the information obtained during a baseline risk assessment can be used to determine whether the cleanup levels were reached.

Illinois Coastal Management Program (ICMP): Illinois' regulation to meet the requirements of National Oceanic and Atmospheric Administration and the federal Coastal Zone Management Act to preserve, protect, restore, and enhance coastal resources. The **ICMP** identifies a framework of existing programs, laws, and policies that bring the state agencies into a comprehensive network.

Initial Assessment Study: An assessment to determine if further environmental analysis is needed.

Land use controls (LUCs): Engineered and non-engineered measures formulated and enforced to regulate current and future land use options. Engineered measures include fencing and posting. Non-engineered measures typically consist of administrative deed restrictions that prohibit residential development and/or construction restrictions.

Memorandum of Agreement (MOA): An agreement between Illinois EPA and Naval Station Great Lakes, on behalf of the Department of the Navy, to implement basewide, certain periodic site inspections, condition certifications, and agency notification procedures to make sure the maintenance by Naval Station Great Lakes personnel of site-specific **LUCs** deemed necessary for present or future protection of human health and the environment.

National Contingency Plan (NCP): The federal government's blueprint for responding to both oil spills and hazardous substance releases. The National Contingency Plan is the result of our country's efforts to develop a national response capability and promote overall coordination among the hierarchy of responders and contingency plans.

Net Present Worth (NPW): A present-worth analysis is used to evaluate costs that occur over different time periods by discounting future costs to a common base year. It represents the amount of money that, if invested in the base year and dispersed as needed, would be sufficient to cover the costs associated with the remedial action over its planned life. NPW considers both capital (construction) costs and costs for annual operation and maintenance.

Polynuclear aromatic hydrocarbons (PAHs): High molecular weight, relatively immobile, and moderately toxic solid organic chemicals that feature multiple benzenic (aromatic) rings in their chemical formula. **PAHs** are typically formed during the incomplete combustion of coal, oil, gas, garbage, or other organic substances.

Preliminary Remediation Goals (PRGs): Chemical-specific goals for site contaminants that when achieved will result in site concentrations that pose acceptable risk for the targeted receptor.

Resource Conservation and Recovery Act (RCRA): Enacted in 1976, is the principal Federal law in the United States governing the disposal of solid waste and hazardous waste.

Remedial Investigation/Risk Assessment (RI/RA): A report that describes the site, documents the type and location of environmental contaminants, and presents the results of the risk assessment.

Remedial Design (RD): The phase in Superfund site cleanup where the technical specifications for cleanup remedies and technologies are designed.

Record of Decision (ROD): An official document that describes the selected Superfund remedy for a specific site. The **ROD** documents the remedy selection process and is issued by the Navy, with concurrence of Illinois EPA following the public comment period.

Tiered Approach to Corrective Action Objectives (TACO): The Illinois EPA's method for developing remediation objectives for contaminated soil and groundwater. These remediation objectives protect human health and take into account site conditions and land use. Remediation objectives generated by **TACO** are risk-based and site-specific.

Toxic Characteristic Leaching Procedure (TCLP): A USEPA test for non-hazardous waste, a test designed to measure substances that might dissolve into the ecosystem.

Volatile organic compound (VOC): Any organic compound that has a high tendency to pass from the solid or liquid state to the vapor state under typical environmental conditions. Such compounds participate in a range of processes that lead to atmospheric pollution, including the formation of urban smog.

WHAT'S A FORMAL COMMENT?

Formal comments are used to improve the final decision for site remedy. During the 30-day formal comment period, the Navy will accept formal written comments and hold a meeting, if requested, to accept formal verbal and written comments. To make a formal comment, you need to submit a written comment during the comment period or present your views during the public meeting.

A request for an extension to the public comment period (minimum of 30 days) must be made in writing. A request for a public meeting to present your formal comments must also be made in writing. These requests must be postmarked no later than June 3, 2013. Written comments and requests for a public meeting or an extension of the public comment period should be sent to:

Department of the Navy
Naval Station Great Lakes
NAVFAC Midwest
Attn: Terese Van Donesl
201 Decatur Avenue
Building 1A, Code EV
Great Lakes, IL 60088
Email: terese.vandonsel@navy.mil

Federal regulations require the Navy to distinguish between "formal" and "informal" comments. Although the Navy uses public comments throughout site investigation and cleanup activities, the Navy is only required to respond in writing to formal comments on the Proposed Plan. If a public meeting is held, there will be no Navy verbal responses to your comments during the formal meeting portion of the meeting. After the formal portion of the public meeting is closed, the Navy may respond to informal questions.

The Navy will review the transcript of formal comments received at the meeting and written comments received during the formal comment period before making a final decision. They will then prepare a written response to formal comments. The transcript of formal comments and the Navy's written responses will then be included in the Responsiveness Summary issued as part of the

Use This Space to Write Your Comments

The Navy wants your written comments on the options under consideration for dealing with Site 19 – Former Small Arms Range 910. You can use the form below to send written comments or request a formal public meeting be held. If you have questions about how to comment, please call Terese Van Donsel at (847) 688-2600, Extension 136. This form is provided for your convenience. Please mail this form or additional sheets of written comments, postmarked no later than June 3, 2013 to the address below. Comments may also be e-mailed to the address shown below. A request for an extension to the public comment period (minimum of 30 days) must be made in writing. A request for a public meeting to present your formal comments must also be made in writing.

Department of the Navy
Naval Station Great Lakes
NAVFAC Midwest
Attn: Terese Van Donsel
201 Decatur Avenue
Building 1A, Code EV
Great Lakes, IL 60088
Email: terese.vandonsel@navy.mil

Comment submitted by: