TECHNICAL REPORT

Phase II Excavation Work Plan for the Evor Phillips Site

Evor Phillips Leasing Company
(EPLC) Site Ad Hoc Committee
Old Bridge, New Jersey

August 1996
Revised September 1996

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

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SECTION 1 INTRODUCTION

Background

In June 1996, the New Jersey Department of Environmental Protection (NJDEP) conducted a geophysical (electromagnetic conductivity) survey of the Evor Phillips (EP) site. Based on this geophysical survey, 10 possible subsurface "anomalies" (anomalies) were identified. The Evor Phillips Leasing Company (EPLC) Site Ad Hoc Committee (Committee) will excavate anomalies under the procedures outlined herein. This work (Phase II) will follow a similar scope of work (Phase I) completed by the Committee under the ACO during the first half of 1996.

The results of the State's geophysical (electromagnetic conductivity) survey are presented in Figure 1. This information was received from Craig Wallace of the NJDEP on 25 July, 1996. Based on this Figure BBL has located the anomalies onto a surveyed site base map. The locations of the anomalies on the site base map are provided on Figure 2. On August 29, 1996, the Committee conducted a supplemental geophysical survey [including electromagnetic (EM) conductivity and ground penetrating radar (GPR)] to further refine the information provided by the NJDEP.

Objectives

BBL has prepared the work plan provided herein for the Phase II work associated with the geophysical anomalies. The objectives of these work efforts and, thus, the basis used to develop this work plan, are summarized below:

- Investigate NJDEP anomalies 1, 2, and 4 through 8 via test trenching to determine the presence of buried drums.
- Remove any intact or partial drums having contents ("drums"), characterize such contents and dispose of them off-site.
- Samples will be collected, for laboratory environmental analyses, from excavations where drums are found.
- The Committee further investigated NJDEP's anomaly No.10 via the recent supplemental geophysical survey work. Based on this survey, it has been concluded that there is no evidence of subsurface drums in this area. The results of this survey will be provided as part of the excavation report.

The following sections of this work plan are organized as follows:

- Section 2 - Site Preparation
- Section 3 - Excavation/Characterization - Project Sequence
- Section 4 - Coordination/Documentation

The Quality Assurance Project Plan (QAPP) is provided in Appendix A. The health and safety plans for this work are provided in Appendices B and C.

SECTION 2 SITE PREPARATION

General

Site preparation and mobilization activities will include the following:

Site Set-up

Site set-up activities will consist of preparing support facilities, establishing temporary utilities, delineating work zones, preparing a decontamination station, and where necessary improving access roads. These actions are described below. It is important to note however, that BBL's oversight manager (BBL) and the selected contractor [Integrated Technical Services, Inc. (ITS)] will meet in the field prior to site set-up and mobilization. The objective of this meeting will be to review site conditions, observe the specific anomalies to be excavated, and discuss the planned work efforts and objectives of the Phase II program. Based upon this initial meeting ITS and BBL will define the specific sequence of operations associated with these site set-up activities to be completed, including:

- **Clearing** - all areas that will either be excavated or utilized for site set-up will be cleared of vegetation or miscellaneous surface debris/obstructions, if required, and stockpiled on site.

- **Work Zone Delineation** - BBL and ITS (health and safety officer/field supervisor) will define and delineate in the field work zones, including a contamination reduction zone, clean zone, and exclusion zone. During the course of the field activities, these zones may be redelineated (in size and/or location) to best accommodate the activities that will be located throughout various areas of the site. All zones will be clearly marked. First aid and fire prevention stations will be provided in the exclusion zone. The first aid station will include an eyewash emergency station, a first aid kit, and a fire blanket. The fire prevention station will include two ABC fire extinguishers. Prior to initiation of work, the work zone delineations will be amended to ITS's health and safety plan, provided as Appendix C.

- **Support Facility/Utilities/Access** - support facilities will be established on site as part of the initial mobilization. Such facilities may include:

  - an office trailer,
  - storage box (for materials/equipment),
  - portable sanitary facility,
  - portable poly tank (optional),
  - trash dumpster,
  - spill response material,
  - first aid/fire prevention materials; and
  - mobile drum basin.

  Electricity for the field trailer will be provided from an existing on-site power service (pending NJDEP approval) as was done for the Phase I activities. All electrical hook-ups will be performed by a N.J. licensed electrician. Water for decontamination and potable use will be brought in from an off-site source.

  As part of this effort, any activities which may be necessary to improve access to and from the work zones will also be completed. Such improvements will be addressed during the initial site meeting when the work zone locations are defined.

- **Decontamination Station** - the contractor will construct a decontamination station for equipment and transportation. The station will have a mechanism for containing washwater, an aboveground holding tank for used washwater; ancillary brushes, scrapes etc.; and if necessary a high pressure, low volume pressure washer. The location of the decontamination station will be included in the ITS health and safety plan (Appendix C) as an amendment.

SECTION 3 EXCAVATION/CHARACTERIZATION - PROJECT SEQUENCE

General

The sequence of the areas to be characterized will be determined during the initial site (pre-construction) meeting with ITS and BBL. Excavation will proceed as follows:

- The area to be characterized will be clearly identified. As an initial plan, two trenches will be excavated at each location forming an "X" pattern with the center of the "X" located in the center of the anomaly. Anomaly areas 4 and 2 may have a third trench excavated due to their size (See Figure 2). Unless drums are discovered, each trench will be approximately 3 feet wide and up to 10 feet deep. If drums are discovered, excavation will proceed as described in the following paragraphs. Sides of the excavation will be sloped back extending the trench width beyond 3 feet as necessary for stability. The length of the excavation will extend 10 feet beyond the anomaly boundary which will be defined in the field based on the results of the geophysical survey. If drums are not identified within the trench excavation described above, the excavation activities will cease. .

The excavations will proceed (as described above) at each anomaly unless drums are identified. In this situation, as per the objective of this program, excavations will proceed to remove, characterize, and properly dispose of the drums.

As part of the excavation activities, an excavation spotter (associated with the contractor) will assist the equipment operator in directing the excavation activities. The spotter's primary responsibility will be close range visual inspection of the area for any debris, drums, discoloration etc. Organic vapors during excavation will be monitored for health and safety purposes.

Staging & Temporary Disposition of Excavated Material

During the excavation of each anomaly, material will be observed, and staged (stockpiled) adjacent to the anomaly. The staging area will be lined with polyethylene sheeting and covered at the completion of each work day. Except for the potential drums, no other excavated materials will be segregated for stockpiling.

Handling of drums may proceed as described below, however variations to these procedures may be warranted depending on specific field conditions/situations.

- When a drum is identified in the excavation (prior to removal), a determination will first be made as to the appropriate handling procedures.

- Drums that are generally intact may be removed utilizing appropriate equipment such as drum nylon slings and hooks. If a drum, which appears to have contents, is deteriorated where drum grapples or slings are not capable of removing the drum, the excavator bucket may be used. Prior to removing any drums, the field crew will determine where possible, whether the drum contains liquid or solid.

- Drums that are intact will be placed directly into designated drum staging area. If the BBL oversight representative determines that drums require overpacking, they will be overpacked and then transferred to the staging area. Leaking drums, or drums that cannot be overpacked due to their physical condition, may be placed into a mobile drum storage basin where the liquid will be transferred to a new drum for staging. All drums/drum overpacks will be placed on pallets in the drum storage area. All drums will be numbered/labeled identifying the location from where it came. A drum inventory log will be prepared referencing the

drum number, location (anomaly/grid location), drum condition, and description of waste type (if known).

If, during staging activities, a drum were to spill or leak, the spill will be immediately contained, the impacted soils immediately excavated/stockpiled (for characterization and subsequent disposal), and the NJDEP Case Manager notified of such event.

Sampling/Analysis and Disposition of Excavated Material

All material excavated from each anomaly, except for the drums that may have been over packed and separately staged, will be placed directly back into the excavation. The drums, staged separately, will be handled as follows:

- All liquids and solids within drums will be sampled and analyzed for compatibility. Once compatibility is determined, all compatible liquids and solids will be bulked at a designated drum accumulation area. Specifics regarding how material will be bulked (types and number of containers) will be determined once the volumes of material and types of material are known.

- Subsequent to bulking, waste classification sampling and analysis will be conducted to profile the material for final off-site disposal.

- Upon receiving waste approval from a designated disposal facility, the materials will be loaded and transported for final disposal.

Prior to backfilling the excavations, soil samples will be collected from within excavations, only where drums have been removed. The objective is to collect information characterizing subsurface data in the areas of the anomaly for inclusion in the supplemental RI report, and to assist in focusing potential supplemental RI activities in these anomaly areas. The sampling and analysis will consist of the following:

- For each anomaly excavation where drums have been removed, a minimum of five samples will be collected (1 per side wall and 1 from the bottom). These samples will be analyzed for TCL volatiles and semivolatiles, and TAL metals.

- Sampling will be conducted in consideration of N.J.A.C. 7:26E - the NJDEP's Technical Requirements for Site Remediation.

- QA/QC sampling will consist of field blanks and MS/MSD's (trip blanks are not required for soil samples) and duplicate samples.

Soil samples may be collected from excavated material (or from within the excavations) where no drums are identified, but where potentially impacted soils are observed. Such information may be used by the Committee to assist in focusing supplemental RI activities.

The analytical results from the excavation sampling will be summarized and reviewed.

SECTION 4 COORDINATION/DOCUMENTATION

During the course of implementating this excavation work plan, various coordination and project/site management activities will be conducted. These activities are summarized below.

Project Coordination

Regularly scheduled coordination meetings will be conducted as follows:

Initial Site Meeting - The objective of this meeting will be to:

- define the specific sequence of operations;
- identify work zone areas/requirements;
- define ingress and egress issues;
- identify site mobilization issues;
- introduce project personnel; and
- review project objectives, implementation operations, and communication procedures.

Based on this meeting, any changes to the work plan will be recorded, as appropriate. At a minimum, ITS' site supervisor and health and safety officer, and BBL's oversight representative, will attend this meeting. Representatives of the NJDEP and the Committee will be invited to this meeting.

Daily Coordination Meeting - Daily meetings will be conducted (either each morning or late afternoon) to define the days/next days activities, and any issues that may require resolution. At a minimum ITS' site supervisor and BBL's oversight representative will attend this meeting.

Documentation

Documentation of daily activities will be completed by BBL's oversight representative. A daily log will be completed by the BBL's representative documenting the area excavated (anomaly number and description of area based on a grid coordinate), estimated volume of material removed, type of material removed, personnel and equipment on site, sampling efforts conducted and observations and issues. Photographs will be taken to document daily activities focusing on those considered critical. Files will be maintained on site for logs, manifests, sampling chain-of-custodies, sampling data, photographs, and other communication information/meeting notes.

Personnel Responsibilities

The project personnel and their responsibilities are summarized below:

- Ms. Lisa Kaul, Technical Committee Chairperson - will be responsible for guiding the overall project direction in accordance with the ACO, based on input from BBL, the contractor, other Committee members, and the NJDEP. Ms. Kaul will also be responsible for coordinating with Mr. Craig Wallace (NJDEP's Case Manager) or other NJDEP personnel.

- Mr. Joseph J. Hochreiter, BBL Project Officer - will be responsible for day-to-day project management and coordination with Ms. Kaul.

- BBL's Oversight Representatives (Mr. D.P. Montanari or M.P. Fleischner) - will be responsible for oversight and documentation of activities, directing the contractor,

coordinating the daily project meeting, and collecting samples. BBL personnel will take direction from Ms. Kaul and the Committee.

- ITS (Committee's Contractor) - responsible for site health and safety, establishing work zones, site mobilization, excavation and stockpiling, material load out and transportation, manifesting, site restoration, maintenance of access roads, utilities etc. ITS will be directed by BBL's oversight representative and Ms. Lisa Kaul.

Health & Safety

BBL's health and safety plan is included as Appendix B. ITS' health and safety plan is included as Appendix C. This plan was utilized by ITS for previous excavation activities (Phase I excavation conducted in the first half of 1996) and was approved by the NJDEP. Upon approval of this work plan by NJDEP and conducting the initial site meeting, ITS will amend the health and safety plan to reflect any required changes or additions. The amendments will be provided to NJDEP. Based on this plan, the contractor will conduct a pre-construction Health & Safety meeting with all site personnel. The contractor will be responsible for Health & Safety throughout the duration of the project including maintaining barricades, fencing and work zone delineation, ingress/egress control, and all OSHA requirements.

Site Maintenance

The contractor will be responsible for overall site maintenance including:

- maintaining a log of all workers and daily visitors;
- inspecting and maintaining (daily at a minimum) stockpiles for proper cover and all drum/debris storage areas for potential spills/leakages;
- maintaining operations of all support facility including decon areas, trailers, fire control items, etc.;
- implementing dust control measures (as necessary) using water;
- maintaining general housekeeping;
- securing all open trenches (from a Health & Safety perspective) as necessary subsequent to completion of the days activities. At a minimum, any trench remaining open at the end of a day will be secured with temporary fencing.

Daily inspections will be conducted by the Contractor and BBL's oversight representative.

Schedule

The proposed schedule is as follows:

Activity	Schedule
Initial Site Meeting	Week one.
Site Mobilization	Week one and two.
Excavation/Stockpiling	Weeks two and three (total duration will depend on what is found in each area and its impact on the speed of excavation and material handling).
Sampling and Analysis	As needed, upon drum removal at completion of excavation in each area.

Activity	Schedule
Drum Consolidation/Bulking	Subsequent to completion of all excavations and collection of all analytical data.
Drum Load Out/Site Restoration	Upon approval of waste characterization by the disposal facilities.

NJDEP will be notified on a weekly basis of any schedule changes and/or details with respect to scheduled activities as the work progresses.

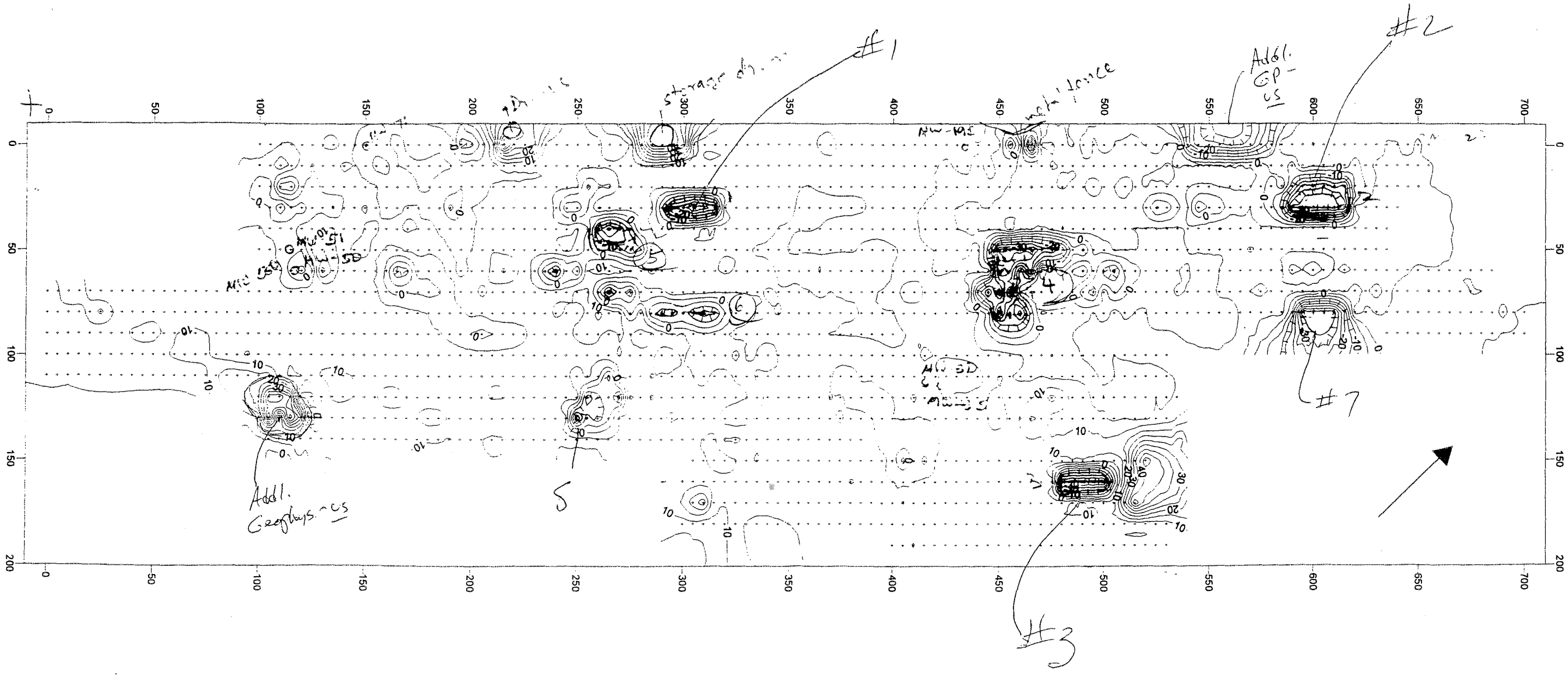
Site Restoration

Upon completion of work activities, Health & Safety fencing, work zones, storage areas, decontamination pads etc. will be removed from the site. All excavated anomalies will be backfilled with material removed from the excavation and, if required, clean fill from off-site. The source of any off-site fill, brought on site for final restoration, will be defined prior to acceptance.

As part of the site restoration, all general refuse (paper, cans, cardboard, etc.) will be disposed at a municipal landfill. All PPE will be properly disposed. Additionally, prior to demobilizing any equipment utilized for removal of impacted material, such equipment will be decontaminated. Decontamination will consist of manually wiping and/or other suitable procedures.

Figures

Evor Phillips In-phase EM Map
Contour interval: 5 ppt



SOURCE:
C. WALLACE, NJDEP, JULY, 1996.

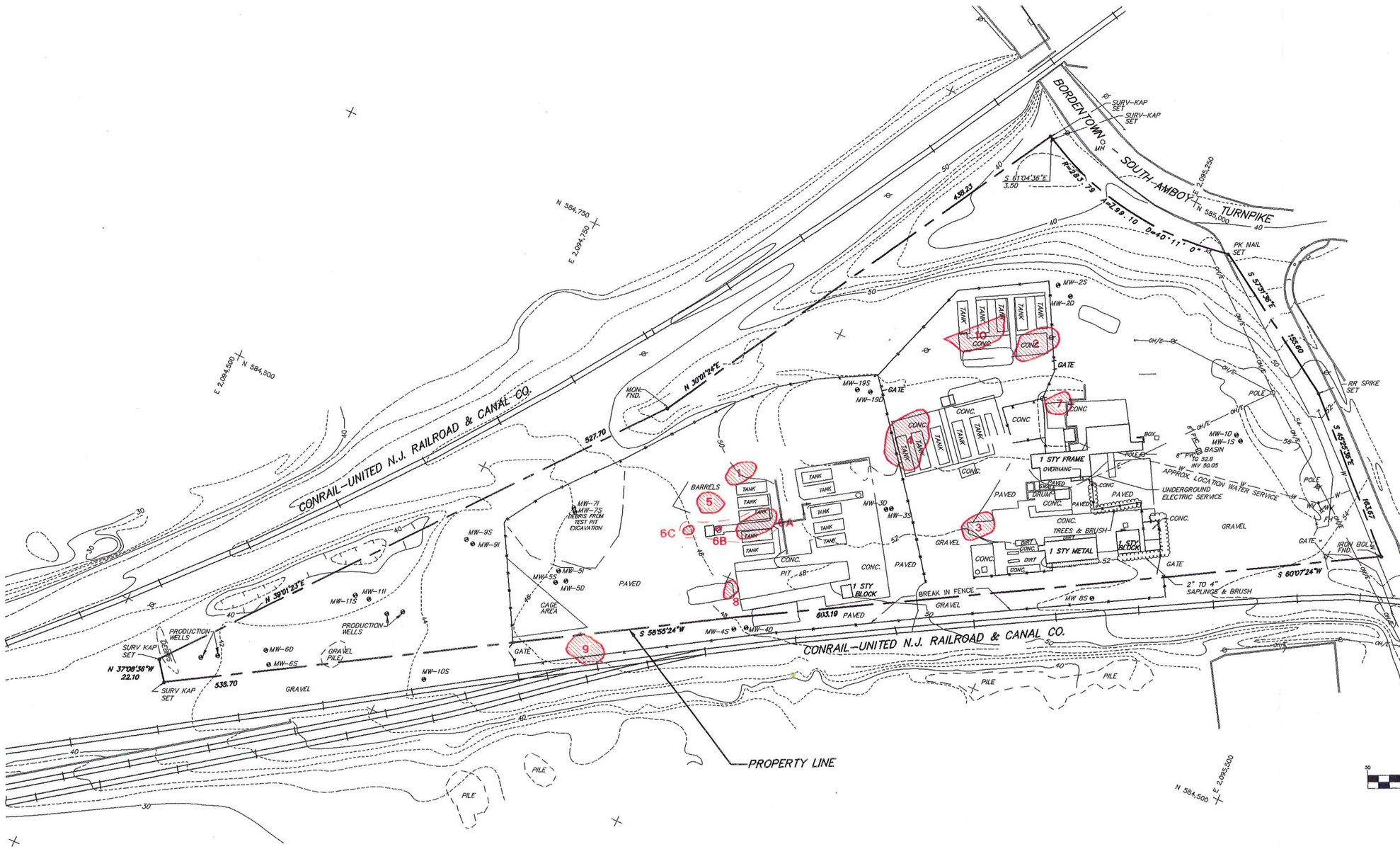
EVOR PHILLIPS LEASING COMPANY SITE
OLD BRIDGE, NEW JERSEY

NJDEP's GEOPHYSICAL SURVEY OF SITE

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 1

AUGUST 20, 1996, CRAN-62-W.D.N.
181.01.010



GENERAL NOTES:

1) REFERENCE MAPS–CONTOUR AND PLANIMETRIC DATA SHOWN ON THIS MAP ARE BASED UPON THE FOLLOWING MAP SOURCES:

A MAP PROVIDED BY VEP ASSOCIATES INC. TITLED "SURVEY MAP, EVOR PHILLIPS LEASING CO., OLD BRIDGE TOWNSHIP, N.J., MIDDLESEX COUNTY, N.J." SCALE: 1"=50', DATED: 6–16–87 AND SEALED BY JULIO E. ESQUIVEL, L.S. N.J. LICENSE 19943.

A MAP PROVIDED BY JAMES M. STEWART, INC. LAND SURVEYORS, TITLED "EVOR PHILLIPS LEASING COMPANY, OLD BRIDGE TOWNSHIP, MIDDLESEX COUNTY, NEW JERSEY", SCALE: 1"=40', DATED: 9–16–93.

2) THE APPROXIMATE LOCATION OF UNDERGROUND UTILITIES SHOWN HAVE BEEN INTERPRETED FROM OTHER MAPS AND SURVEYED LOCATIONS OF ABOVE GROUND FEATURES SUCH AS VALVE PITS. CONTRACTOR MUST VERIFY COMPLETENESS AND LOCATIONS BEFORE COMMENCEMENT OF WORK IN ANY AREA.

3) HORIZONTAL CONTROL–BASED ON NEW JERSEY PLANE COORDINATE SYSTEM, NAD 27.
VERTICAL CONTROL–NATIONAL GEODETIC DATUM OF 1929.

SOURCE:

BASEMAP INFORMATION WAS TAKEN FROM A MAP ENTITLED "EXISTING SITE PLAN – OUT INTERIM REMEDIAL MEASURE" PREPARED FOR EVOR PHILLIPS, MIDDLESEX COUNTY, OLD BRIDGE TOWNSHIP, NEW JERSEY BY TRC ENVIRONMENTAL CORP., 5 WATERSIDE CROSSING, WINDSOR, CONN. DATED 9/21/93 AND LAST REVISED 7/8/94. CAD FILE No. C:\14732\C1–14732.

LEGEND:

- PROPERTY BOUNDARY
- MONITORING WELL
- ANOMALIES

50 0 25 50 100 200

GRAPHIC SCALE (IN FEET)

EVOR PHILLIPS LEASING COMPANY SITE
OLD BRIDGE, NEW JERSEY

PHASE II EXCAVATION WORK PLAN

NJDEP ANOMALIES

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 2

SEPTEMBER 11, 1996, CRAN–62–W.O.N.
181\1810110R\18101G04.DWG

Appendix A

Quality Assurance Project Plan for Phase II Excavation Work Plan

September 1996

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Attachment 1 IEA - NJ Quality Assurance Program Plan

1. Introduction

1.1 Project Plan Description

This Quality Assurance Project Plan (QAPP) presents quality assurance (QA) and quality control (QC) procedures which will be used for potential soil sampling associated with the Phase II excavation activities to be conducted at the EPLC site located in Old Bridge, New Jersey. The QAPP is designed to ensure that data quality objectives (DQO), field sampling activities, and laboratory analysis conform to specific standards and guidelines from project initiation to completion. The guidance used to construct this document was from the New Jersey Administrative Code (N.J.A.C.), specifically N.J.A.C. 7:26E2.2 and from the New Jersey Department of Environmental Protection and Energy (NJDEP) May 1992 Field Sampling Procedures Manual. This QAPP was developed and corresponds to the outline described in N.J.A.C. 7:26E2.2.

1.2 Project Objective and Scope of Work

The scope of the Phase II excavation activities are presented in Section I of the Phase II excavation work plan and are summarized below:

- Investigate NJDEP anomalies 1 through 8 via test trenching to determine the presence of buried drums.
- Remove any intact or partial drums having contents ("drums").
- Collect samples, for laboratory environmental analyses, from trench excavations where drums are found.

The objective of the sampling activities is to collect soils data to be used as part of, or to assist in the focusing of, the upcoming supplemental soils RI.

1.3 Site Background

The following sections briefly describe the land use, hydrogeology and water use, occurrence of potable wells, and surface water in the vicinity of the EPLC site. These sections are largely adapted from the TRC Environmental Consultants, Inc. (TRC) draft Remedial Investigation Report for the EPLC site, dated September 1991. Following these sections is a presentation of historical soil quality data for the EPLC site.

The area surrounding the EPLC site is primarily industrial. The CPS/Madison Industries site, which is also listed on the USEPA National Priorities List of hazardous waste sites, is located approximately 800 feet southwest of the site. In 1991, TRC identified other nearby industries that include Lionett Oil Recovery Company to the east, the Jersey Billets Division of Easco Aluminum Company to the northeast, and Forte Pallet, also to the east. Businesses located east of Jersey Billets include wooden pole manufacturing plant, a construction debris landfill, a gravel pit operation, and a construction company.

The closest residences to the EPLC site are four dwellings located approximately 750 feet to the northwest along Bordentown Avenue, which from a groundwater flow perspective are situated hydraulically side gradient of the

influence of the site. Major population centers are located approximately 3 miles to the southwest in the East Spotswood/South Old Bridge section of Old Bridge Township, approximately 2 miles to the east in Sayreville, approximately 2 miles to the west in South River, and approximately 3 miles to the southwest in the East Spotswood/South Old Bridge section of Old Bridge Township, approximately two miles to the east in Sayreville, approximately two miles to the est in South River, and approximately three miles to the southwest in East Brunswick.

Groundwater flow beneath the site, within the unconsolidated Quaternary deposits and Old Bridge Sand, is generally to the south-southwest. This flow is interrupted in the western portion of the site where shallow groundwater is mounding on top of the localized occurrence of the Amboy Stoneware Clay. The contact of the clay and the overlying Cape May Formation dips to the east, causing the mounded shallow groundwater to be shed to the east.

The intermediate monitoring wells, screened directly below the Amboy Stoneware Clay, indicate a dynamic groundwater flow condition where the direction of groundwater flow varies. Flow was reported by TRC to be to the east during TRC's Phase I investigation and to the south during their Phase II study. Groundwater flow as evidenced in the deep monitoring wells is reported by TRC to be towards the southwest.

2. Data Quality Objectives

2.1 Data Quality Objectives

The data quality required to ensure that project objectives will be achieved must be addressed in terms of end-user or decision-maker needs. This requires definition of the data type, data uses, and data quality objectives (DQOs) in terms of data precision, accuracy, representativeness, completeness, and comparability (PARCC). The DQO's for this program are to determine if there are constituents (at anomalies from which drums are found and removed) exceeding the NJ soils cleanup criteria and to assist in focusing any potential supplemental RI sampling, if warranted.

2.2 Types and Uses of Data

Site soils will be evaluated via collection and use of three types of data: visual observations of soil properties; measurement of volatile emissions from soil samples; and chemical analysis of soil samples.

Volatile emissions will be measured in the headspace of the soil sample containers through the use of a flame ionization detector (FID) or photoionization detector (PID). Readings above background will be noted in a field logbook. Quality Assurance/Quality Control (QA/QC) measures for FID/PID operation, calibration, and maintenance will be implemented and documented in accordance with manufacturer's instructions and recommendations which are kept with the instrument as available in the field. These steps will ensure the precision and accuracy of FID/PID measurement data. These data will be compared to analytical results to correlate occurrence of volatile contaminants within the headspace of a sample container and within the sample itself.

To evaluate the presence or absence of constituents in soils, samples will be collected for analysis of TCL volatiles and semi-volatiles and TAL metals.

Precision and accuracy will be explicitly demonstrated for all sampling and analysis activities. As detailed in Section 8, duplicate and matrix spike samples will be collected to demonstrate achievement of sampling precision and accuracy, respectively. Additionally, the potential for systematic errors will be assessed through collection of field blanks, as required. Procedures for determining and documenting analytical precision and accuracy are addressed in Section 10.

Representativeness of the quantitative data and information collected will be assured via the strategy to be implemented for sample collection which includes:

- collection of samples from multiple areas within the excavation;
- the observance of areas of discoloration; and
- the observance of areas where drums were removed

Measures will be taken to ensure that the collected data are of sufficient validity and are comparable. Completeness of the data will be achieved when all data considered critical to the investigation have been validated. In general, 100 percent completeness of data will be the objective; however, if some data are not validated, completeness will be assessed on a case-by-case basis. To optimize comparability of the data, only the field and laboratory procedures specified in this QAPP will be followed.

3. Analytical Laboratory

3.1 Analytical Laboratory

The proposed analytical laboratory is IEA Laboratory of Whippany, New Jersey (New Jersey Certification Number 14530). IEA's quality assurance manager is in NJ is Mr. Kevin Gorman.

4. Management Plan

4.1 Project Management Plan

The individuals responsible for implementating the excavation work plan and their roles are identified in the work plan. Individuals responsible for overall project coordination, sampling activities, and laboratory activities, and their telephone numbers, are reiterated below. If the responsibilities or individuals specified below are modified, this Plan will be updated accordingly.

1. Overall Project Coordinator

   Ms. Lisa Kaul
   Environmental Project Control
   (217) 398-4017

2. Sampling Activities Coordinator (including QA/QC)

   Mr. Michael J. McNally
   Blasland, Bouck & Lee, Inc.
   (609) 860-0590

3. Laboratory Activities Coordinator (including QA/QC)

   Mr. Ward Donigian
   IEA Laboratories
   (201) 428-8181

5. Analytical Methods/Quality Assurance Summary Table

The Analytical Methods/Quality Assurance Summary as required in N.J.A.C. 7:25E 2.2, is provided below:

Parameters*	***Methodology***
Volatiles	SW-846/8240
Semi-Volatiles	SW-846/8250
Metals	SW-846/6010

* Note: All samples analyzed for TCL/TAL Parameters

6. Soil Sampling Methods

Only soil samples will be collected during this phase of the investigation. The following is a description of soil sampling procedures that will be used in the field.

A backhoe will be utilized to collect samples within the trenches. Prior to beginning the excavation for sampling, gross contamination of the backhoe bucket shall be removed by scraping and wiping the interior surfaces of the bucket. Plastic sheeting shall be placed for the staging of excavated materials. The sample shall then be collected from the desired interval with the backhoe bucket and transported away from the excavation to a sampling area. The operator will then signal the sampler to approach the bucket to collect the sample. Samples shall be collected from the middle of the bucket. Materials collected for chemical analysis should not have been in contact with the surface of the bucket.

The following type of sample information will be recorded in the field notebook:

1. appropriate depth of sample;
2. material classification/description;
3. time of sample collection;
4. analytical parameters;
5. FID/PID scan results; and
6. jar lot number.

The following is a list of supplies which may be necessary for collection of soil samples:

1. stainless steel or Teflon spatula, knife, or trowel;
2. disposable gloves;
3. stainless-steel mixing bowl;
4. sample jar; a. 125 ml VOA/b. 8 ounce glass jar
5. decontamination supplies; and
6. field notebook with appropriate forms.

All sampling will be conducted with dedicated, cleaned sampling equipment and/or equipment decontaminated in the field between each sampling point. Decontamination procedures will include:

- soap and water wash,
- distilled and deionized water rinse;
- methanol rinse; and
- distilled and deionized water rinse.

All rinse/decontamination water will be collected and disposed of off-site with all other equipment decontamination waters upon project completion.

7. Calibration and Preventative Maintenance

Calibration and preventative maintenance issues for this project concern the use of the FID/PID. Those issues pertinent to the PID are addressed within the manufacturers operating procedures manual. Calibration and preventative maintenance issues pertinent to the FID will be addressed in a manner similar to the PID; by following manufacturer's operating procedures manual.

8. Quality Control/Quality Assurance Samples

To maintain a check on the quality of the analytical work, a number of QA/QC samples will be added to the analytical program. Three types of QA/QC samples will be utilized:

1. duplicate samples;
2. matrix spike and matrix spike duplicate samples; and
3. field blanks.

8.1 Duplicate Samples

To evaluate the reproducibility of the analyses, 10 percent of all samples will be collected in duplicate. If less than 20 samples are to be collected, one duplicate sample will be included. In addition to providing information on the precision of the analyses, duplicate samples are useful in providing an indication of the homogeneity, handling, shipping, and preparation of samples.

8.2 Matrix Spike and Matrix Spike Duplicates

Five percent of samples will be collected in triplicate; or at least one sample, if less than 20 samples are to be collected. The laboratory will add known quantities of analytes to these samples and then analyze. This procedure will enable the laboratory to evaluate the accuracy of the analyses, and matrix effects such as interference can be determined.

8.3 Field Blank

To evaluate the effectiveness of the decontamination procedures, a field blank will be performed each day or on 10% of total samples collected on multiple day sampling events. The equipment blank will be performed by running laboratory-certified, analyte-free water through or over a decontaminated sampling device and collecting the rinseate. The rinseate will then be analyzed for volatile organics, only if volatile organics are being analyzed for. Field blanks will be collected at the rate of 10%.

9. Documentation of Activities

9.1 Documentation

The Sampling Activities Field Coordinator or a designee will keep detailed records of inspections and investigations, and will thoroughly review all notes before leaving the site each day of field work. Such information will be maintained in a field logbook.

9.2 Field Logbook

All information pertinent to field activities will be entered in a bound book with consecutively numbered pages. Entries in the logbook will include pertinent information from the following:

1. Date and time of site entry.
2. Purpose of sampling.
3. Name(s) of field investigator(s) and sample collector(s).
4. Name of facility.
5. Type of process that produced contamination, if known.
6. Date and time of sample collection and sample I.D. number.
7. Weather conditions.
8. Anticipated contaminant components and concentrations, if known.
9. Description and location of sampling point.
10. Air monitoring device readings and the significance of the readings (presence of volatile compounds, need for respiratory protection, etc.).
11. Soil sample preparation methods and sampling equipment utilized.
12. Where and when sampling equipment refusal occurred and the corrective action taken.
13. Sample equipment decontamination procedures and when equipment was decontaminated.
14. Number and size of samples taken.
15. Physical properties observed of samples taken; color, odor, turbidity, non-aqueous phase, stratification, etc.
16. Purge water and other sampled media material disposal practices.
17. When samples were shipped to lab.
18. Any other relevant field observations.

Because sampling situations vary widely, notes should be as descriptive and inclusive as possible. If entries must be changed, the change should not obscure the original entry. The correction will be signed and dated at the time the correction is made. If anyone other than the person to whom the logbook was assigned makes an entry, he/she must date and sign it.

9.3 Sampling Locations

Sampling points should be documented as to their location for purposes of future re-occupation and data interpretation. Each location will be taped (measured) off from a known location or grid point.

9.4 Photographs

If photographs of field operations and sampling locations are to be taken, they must include reference points so that the location of the scene may be re-established, if needed. Photographs of samples must include a scale and a

unique identifier (such as a placard with the Sample ID). The following information must be recorded in the logbook:

1. roll number;
2. type of film;
3. number of exposure; and
4. date.

The recorded information also must include a general description of the activity photographed, including the direction the camera was facing and the direction and distance to the nearest field reference point.

9.5 Logs

To facilitate data management and guide the field personnel in their decisions, trenching information will be recorded on trench log forms. To ensure proper document identification, all the header information will be filled out on the form. The field personnel will note their observations in the space provided on the log form. Information on grain size, grading, presence of waste materials, texture, and structure of the soils will be recorded. In addition, the boundaries of the different units will be placed on the log. The emphasis of the logging is on recording soil units with similar properties rather than individual samples. Depth and date of completion will be recorded at the bottom of the log. Sample locations will be recorded at the appropriate depth intervals, with their respective ID numbers and test parameters. All completed log forms will be photocopied and filed at Blasland, Bouck & Lee's home office.

9.6 Chain-of-Custody

An essential part of any sampling/analytical scheme is ensuring the integrity of the sample from collection to data reporting. This includes the ability to trace the possession and handling of samples from the time of collection through analysis and final disposition. The documentation of the history of the sample is referred to as the chain-of-custody.

A sample is considered to be under a person's custody if (1) it is in the person's physical possession, (2) in view of the person after he has taken possession, (3) secured by that person so that no one can tamper with the sample, or (4) secured by that person in an area which is restricted to authorized personnel. Chain-of-custody documentation will be retained for all samples collected.

When transferring samples, the transferee must sign and record the date and time on the chain-of-custody (C-O-C) record. Custody transfers made to others in the field should account for each sample, although samples may be transferred as a group. Every person who takes custody must fill in the appropriate section of the chain-of-custody record. To minimize custody records, the number of custodians in the chain-of-possession should be minimized.

The field sampling activities coordinator is responsible for properly packaging and dispatching samples to the laboratory. This responsibility includes filling out, dating, and signing the appropriate portion of the chain-of-custody record.

The C-O-C form is intended as a record of possession of the samples. The C-O-C form is initiated at the laboratory with bottle preparation and shipment to the site. The C-O-C form remains with the sample at all times and bears the name of the person assuming responsibility for the sample. The C-O-C record must contain the following minimum information:

1. Site name and address
2. Sample number
3. Sample type (composite or grab) and matrix
4. Date and time of collection
5. Number of containers
6. Parameters for which analyses are requested
7. Signature of collector
8. Signatures of persons involved in chain-of-custody
9. Inclusive times and dates of possession
10. Condition of sample upon arrival at laboratory
11. Temperature of the cooler upon receipt by the laboratory

Upon receipt of the sample containers, the glassware listed on the C-O-C form will be compared with the glassware received. Any discrepancies or losses will be reported to the lab immediately, and the glassware will be returned to the lab with the C-O-C forms. These issues will be recorded on the C-O-C form and in the field logbook. Prior to shipping, the required information will be completed: the project title; sample type; location; the requested analyses; and other information, that, in the judgement of the field personnel, may be necessary. All packages sent to the laboratory should be accompanied by the C-O-C record and other pertinent forms. A copy of these forms should be retained by the originating office (either carbon or photocopy). Mailed packages can be registered with return receipt requested. For packages sent by common carrier, receipts should be retained as part of the permanent C-O-C documentation.

10. Lab Sample Storage Procedures

The laboratory sample storage and handling procedures are described in the attached Corporate Quality Assurance Program Document from IEA. The attachment also describes the laboratory's Quality Assurance/Quality Control Program.

11. Lab Data Deliverable Formats

11.1 Laboratory Data Deliverable Formats

All laboratory data provided by IEA laboratories will be provided in a NJDEP Reduced Deliverable format including PQLs.

IEA
An Aquarion Company

IEA-New Jersey
Quality Assurance Program Plan

prepared by

Kevin J. Gorman
Quality Assurance Manager

for

IEA Corporation
Whippany, New Jersey

This document has been prepared by IEA Corporation and will be updated annually. The material contained herein is not to be disclosed to, or made available to any third party without the prior expressed written approval of the Corporate Quality Assurance Staff.

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1.0 QUALITY ASSURANCE PROGRAM-IDENTIFICATION FORM

Document Title: **IEA-NEW JERSEY QUALITY ASSURANCE PROGRAM PLAN**

Address: IEA New Jersey
628 Route 10
Whippany, New Jersey 07981

Company Official: Mr. Kyle E. Dolbow
Title: Director of Operations
Telephone: (201) 428-8181

Company Official: Mr. Brian Wood
Title: Laboratory Manager

Company Official: Mr. Kevin J. Gorman
Title: Quality Assurance Manager

Plan Coverage: IEA-New Jersey Laboratory including the following functions:

Administration	Computer Systems
Sample Receipt	Inorganics Laboratories
GC Laboratories	GC/MS Laboratories
Quality Assurance	Facilities and Safety
Sample Preparation Laboratories	Report Production
Project Management	Metals Laboratories

Concurrences:

Name: Mr. Kyle E. Dolbow
Title: Director of Operations
Signature: Kyle E Dolbow
Date: 5/3/96

Name: Mr. Brian Wood
Title: Laboratory Manager
Signature: Brian W. Wood
Date: 5/3/96

Name: Mr. Kevin J. Gorman
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Date: 5/3/96

Name: Mr. Brian Wood
Title: Laboratory Manager
Signature: Brian W. Wood
Date: 5/3/96

Name: Mr. Kevin J. Gorman
Title: Quality Assurance Manager
Signature: Kevin J. Gorman
Date: 5/3/96

2.0 INTRODUCTION

2.1 Background

Industrial & Environmental Analyst's, Inc. (IEA) is a full-service environmental organization specializing in laboratory analytical services and field support services.

The IEA organization is a network of six (6) integrated environmental laboratories located throughout the Eastern United States with over 300 employees, making it one of the top ten environmental testing companies in the United States. The corporation serves a broad range of industries including environmental consulting and engineering firms, state and federal agencies, pharmaceutical, petroleum, and electronic component manufacturers. In support of these activities the corporation presently maintains environmental laboratory certifications in over twenty five state programs. IEA Corporate headquarters are located in Cary, North Carolina.

IEA is a wholly-owned subsidiary of the AQUARION Company, headquartered in Bridgeport, Connecticut. AQUARION is listed on the New York Stock Exchange and has annual revenues exceeding 100 million. It is also the largest investor-owned water utility in the country.

The IEA laboratories are located as follows:

IEA/Connecticut	Monroe
IEA/Illinois	Schaumburg
IEA/North Carolina	Cary
IEA/NC-Radiological	Morrisville
IEA/Massachusetts	N. Billerica
IEA/New Jersey	Whippany

Detailed information such as mailing addresses and telephone numbers for each of the laboratories is presented in Table 2.2.1.

HISTORY OF IEA

IEA was founded in 1977, in Burlington, Vermont, as a water resources testing facility in support of IBM's facility in Essex Junction, Vermont. IEA served the IBM site exclusively for three years performing ultrapure water analysis, wastewater treatment and pollution control. In 1982, IEA opened a second facility in Research Triangle Park (RTP), North Carolina in order to provide desired services from the IBM facility in RTP. In 1984 IEA expanded its market and began serving the developing environmental testing market. By 1985 IEA had expanded to a full service laboratory offering complete soil and water analysis, field sampling, groundwater analysis and evaluation of hazardous waste. The North Carolina laboratory, which serves as IEA's corporate headquarters, is located in Cary, North Carolina.

In the fall of 1988, IEA positioned itself as one of the leading laboratories in the country by qualifying for the USEPA Contract Laboratory Program (CLP). This development created a favorable position for winning major consulting engineering contracts. As such, IEA grew rapidly and expanded its commercial client base considerably. Due to the rapid increase in demand for environmental services IEA sought potential buyers in 1989 in order to provide resources for future expansion. As a result, IEA was purchased by The Aquarion Corporation, based in Bridgeport, Connecticut in 1989. Aquarion is a New York Stock Exchange-listed corporation that traces its roots to 1857. It has the distinction of being the largest investor-owned water utility in the nation. Annual revenues of Aquarion exceed 100 million.

Since the initial purchase, IEA has acquired several existing environmental laboratories which were operated in strategic locations along the Eastern United States. As a result, IEA now offers very comprehensive environmental testing services including mixed waste radiological testing and a full range of chemical testing performed in support of DOD, DOE, RCRA, CERCLA, NPDES, TSCA and SDWA regulations.

This plan is intended to describe the quality assurance program of the IEA-New Jersey facility located at 628 Route 10, Whippany, New Jersey. IEA operates a corporate wide quality assurance program (Doc.# QAQ00103.NET) and this facility QA program complies with the requirements set forth in the corporate program. In some cases, the requirements in the facility QA program may be more stringent than the corporate program, but in no case can they be less stringent.

TABLE 2.1.1 IEA NETWORK LOCATIONS

North Carolina
Corporate Headquarters
3000 Weston Parkway
Cary, NC 27513
(919) 677-0090
(919) 677-0427 (Fax)
(800) 444-9919

North Carolina
Radiological Laboratory
120 South Center Court
Suite 300
Morrisville, NC 27560
(919) 460-8505
(919) 469-2646 (Fax)

Illinois
126 West Center Court
Schaumburg, IL 60195
(708) 705-0740
(708) 705-1567 (Fax)
(800) 933-2580

Connecticut
200 Monroe Turnpike
Monroe, CT 06468
(203) 261-4458
(203) 268-5346 (Fax)

New Jersey
628 Route 10
Whippany, NJ 07981
(201) 428-8181
(201) 428-5222 (Fax)

Massachusetts
149 Rangeway Road
N. Billerica, MA 01862
(617) 272-5212
(508) 667-7871 (Fax)
(800) 950-5212

2.2 Definition of Terms

A number of terms are used within this document to describe the corporate QA program in effect at IEA laboratories. To ensure effective communication, the following terms are being defined:

Accuracy	- the degree of agreement of a measurement with an accepted reference or true value. Accuracy is usually expressed as the difference between the measurement and the true value. It is a measurement of the bias in a system.
Analytical Report Turnaround Time	- in order to ensure proper communication is maintained, IEA has defined analytical report turnaround times to be always based upon calendar days, not business days. Analytical holding times are also based on calendar days.
Audit	- a systematic check to determine the quality of some function or activity. Audits may be of two basic types, performance audits or system audits. Performance audits involve a quantitative comparison of the labs results to that of a proficiency sample containing known concentrations of analytes. A system audit is a qualitative evaluation that normally consists of an on-site review of a laboratory's quality assurance system and physical facilities.
Batch	- the basic unit for analytical quality control. It is defined as a group of samples which are analyzed together with the same method sequence and the same lots of reagents and with the manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each batch should be of similar composition (matrix). At IEA laboratories, the maximum batch size has been set at 20 samples. At IEA's smaller laboratories where the number of samples received daily may be low, samples received in a given week may be combined into one analytical batch. Due to holding time constraints, individual samples may be extracted on different days as compared to other samples in the batch. If this is the case, a method blank must be performed daily with every sample extraction. The other QC samples such as MS and MSD are only performed for the total analytical batch.
Comparability	- a measure of the confidence with which one data set can be compared to another.
Completeness	- a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under routine operating conditions.
Data Quality Objectives	- during the planning phase of a project requiring laboratory support, the data user must establish the quality of data required from the investigation. Such statements of data quality are known as data quality objectives (DQOs). The DQOs are qualitative and quantitative statements of the quality of data required to support specific decisions or regulatory actions.
Data Validation	- a systematic effort to review data to identify any outliers or errors and thereby cause deletion or flagging of suspect values to assure the validity of the data to the user. This process may be done by manual or computer methods.
Field Blank	- contaminant free water, or appropriate matrix, used during sampling activities to determine if there is any potential for sample contamination associated with the field sampling or equipment.
Library Search	- a technique used by which a mass spectrum of an unknown compound is compared to the mass spectrum of compounds contained in a computer library in an effort to identify

unknown compounds. Compounds identified in this manner are referred to as "tentatively identified compounds" (TICs).

Matrix Spike - the process of adding a known amount of analyte to a sample and analyzing the sample. The amount of analyte recovered is calculated as a percent recovery. This technique is used to assess accuracy of analysis.

Matrix Spike Duplicate - a second matrix spike is compared to the results of the matrix spike to assess precision of the analysis.

Method Blank - contaminant free water, or appropriate matrix, taken through the entire analytical process to determine if there is any contamination associated with the analytical procedures.

Method Detection Limit (MDL) - the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

Practical Quantitation Limit (PQL) - is the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine operating conditions.

Precision - a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is usually expressed in terms of standard deviation.

Quality Assurance (QA) - the total integrated program put in place to assure the reliability of data generated in the laboratory.

Quality Control (QC) - the routine application of specific, well-defined procedures which ensure the generation of data which fulfill the objectives of the QA program.

Quality Assurance Program Plan (QAPP) - a written assembly of management policies, objectives, principles and general procedures which outline how the laboratory intends to generate data of known and accepted quality.

Quality Assurance Project Plan (QAPjP) - a written document, which presents, in specific terms, the policies, organization, objectives, functional activities and specific QA/QC activities designed to achieve the data quality objectives of a specific project. There are 16 essential elements which EPA has mandated to be addressed in a project plan.

Relative Percent Difference (RPD) - relative percent difference (RPD) is used as the measure of precision between sample duplicates. The formula utilized to calculate RPD is as follows:

Relative Percent Difference (RPD)

$$RPD = \frac{\text{(Sample Result - Duplicate Result)}}{\text{Mean of Sample and Duplicate Results}} \times 100$$

Note: RPD is expressed as the absolute value obtained from the above formula.

Representativeness	- the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition.
Standard Operating Procedure (SOP)	- a detailed, written description of how a laboratory executes a particular procedure or method. It is intended to standardize the performance of the procedure.
Surrogates	- generally, organic compounds which are not target analytes, that are added to samples to assess analytical performance of a method. These compounds are spiked into all blanks, samples and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate.
Trip Blank	- contaminant free water, or appropriate matrix, which accompanies bottles and samples during shipment to assess the potential for sample contamination during shipment. Trip blanks are not opened in the field.
Tuning	- a technique used in GC/MS procedures to verify that the instrument is properly calibrated to produce reliable mass spectral information.

2.3 Purpose

The IEA-New Jersey quality assurance program serves as an operational charter for the organization. It defines the purpose, organizational structure, and operating principles of the laboratory and presents an overview of the key elements of the quality assurance program. This quality assurance program will be reviewed and modified as necessary on an annual basis. Any deviation from this program must be approved in writing by the facility QA manager .

This quality assurance program has been prepared according to guidelines presented in the USEPA document entitled "Guidelines and Specifications for Preparing Quality Assurance Program Plans", Office of Monitoring Systems and Quality Assurance, Office of Research and Development, USEPA, (QAMS-004/80), EPA-600/8-83-024, June, 1983.

2.4 Scope

This QA program applies to the generation of analytical data at the IEA-New Jersey lab location. Since the vast majority of environmental client needs are driven by various federal and state regulations, the program has been designed to meet the requirements of the following programs:

Clean Water Act (CWA)
Clean Air Act (CAA)
Safe Drinking Water Act (SDWA)
Resource Conservation and Recovery Act (RCRA)
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

This Quality Assurance Program Plan (QAPmP) covers laboratory operation at IEA-New Jersey. The purpose of this QAPmP is to provide information on laboratory operations as required for specific Quality Assurance Project Plans (QAPjPs), and to provide the basis for the Quality Assurance Program at IEA-New Jersey. This program is based on the IEA Corporate Quality Assurance Program Plan (Doc# QAQ00103.NET).

This QA program applies to the generation of analytical data utilized for environmental monitoring and assessment programs. The major types of laboratory support for government regulations are as follows:

- Analysis and characterization of environmental (soil, sediment, water and air) and waste samples per the Resource Conservation and Recovery Act (RCRA) for either compliance, disposal or delisting purposes.
- Analysis of drinking water samples in support of the Safe Drinking Water Act (SDWA).
- Analysis of environmental samples in accordance with contracts with the USEPA CLP program and various state agencies (CERCLA and NYSDEC).
- Analysis of environmental samples (soil, sediment, water and air) for contaminants such as those compounds found on the EPA priority pollutant list, target compound list, etc. for site assessment purposes.
- Analysis of waste stream samples in accordance with NPDES requirements.

3.0 QUALITY ASSURANCE POLICY STATEMENT

It is the intention of IEA corporation to consistently produce analytical data of known and documented quality at all network laboratories which fully meet clients' data quality objectives.

The contents of the QA program describe the activities which are utilized in order to ensure this commitment is maintained.

IEA Quality Policy

"Management and staff are committed to maintaining a carefully controlled analytical environment in order to ensure the consistent generation of accurate data which meets or exceeds the data quality objectives of our clientele."

IEA recognizes that maintaining a proper ethical standard is an important element of an effective quality assurance program. In order to ensure that all personnel understand the importance the company places on maintaining high ethical standards at all times, IEA has established an "Ethics Policy" and it is presented for your information. This policy is used to set the standard within the organization for day-to-day performance. Each employee is requested to sign the ethics policy, signifying agreed compliance with it's stated purpose. Copies of all signed ethics policy statements are maintained in personnel files.

IEA ETHICS POLICY

The management of IEA corporation recognizes our responsibility to clients and fellow employees to ensure that fair and ethical business practices are followed at all facilities.

Our clients have placed their trust in our organization to continually provide high quality data which is valid, defensible and represents sound professional judgement at all times. In order to meet this responsibility it is imperative that high ethical standards be maintained at all times by all employees.

The management and staff are committed to maintaining a carefully controlled analytical environment which assures the consistent generation of accurate data which meets the data quality objectives of our clientele.

The following represents the IEA ethics policy which has been adopted to clearly identify the corporate position on ethical practices. Failure to comply with this policy cannot and will not be tolerated.

The Company and all its Employees will:

- Fully comply with all applicable federal, state, and local laws and regulations.
- Produce analytical products that are accurate, defensible and which represent sound professional judgement at all times.
- Provide employees with guidance and an understanding of the ethical and quality standards required in the environmental industry. In this regard, all employees should feel free to identify any ethical misconduct without fear of retribution. Any employee involved in any form of ethical misconduct will be subject to immediate disciplinary action including potential termination of employment.
- Present services to clients in a confidential, honest and forthright manner and strive to deliver quality products at a fair price.
- Treat employees equitably by compensating them fairly, acknowledging their scientific contributions, and providing them opportunities for professional growth and development.
- Offer employment opportunities to qualified candidates regardless of their race, creed, color, sex or age.
- Be a responsible corporate citizen of the community by operating in an environmentally sound manner at all times.
- Maintain all facilities in a safe and professional manner through maintenance of a safety awareness program and provide the necessary safety equipment and training to protect all employees from preventable injury and chemical exposure.

4.0 QUALITY ASSURANCE MANAGEMENT

4.1 Introduction

The management of IEA-New Jersey is committed to the execution of the quality assurance program described in this document. The officers of IEA as well as lab directors and lab managers are required to comply with the program's stated goals, requirements and responsibilities.

In addition, each staff member has a responsibility to ensure compliance at all times with the QA program.

4.2 Assignment of Responsibilities

The primary objective of the network quality assurance program is to ensure that systems are in place such that all network laboratories consistently generate high quality analytical data.

Additionally, the QA program provides a mechanism to identify and implement policies to improve the quality of products and services. Records must also be maintained to document the laboratory's performance.

Quality assurance at IEA is monitored at both the corporate and laboratory levels. IEA's network quality assurance program is led by the President of IEA. The QA program at each network lab is directed by the QA manager at that facility, who reports directly to the laboratory's director and indirectly to the President. Figure 4.2.1 presents the organizational structure of network quality assurance functions and Figure 4.2.2 illustrates the overall general management of the corporation.

The following provides a listing of responsibilities and authority of key managerial personnel. Section 5 of the Appendix presents the organizational structure of the IEA-New Jersey facility.

Director of Operations

Responsibility:

All corporate directors and managers comply with the quality assurance program and require similar compliance by all staff personnel.

Ensure that all laboratory operations under their control are active participants in attaining the network quality assurance objectives.

Ensure compliance with methods and procedures as written.

Timely compliance with any corrective action requirements.

Ensure that instrument tunings and calibrations are performed at the required frequency and that instrument maintenance and logbooks are maintained in an orderly manner.

Authority:

Maintain the authority to suspend or terminate employees for dishonesty, or non-compliance with established QA policies and procedures.

The directors' or managers' authority is granted from the President of IEA, to whom they report.

Laboratory Manager

Responsibility:

Ensure compliance with methods and procedures as written.

Ensure that analytical procedures are performed in accordance with the requested method and SOPs.

Oversee preparation of analytical reports and data review.

Authority:

Maintain the authority to suspend or terminate employees for dishonesty, or non-compliance with established QA policies and procedures.

Authority is granted from the Director of Operations, to whom they report.

Laboratory Quality Assurance Manager

Responsibility:

Responsible for recommending pertinent additions to the network QA program.

Responsible for monitoring and assessing compliance of the laboratory with the requirements contained in the QA program.

Function as a liaison between the Director of Operations and laboratory staff at their facility.

Represent the laboratory during all external audits conducted by clients or regulatory agencies.

Conduct semi-annual audits and inspections to assess compliance with established methods, policies and procedures. Results of these audits are reported to the President and the Director of Operations.

Maintain a document control system containing current policies and procedures utilized by the laboratory.

Maintain various certification programs for the laboratory.

Review laboratory performance on various QC proficiency samples submitted to laboratories by state and federal agencies.

Inform local and corporate management of the status of the QA program at the particular facility through a monthly QA report.

Investigate all inquiries relative to data quality issues and follow up on corrective action if necessary.

Authority:

The quality assurance staff has the authority to stop or change any analytical procedure in order to assure that data quality is maintained.

The authority of the QA staff is granted by the director of the facility.

FIGURE 4.2.1 NETWORK QUALITY ASSURANCE ORGANIZATIONAL CHART

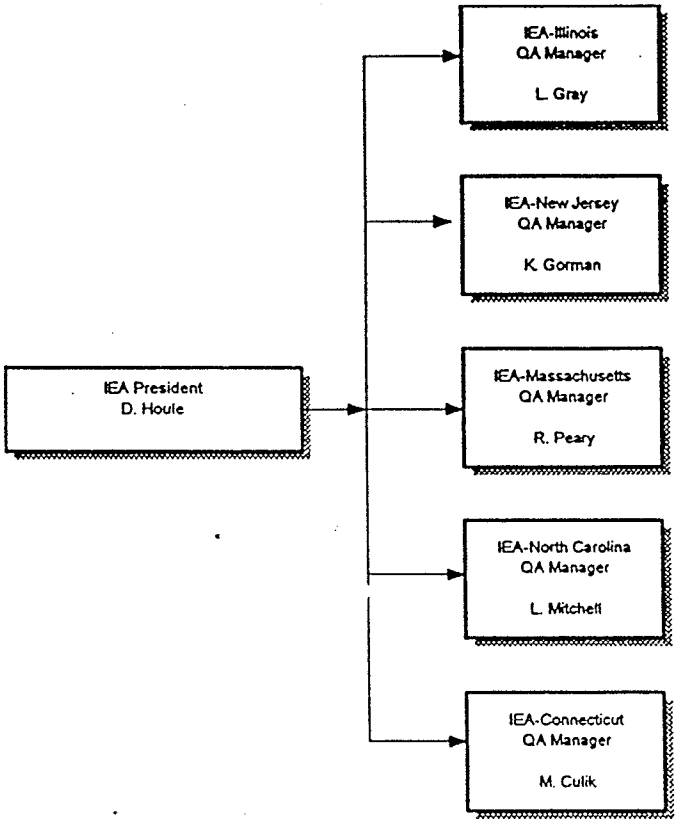
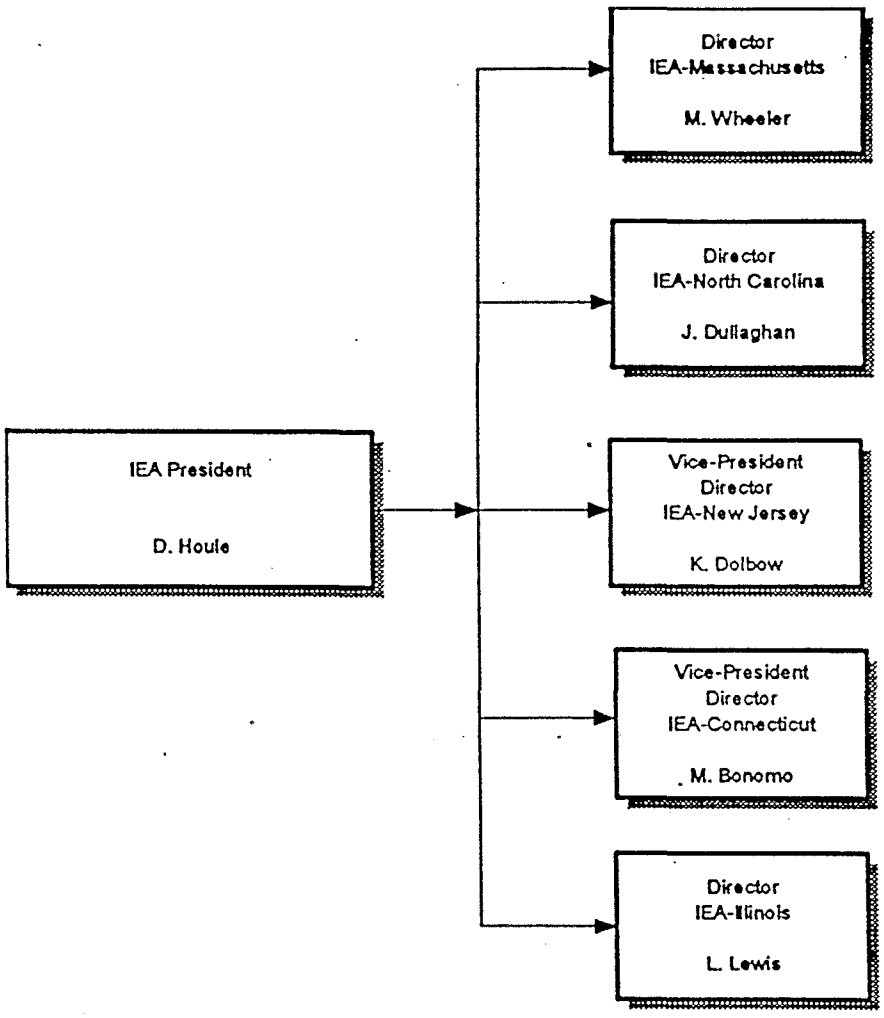


FIGURE 4.2.2 NETWORK ORGANIZATIONAL CHART



4.3 Communications

The quality assurance department communicates internally and externally through various means. Communication can take place via telephone, memoranda or take the form of audit reports. At the present time, the quality assurance department participates in a weekly conference call to discuss relevant issues and disseminate information.

In addition, various quality assurance reports are routinely generated as discussed in section 4.5.

4.4 Document Control

A system of document control is essential to provide the framework necessary to ensure that methods and procedures are followed in a consistent manner.

IEA has developed a centralized document control system which is maintained for the entire network and is administered by the corporate staff located at the Cary, North Carolina facility. The document control system provides for the following:

- A unique document control number for each document
- A central location for all documents
- A systematic method for distribution of approved documents
- A tracking system for existing documents
- Identification of document revisions
- A mechanism for periodic review of documents
- Archival of outdated material
- A focal point for information exchange
- Facilitates the establishment of standardized methods and procedures

A detailed description of the document control system is contained in IEA document number QAS00101.NET. This document is available for inspection and review during a site visit. The Quality Assurance Manager is responsible for ensuring that the document control system is properly managed. Any new or revised document must be submitted to the QA Manager for review and distribution.

It is the responsibility of all members of the laboratory to maintain complete records of all operations performed. All records shall be neat and organized. All laboratory records are the property of the laboratory and shall not be removed from the premises without permission from supervisors. All records are considered confidential and must be safeguarded. Unauthorized changes, loss or destruction of records can be grounds for dismissal from the laboratory. Consult the IEA, Inc. Ethics Policy regarding integrity of data and employee conduct.

Measurement records must be recorded in pre-printed record logs or pre-printed measurement logs. This policy will facilitate the organization and archival of all laboratory data for future reference.

All injection forms, instrumentation forms, sample prep forms, QC forms, etc. which are used to process samples and measurement results are described and attached to each analytical SOP. The SOP specifies where these records and forms are cataloged and stored.

All measurement data is recorded in logbooks or on pre-printed log sheets in permanent ink. Transcriptions will be avoided whenever possible. The record will reflect the measurement performed and all appropriate details for conclusions related to the measurement. The record must be initialed and dated by the individual performing the measurement on the day the measurement is performed. Corrections shall be made by drawing a single line through the error, initialing and dating the error. All forms will be reviewed by the QA Manager annually. If it is found that the document does not meet the requirements of the SOP, the discrepancy is forwarded to the group/section leader through the corrective action process (reference SOP on Problem Documentation -QAS00500.NJ).

4.5 QA Program Assessment

The quality assurance program can only accomplish its objectives if management and staff are committed to adherence to the program. In order to assess continued compliance and to identify strong and weak points of the program, Corporate Quality Assurance conducts annual assessments at each location.

In addition each quality assurance manager conducts an annual audit of the particular laboratory. A copy of the audit along with any proficiency test results obtained are submitted to the President.

A written status report is prepared monthly by each of the facility QA managers. A copy of this report is issued to the facility laboratory director as well as the President. The Corporate Quality Assurance staff provides a summary of these reports each month to upper management. A typical status report would include such information as:

- Changes in the quality assurance program
- Summary of proficiency results at each network lab
- Summary of on-time report issuance
- Changes in certification status
- Summary of system audits conducted at each network lab
- Significant QA concerns and recommendations for resolution
- Accomplishments since the previous report

4.6 Additional Lab Policies to Achieve QA Objectives

In addition to policies and procedures specified in other sections of this document there are numerous policies and standard procedures which have been implemented to ensure that data of known quality is continually generated by all network laboratories. Examples and a brief description of a few of these additional policies are presented below:

4.6.1 Participation in EPA Water Supply and Water Pollution Proficiencies

The USEPA currently operates a Water Supply (WS) and a Water Pollution (WP) proficiency program. Each program consists of the issuance of proficiency samples twice in a calendar year. Analysis of proficiency samples on the second set of samples in a year are only required by EPA for those parameters which the laboratory failed during the first round in a given year. As part of IEA's QA program, full participation and analysis of all appropriate parameters is required of all IEA labs regardless of past performance. This serves as an important indicator on the continuing quality of data being generated at each facility.

The laboratory also participates in the NYSDOH proficiency testing program for Potable Water, Hazardous Waste and CLP. The lab currently analyzes quarterly organic PE samples from EPA for the CLP program.

4.6.2 Corporate Laboratory Performance Evaluation Program

In addition to participating in various agency sponsored performance evaluation programs such as Water Supply (WS) and Water Pollution (WP) studies, the corporate quality assurance staff conducts additional performance evaluation studies.

Periodically, performance evaluation samples are submitted to each laboratory for parameters which are not addressed in other performance evaluation programs (ie. TCLP testing). In this type of testing, the laboratory is aware the samples are performance check samples but the "true" concentration values are unknown. The results are submitted to corporate QA for evaluation and a report is issued on the findings. Corrective actions are taken if required, as a result of these test findings.

4.6.3 Routine Use of QC Check Samples

One of the most important goals of a strong quality assurance program is to ensure that data of known quality is consistently generated during day-to-day operations. IEA accomplishes this through the routine inclusion of a QC check sample in every inorganic analytical batch which includes metals and wet chemistries. For organic testing including GC and GC/MS a QC check sample is analyzed at the frequency required in the particular method. A QC check sample is an artificially prepared sample which contains the analytes of interest. The source of the standards used for preparation of the check sample must be independent (either another vendor or a different lot from the same vendor) from those used to prepare a calibration curve. The QC check sample is an important mechanism to confirm the method is being executed properly during routine analysis. The QC check also serves as a useful tool in identifying possible problems such as matrix interference, degraded analytical standards, and inaccurate standard preparation.

In certain cases, reliable QC check samples are not available for a particular procedure. In such cases, the QA manager has the authority to waive this requirement for that particular test. The QA manager must document this waiver in writing and provide a copy to the President.

4.6.4 Central Solvent Monitoring Program

IEA has established a central monitoring program for commonly used solvents within the corporation. Prior to use, a specific lot number of these solvents is provided to the laboratory for testing. The solvents are concentrated and tested for the presence of interfering substances relative to their intended use. If the particular lot of solvent passes the defined acceptance criteria, the vendor is notified and the solvent lot is reserved for use by the entire corporation. The approved lot numbers are provided to all laboratories and only approved solvents can be employed. IEA Document # QAS00400.NET describes the details of the solvent approval program and is available for review during a site audit.

4.6.5 Quality Assurance Final Report Review

An integral portion of the overall quality assurance program is the consistent monitoring of final reports as they leave IEA facilities. Each QA manager is responsible for reviewing 5 percent of the final data reports issued each month. The reports to be reviewed are picked at random. The reports are reviewed for typographical errors, technical clarity and overall presentation.

4.6.6 Lateness of Data Reports

IEA recognizes that one cannot overlook the timeliness of data generation when assessing the quality of our services from our client's perspective. High quality data, when delivered several weeks late is not acceptable. In recognition of this, IEA monitors the lateness of all reports on a monthly basis from each of its laboratory operations. The actual report shipment date is compared to the date originally projected to the client. This information is gathered monthly through the QA department and a monthly report is issued to each laboratory director and to corporate management. This monitoring program serves to identify service trends, and to ensure that corrective action will be taken before problems occur.

4.6.7 Method Detection Limit Verification

Each laboratory is required to perform a method detection limit study for all commonly performed test methods. The study must be performed during the initial setup and verification of the particular method. In addition, the MDL study must be conducted in the event of a major change in the technique or instrumentation. The results of the MDL studies must be fully documented and available for review upon request. The quality assurance manager is responsible for maintaining such records. Specific state certification programs may require MDLs to be determined annually. If this is the case, the laboratory will comply with this requirement.

4.6.8 Establishment of IEA Good Laboratory Practices

In order to ensure that various procedures are executed in a consistent and comprehensive manner, IEA has developed a series of procedures which fall into the category of "Good Laboratory Practices". These practices have been endorsed by the corporation for routine use at each laboratory facility and are defined in various standard operating procedures throughout the organization. Examples of a few of these "Good Lab Practices" are presented below for the reader's information:

A. Standardized logbook requirements (Doc# QAS01202.NET)

Preprinted pages
Prenumbered pages
Dedicated logbooks per test method
Bound logbooks
Use of black ink only
Document controlling of logbooks
Archival of old logbooks
Acceptance criteria in logbook
Making corrections
Secondary review of logbook entries

B. Balance calibration (Doc# QAS01002.NET)

Unique identifier for each balance
Balance must be checked daily with use and documented
Acceptance ranges are established for each balance
Balance must be checked in the weight range normally used
All balances must be professionally serviced and calibrated annually

C. Temperature monitoring requirements for lab apparatus (Doc# QAS00801.NET)

Refrigerators, freezers and lab ovens are checked each work day
Unique identifier assigned for each unit
Acceptance ranges are established for each unit
Thermometers used in monitoring must be calibrated to a NIST traceable thermometer annually, at a minimum. State certification requirements may require more frequent calibration
All thermometers are immersed in appropriate media to avoid temperature fluctuations during measurement

D. Correcting data and general laboratory records (Doc# QAS01300.NET)

All entries must be entered in black ink.
"White Out" is not to be used at any time within the laboratory for alteration or correction of lab documents
Corrections are made using a one-line strikeout
All corrections are initialed and dated by the data editor

E. Handling reagents and analytical standards (including the following)

Recording receipt and expiration dates
Documenting preparation of reagents and standards
Labelling requirements
Disposal

F. Cleaning procedures for sample containers and laboratory glassware (Doc# QAS01400.NET) (including the following)

Cleaning sample containers
Cleaning inorganic glassware
Procedures for cleaning organic glassware

G. Requirements for general lab calibration curves (including the following)

In cases where the referenced analytical method does not provide specific guidance or requirements for development of initial or continuing calibration curves, the following procedure is to be utilized by the laboratory.

All standard calibration curves must consist of a minimum of three points. Any deviation from this must be approved in writing by the facility QA manager.

All calibration points must be recalculated using the generated curve and all calibration points must be within 10% of the expected value for the curve to be considered acceptable.

Concentration of compounds or analytes must fall within the calibration range of the curve to be acceptable for quantitation for inorganic and organic methodology.

H. Method blank subtraction

Subtraction of method blanks from sample results is not permitted unless specifically authorized by the laboratory QA manager.

4.6.9 Quality Control Charts

Maintaining quality control charts is currently not mandatory under IEA's corporate quality assurance program, however, many state certification programs require them. As a result, laboratories are required to comply with such state certification requirements.

5.0 PERSONNEL QUALIFICATIONS

5.1 Introduction

IEA's management is very proud of its highly qualified and professional staff. The IEA-NJ staff consists of over 60 professionals and support personnel which include:

Analytical Chemists
Quality Assurance Specialists
Computer Systems Analysts
Environmental Technicians
Customer Service Staff
Account Executives

5.2 Education and Experience

In order to ensure that employees have sufficient education and experience to perform a particular task, requirements have been defined for each laboratory position.

The personnel who are responsible for operations of sample analyses and data validation are outlined in Section 5 of the Appendix. Section 1 of the appendix presents professional profiles of key personnel within the IEA-New Jersey organization. Profiles of additional IEA staff members are available for review during a facility visit or are available upon special request.

Throughout the years, IEA has performed sophisticated environmental analysis for a significant number of large corporations. Examples of relevant experience are available upon request.

5.3 Training

IEA is committed to furthering the technical and interpersonal skills of employees at all levels. Technical training is accomplished within each laboratory by management to ensure method comprehension. It is at these training sessions that staff is updated on all current technical advances. It is IEA policy that all new personnel must demonstrate competency in performing a particular method through the analysis of QC check samples prior to the analyst conducting analysis independently on client samples. New analysts may conduct analysis on client samples along with another experienced analyst prior to the completion of the training period. All laboratory personnel are required to acknowledge through signature that they have read and understood the SOP's that are appropriate for their particular area.

All laboratory personnel must have adequate education, training, and experience to carry out their responsibilities. The QA Manager and the Laboratory Management will periodically review the training needs of the staff and make recommendations for any additional training. Each department within the laboratory is responsible for personnel training. Training sessions are scheduled on a monthly basis. Each training session, whether it be individual or group training must be documented utilizing the forms attached to the corporate SOP for Employee Training QAS01601.NET. The completed forms must be submitted to the Human Resource department for placement into the employee training files. Included in the training process is analyst proficiency testing. A successful QC check sample must be analyzed and documented. This information is on file with the QA Manager.

5.4 Certifications

Table 5.4.1 presents the state certifications held by the IEA-New Jersey laboratory. Many states certify laboratories for specific parameters or tests within a category (i.e. method 325.2 for wastewater). The information in the following table indicates the lab is certified in a general category of testing such as drinking water or wastewater analysis. The laboratory should be contacted directly if parameter-specific certification information is required.

IEA-NJ currently participates in the USEPA Superfund Contract Laboratory Program (CLP). The lab is also in the process of obtaining approval to perform work for the Army Corps of Engineers which validates laboratories on a project-by-project basis.

This document is updated annually; therefore, it is likely that additional certifications, beyond those listed, may be currently available. This information can be obtained easily by calling the specific laboratory (See Table 2.2.1 for phone) and asking for the QA manager.

TABLE 5.4.1

STATE CERTIFICATIONS

In some instances it may be necessary for environmental data to be reported to a regulatory authority with reference to a certified laboratory. For your convenience, the laboratory identification numbers for the IEA-New Jersey laboratory are provided in the following table. Many states certify laboratories for specific parameters or tests within a category (i.e. method 325.2 for wastewater). The information in the following table indicates the lab is certified in a general category of testing such as drinking water or wastewater analysis. The laboratory should be contacted directly if parameter-specific certification information is required.

IEA-New Jersey
Certification Summary (as of May 1996)

State	Responsible Agency	Certification	Lab Number
Connecticut	Department of Health Services	Drinking Water, Wastewater	PH-0722
Utah	Department of Health	Wastewater/Solid, Hazardous Waste	E-245
Pennsylvania	Department of Environmental Protection	Drinking Water	68-355
Maryland	Department of Health & Mental Hygiene	Drinking Water	195
New Jersey	Department of Environmental Protection	Drinking Water, Wastewater	14530
New York	Department of Health	CLP, Wastewater, Solid/ Hazardous Waste	10997
West Virginia	Division of Environmental Protection	Wastewater, Solid/hazardous Waste	Interim
North Carolina	Division of Environmental Management	Drinking Water, Wastewater	339

6.0 FACILITIES, EQUIPMENT AND SERVICES

6.1 Introduction

The following describes the physical facility of the IEA-New Jersey laboratory.

6.2 Facilities

IEA-New Jersey

The laboratory currently maintains a staff of approximately 65 environmental professionals and occupies a 14,000 square foot building of which 70% is dedicated to the analytical laboratories. Separate laboratory areas are dedicated to GC and GC/MS instrumentation, volatile analysis, extractions for organic parameters, sample preparation for metals analysis, metals analysis by atomic absorption (GFAA) and inductively coupled plasma (ICP), wet chemistry and standards preparation.

The volatile analysis laboratory containing GC/MS instrumentation has a separate air handling system which maintains positive pressure at all times. The room is isolated from the rest of the laboratory, and the air that enters is filtered twice through two separate carbon filtering units. This design results in a contaminant-free environment for trace-level volatile analysis.

The laboratory has eleven (11) fume hoods strategically located for a total of over 66 linear feet to hood capacity. The instrumentation is powered by 110/220 volt circuits.

The floor plan of the analytical laboratory is included in Section 4 of the Appendix.

Security of Facilities

The laboratory is secured by a punch key access and alarm system. Only authorized IEA-NJ personnel have access to the facility. All visitors must sign in with the receptionist and must be accompanied by an IEA-NJ employee.

The sample receipt and storage area is under the responsibility of the sample custodian. This area is a locked, secure area opened by the sample control department each day. A walk-in refrigeration unit is used to store samples waiting for analysis. Samples for volatile analysis are stored in a separate refrigeration unit. Locked laboratory refrigerators, located throughout the laboratory, are used to maintain sample extracts or laboratory reagents. Each laboratory refrigerator is dedicated to sample, sample extract, or reagent storage.

6.3 Equipment

The following is a summary listing of equipment utilized at the IEA-NJ facility. A more detailed listing is presented in Table 6.3.1.

Analytical instrumentation at IEA-New Jersey includes:

6 Gas Chromatographs/Mass Spectrometers (GC/MS)
5 Gas Chromatographs (GC)
2 Atomic Absorption Spectrometers (Graphite Furnace/AA)
1 Inductively Coupled Argon Plasma (ICP) Emission Spectrometer
1 Trace Inductively Coupled Argon Plasma (ICP) Emission Spectrometer
2 Gel Permeation Chromatographs
1 Infrared Spectrometer (IR)
1 Total Organic Carbon Analyzer
1 LIMS (Laboratory Information System)
Automated Data Acquisition Management System (ADAM)
1 Mercury Analyzer
1 UV-VIS Spectrometer

Table 6.3.1-Laboratory Equipment Listing

WET CHEMISTRY

Equipment Name	Manufacturer	Model Number	Serial Number
Infrared Spectrophotometer	Perkin Elmer	1310-IR	PE#134414/IEA01531
Direct Reading Spec (400-900nm)	HACH	DR/2000	910514327/IEA00332
Reagent Refrigerator	Whirlpool	ET14DCXRWRO	70328440
Sample Refrigerator	Gibson	RM18F6WS	LA93821627
Analytical Balance	Mettler	AE200	N36959/IEA
Toploading Balance	Ohaus	E400	1391
Toploading Balance	Mettler	PE3000	E32990/IEA02539
180C Oven	VWR	1300U	IEA01516
105C Oven	Precision	Economy Model 18EM	IEA01517
Muffle Furnace	NEY	M-525 SeriesII	----------
COD Reactor	HACH	45600	910504927
110C Oven	Blue M	SW-171A-1	SW4540/IEA02540
9 Position Hotplate/Stirrer	PMC	529	0727C/IEA03413
6 Position Stirplate	Labline	1278	IEA01420
DO Meter	YSI	57	90FO16379
pH Meter	Corning	Ion Analyzer 250	3699
ZHE Tumbler	Analytical Testing	3M137B (Motor)	IEA02533
TCLP Tumbler	Environmental Express	5K939C (Motor)	IEA00202
Dessicator	Sanplatec Corp	Drykeeper	IEA01519
Dessicator	Sanplatec Corp	Drykeeper	IEA01520
Dessicator	Sanplatec Corp	Drykeeper	IEA01518
Dessicator	Sanplatec Corp	Drykeeper	IEA01521
Oxygen Probe	YSI	YS15/20	----------
Specific Conductance Meter	VWR	1052	891069
Hot Plate	Thermolyne	HP47135-60	611950251689
Hot Plate	Thermolyne	HP47135-60	611950251685
Flashpoint Apparatus	Precision Scientific	777140064	10AW-4
Centrifuge	IEC	HN-SII	----------

Table 6.3.1-Laboratory Equipment Listing

METALS

Equipment Name	Manufacturer	Model Number	Serial Number
Atomic Absorption Spec	Perkin Elmer	5100	134786
AA Spec with Flame	Perkin Elmer	5100	131282
Coolflow CFT-33	Neslab	CFT-33	
PS 200 Hg	Leeman	PS200	B125
Coolflow CFT-33	Neslab	CFT-33	92cml17620-1
Coolflow CFT-33	Neslab	CFT-33	87nml63970-31
ICP 61	TJA	61	66782
ICP 61E Trace	TJA	61E	356490
Neslab CFT-33	Neslab	CFT-33	----------
Water Bath	Precision	186	----------
(5) Hot Plates	Thermolyne	Cimarec 3	----------

ORGANIC EXTRACTIONS

Equipment Name	Manufacturer	Model Number	Serial Number
Ultra-Sonic Disruptor	Tekmar	TM-6002	15977F
Ultra-Sonic Disruptor	Tekmar	TM-500	9976
Ultra-Sonic Disruptor	Tekmar	TM-500	7919
Ultra-Sonic Disruptor	Tekmar	TMX-400	18481
Analytical Balance	Mettler	AE-163	----------
Toploading Balance	Sartorious	PT-600	40707803
GPC	ABC Labs	Ap-1000	9179-SI
GPC	ABC Labs	GPC-1002A	589A
Nitrogen Evap. Manifold	Organomations	112	10253
Nitrogen Evap. Manifold	Organomations	111	7185
Nitrogen Evap. Manifold	Organomations	111	9915

Table 6.3.1-Laboratory Equipment Listing

ORGANIC EXTRACTIONS

Equipment Name	Manufacturer	Model Number	Serial Number
Hot Plates	Thermolyne	RC2235	410950140204
Hot Plates	Thermolyne	RC2235	410950145914
Hot Plates	Thermolyne	RC2235	41095015662
Hot Plates	Thermolyne	RC2235	410950687887
Hot Plates	Thermolyne	RC2235	410940903189
Hot Plates	Thermolyne	RC2235	410940893506
Portable Fume Hood	Captair	————	————
Recirculator	VWR	1135	909828
Recirculator	Neslab	CFT-75	293244043
Constant Temp Circulator	Haake	002-4177	195004736028
Constant Temp Circulator	VWR	1135	909828
KD Bath (S-VAP)	Organomation	120	10720
Muffle Oven	Thermolyne	FA1635	32400816
Muffle Oven	Shel-Lab	1305U	0803389
Stir Plate	Lab-Line	1278	1089
Sonic Bath	Branson	1210R-MT	————

GC/MS VOLATILES

Equipment Name	Manufacturer	Model Number	Serial Number
Purge & Trap	Tekmar	LSC 2000	————
Purge & Trap	Tekmar	ALS 2016	38034014
Purge & Trap	OI	4560	313187
Purge & Trap	OI	DPM16	317321
GCMS	Hewlett Packard	5972 Series	3307A00368
Gas Chromatograph	Hew lett Packard	5890 Series II	C-128/83
Laser Jet 4 Printer	Hewlett Packard	Laser Jet 4	USBC128700
486/66 Computer	Hewlett Packard	M2 4/66	3430A02528
GCMS	Hewlett Packard	5995	23915

Table 6.3.1-Laboratory Equipment Listing

GCMS	Hewlett Packard	5995	08898
Dynamic Headspace Conc.	Tekmar	4000	————
Autosampler Heated Module	Tekmar	4200	————
Explosion Proof Freezer	VWR	————	————
Oven	VWR	1320	————
Balance	Sartorious	————	1002mpg
Laser Jet IIP	Hewlett Packard	IIP	02402
Potable Hood	Captair	————	LR43145
Refrigerator	World Refeigerator	RW100	IEA03362
Coolflow	Neslab	CFT75	IEA04113
HP Printer	Hewlett Packard	2934A	2715A43527
HP Printer	Hewlett Packard	2932A	20650A29136
Reel to Reel Tape	Hewlett Packard	7970E	————
Computer Eseries	Hewlett Packard	HP-1000	————
Scan Box	Hewlett Packard	59824A	————
Scan Box	Hewlett Packard	59824A	————
Terminal	Hewlett Packard	2397A	————
Terminal	Hewlett Packard	2393A	————
Network Terminal (4)	————	————	————

Table 6.3.1-Laboratory Equipment Listing

GC/MS SEMI-VOLATILE

Equipment Name	Manufacturer	Model Number	Serial Number
GCMS	Hewlett-Packard	5890 SeriesII/5972	3524A02678
GCMS	Hewlett-Packard	5890/5970	----------
GCMS	Hewlett-Packard	5890/5970	----------
Printer	Hewlett-Packard	Laser Jet 4	IEA03532
Printer	Hewlett-Packard	Laser Jet 4	IEA04456
Printer	Hewlett-Packard	Laser Jet 4	IEA04457
ChemStation	Hewlett-Packard	Vectra M24/66	IEA04453
ChemStation	Hewlett-Packard	Vectra M24/66	IEA04454
ChemStation	Hewlett-Packard	Vectra M24/66	3447A01843
Controller (2)	Hewlett-Packard	7673A	----------
Autosampler (2)	Hewlett-Packard	7373A	----------
Autosampler (1)	Hewlett-Packard	6890 Series A	3530A43339
Controller (1)	Hewlett-Packard	G1512A	3530A02478

Table 6.3.1-Laboratory Equipment Listing

GAS CHROMATOGRAPHY

Equipment Name	Manufacturer	Model Number	Serial Number
GC Dual ECD w/ALS	Hewlett-Packard	HP5890	2643A12115
GC Dual ECD w/ALS	Hewlett-Packard	HP5890	2612A07645
GC Dual ECD w/ALS	Hewlett-Packard	HP5890 Series II	3223A42491
GC ECD/FID	Hewlett-Packard	HP5890	2612A07644
GC FID/NPD	Hewlett-Packard	HP5890	2643A09621
GC PID/FID	Hewlett-Packard	HP5890 Series II	3336A52493
GC FID/FID	Hewlett-Packard	HP5890 Series II	3121A35833
OI Purge and Trap Conc.	OI Analytical	4560	H3474460056
OI 16 Port ALS	OI Analytical	DPM16	C423411278

Table 6.3.1-Laboratory Equipment Listing

FIELD SERVICES

Equipment Name	Manufacturer	Model Number	Serial Number
Air Compresser	Campbell Hausfeld	————	VT617203AJ
Air Compresser	Emglo	————	————
Submersible Pump	Fultz	4	1313
Submersible Pump	Fultz	2	30052
Submersible Pump	Grundfos	1A106003	9512R
Submersible Pump	Myers	————	————
Generator	Tanaka	QEG-3UD	D282838
Diaphragm Pump	ARU	666053-344	B9182012
Diaphragm Pump	ARU	666053-344	A9143-42
Trash Pump	Teel	80232	89072703
Interface Motor	Sulinst	121	INT 001074
Water Level Motor	Sulinst	100 P2	11536
Water Level Motor	Sulinst	100 P2	NA
Water Level Motor	Garth Science Instruments	————	760
OVM	TEI	580B	58B-34124-246
pH Meter	DIGI	5938-00	692005848
pH Meter	VWR	34100-632	59-2329
pH Meter	VWR	34100-632	59-1457
Conductivity Meter	ESD	76	76-707
Conductivity Meter	ESD	76	NA
Conductivity Meter	ESD	76	76-801
DO Meter	Otterbine	Suntry III	9095C
DO Meter	Otterbine	Suntry III	U8273C
Composite Sampler	ISCO	1580	52287
Composite Sampler	ISCO	2900	————
Composite Sampler	ISCO	3700	————

Table 6.3.1-Laboratory Equipment Listing

SYSTEMS DEPARTMENT

Equipment Name	Manufacturer	Model Number	Serial Number
Scan Jet IIc	Hewlett-Packard	CL750A	3124A22461
Laser Jet Series II	Hewlett-Packard	----------	FKG81312
Desk Jet 550c	Hewlett-Packard	C2121A	US2CG1401D
15" Monitor	Business Land	C3E1609/742	61570346
15" Monitor (2)	Dell	V1528UBP	----------
17" Monitor	NEC	JC-1731VMA-3	4503602 DA
17" Monitor	NEC	JC-1731VMA-3	4503627 DA
17" Monitor	NEC	JC-1731VMA-3	4503627 DA
17" Monitor	NEC	JC-1731VMA-3	4503629 DA
PC Desktop	Gateway 2000	486/33c	671312
Dimension PC Desktops	Dell	XPSP90	4CK7J
Dimension PC Desktops	Dell	XPSP90	4CK7S
Dimension PC Desktops	Dell	XPSP60	3WCNH
Dimension PC Desktops	Dell	XPSP60	3W6QH
Dimension PC Desktops	Dell	XPSP60	4811P
UPS	APC	----------	----------
UPS (3)	Tripplite	----------	----------
Base-T Concentrators (9)	Thomas Conrad	TC 5055-10	----------
Hard Dr Array CAB's (4)	Compaq	Proliant	----------
Processor Tower	Compaq	Proliant 4000	----------
File Server	Dell	Power Edge SP466	----------
Unix Data Base Server	Dell	466SE	----------
Unix Data Base Server	Gateway 2000	486 DX/33	----------
Unix Developer	Gateway 2000	----------	----------
Data Transfer Switch	----------	----------	----------
Fax Modem	Intel	400E	----------

Table 6.3.1-Laboratory Equipment Listing

SYSTEMS DEPARTMENT (con't)

Equipment Name	Manufacturer	Model Number	Serial Number
Wang DAT	WANGDAT	3200SE	————
(Double) Modular Term Adapter (2)	Speciality	————	————
Network RJ45 Wire P (3)	————	————	————
Computer Towers	Dell	433TE	————
Computer Towers	Gateway 2000	4DX2-66E	————
UPS	Tripplite	————	————

6.4 Instrument Maintenance

Where it is economically feasible, the IEA-NJ laboratory has service contracts for major instruments. These contracts provide routine preventative maintenance according to the manufacturer's requirements. Additionally, the laboratory maintains an inventory of expendable parts and supplies to minimize downtime and allow laboratory personnel to make minor repairs if necessary.

Each analytical department must maintain a log of all in-house and external preventative maintenance activities. Table 6.4.1 presents examples of general measures which are performed throughout the laboratory.

Table 6.4.1 Laboratory Preventative Maintenance

GC/MS SYSTEMS		
EQUIPMENT	ACTION PERFORMED	FREQUENCY
Hewlett-Packard 5995 GC/MS	Check oil level in mechanical pumps	Weekly
	Check water level and operating condition in the Neslab cooling units	Weekly
	Check compressed air gas supply	Daily
	Check helium gas supply	Weekly
	Check carbon dioxide gas supply	Daily
	Change the oil in the mechanical pumps	Every 6 months
	Inspect the pump hoses and replace if required	Every 6 months
	Change oil in the diffusion pump	Every 6 months
	Change foreline and exhaust trap absorbent	Every 6 months
	Inspect and refill the calibration sample vial with PFTBA	As needed
	Vacuum fan grills and filters	Every 6 months
	Check fore and separator pump pressures	Daily
	Ion source cleaning and filament replacement	As needed
	Column replacement and conditioning	As needed
	Column cutting and reinstallation	As needed
	Manual tuning	As needed
	Change compressed air gas supply	As needed
	Change helium gas supply	As needed
	Change carbon dioxide gas supply	As needed
	Recharge Neslab cooling units	As needed
	Replace electron multiplier	As needed
	Remove and clean or replace jet separator	As needed

Table 6.4.1 Laboratory Preventative Maintenance

EQUIPMENT	ACTION PERFORMED	FREQUENCY
Hewlett-Packard 5970 MSD / 5972 MSD	Check oil level in mechanical pumps	Weekly
	Change the oil in the mechanical pumps	Every 6 months
	Inspect the pump hoses and replace if required	Every 6 months
	Change oil in the turbo pump	Every 6 months
	Change exhaust trap absorbent	Every 6 months
	Inspect and refill the calibration sample vial with PFTBA	As needed
	Vacuum fan grills and filters	Every 6 months
	Ion source cleaning and filament replacement	As needed
	Manual tuning	As needed
	Replace electron multiplier	As needed
	Clean out transfer line to GC	As needed
Hewlett-Packard 5890 GC	Check helium gas supply	Daily
	Change split vent trap	Every 3 months
	Column replacement and conditioning	As needed
	Column cutting and reinstallation	Daily or as needed
	Change helium gas cylinder	As needed
	Change liner and septum	Daily or as needed
	Clean injection port	Daily or As needed

Table 6.4.1 Laboratory Preventative Maintenance

EQUIPMENT	ACTION PERFORMED	FREQUENCY
Hewlett-Packard 7673A/6890A Autosampler	Inspect syringe	Daily
	Inspect seating of injector	Daily
	Change rinse vials	Daily
	Change waste vials	Weekly
	Replace syringe	As needed
	Reset control box	As needed
Tekmar Purge and Trap Sample Concentrators and Autosamplers	Inspect spargers and fittings	Daily
	Check purge flow	Daily
	Inspect line and valve temperatures	Daily
	Change and condition trap	As needed
	Adjust purge flow	As needed
	Rinse or clean sparging vessels (replace if necessary)	Daily
	Rinse sample lines	Daily
	Bake out trap	After each analysis, extend as needed
	Replace lines and fittings	As needed
	Adjust line and valve temperatures	As needed

Table 6.4.1 Laboratory Preventative Maintenance

EQUIPMENT	ACTION PERFORMED	FREQUENCY
Hewlett-Packard 5890A GC ECD	Check gas supply	Daily
	Check breakdown criteria	As required by run sequence
	Vacuum filters and grills	Quarterly
	Column replacement and conditioning	As needed
	Column cutting and reinstallation	As needed
	Change gas cylinders	As needed
	Change liner and septum	As needed
	Replace guard column	As needed
	Clean injection port	As needed
	Recondition ECD	As needed
	Change ECD vent absorbent traps	Quarterly
Hewlett-Packard 5890A GC FID/NPD	Check gas supply	Daily
	Vacuum filters and grills	Quarterly
	Column replacement and conditioning	As needed
	Column cutting and reinstallation	As needed
	Change gas cylinders	As needed
	Change liner and septum	As needed
	Clean injection port	As needed
	Replace or reactivate the NPD collector	As needed
Hewlett-Packard 7673A Autosampler	Inspect syringe	Daily
	Inspect seating of injector	Daily
	Inspect rinse and waste vials	Daily
	Vacuum filters and grills	Quarterly
	Replace syringe	As needed
	Change rinse and waste vials	As needed

Table 6.4.1 Laboratory Preventative Maintenance

METALS SYSTEMS		
Graphite Furnace	Clean contact rings, furnace housing and quartz windows	Daily
	Inspect, clean or replace graphite tubes	Daily
	Replenish matrix modifiers	Daily
	Check lamp alignments and energies	Daily
	Clean mirrors for the optical sensors	Daily
	Clean windows on furnace housing	Daily
	Inspect contact rings for excessive wear	Daily
Inductively Coupled Plasma	Change capillary and pump tubing	Twice weekly
	Replace liquid argon tank	As required
	Reprofile via slit micrometer	Daily
	Replace and realign plasma torch	As needed
	Clean nebulizer and spray chamber	As needed
	Check primary imaging mirror	Weekly
Mercury Analyzer	Clean sample cell and tubing	Daily
	Check sparger condition	Daily
	Check level of mercury scrubber solution	Daily
	Replace lamps	As required

Table 6.4.1 Laboratory Preventative Maintenance

WET CHEMISTRY SYSTEMS		
EQUIPMENT	ACTION PERFORMED	FREQUENCY
pH Meters	Clean electrode if calibration has deteriorated	As needed
	Store pH electrodes in pH 7.0 buffer	Daily
	Check ISE electrodes and meter	Per manual
Analytical Balances	Surfaces cleaned and covered	Daily
	Calibrated and cleaned by manufacturer	Semi-annually
	Accuracy checked by class "S" weights	Prior to use
Conductivity Meters	Instrument surfaces inspected and cleaned	Daily
	Calibrated using 0.01M potassium chloride	Daily
	Spare cells on inventory	As needed
Spectrophotometers	Instrument cleaned	Daily use
Infrared Spectrophotometer	Polystyrene Check	Monthly

7.0 DATA GENERATION

7.1 Introduction

There are numerous policies and standard procedures which have been implemented to ensure that data of known quality is continually generated by the IEA-NJ laboratory. The IEA Corporate and Laboratory Facility Quality Assurance Plans are examples of documents which are generated. Guidelines for the facility QA plans are detailed in section 7.2.1 of the Corporate Quality Assurance Program Plan Doc#QAQ00103.NET.

7.2 Quality Assurance Project Plans

Quality Assurance Project Plans (QAPjP) are developed to meet contract and agency requirements on a project specific basis. These plans discuss specific terms, policies, objectives and QA activities designed to achieve the data quality objectives of the project.

All QA project plans are written in accordance with the following USEPA Document: USEPA Guidelines and Specification for Preparing Quality Assurance Project Plans, QAMS-005/80, Washington DC: USEPA, Quality Assurance Management Staff, October 17, 1980.

Guidelines for preparing QA project plans are also detailed in the Corporate Quality Assurance Program Plan Doc#QAQ00103.NET.

7.3 Methods

IEA-NJ utilizes a wide variety of analytical methods. A listing of general analytical capabilities is presented in Table 7.3.1. Section 8 of the Appendix lists the analytical method and detection limits associated with various analytical procedures.

Each department is required to have a written standard operating procedure (SOP) in use which describes how the requirements of the method are met. All SOPs must be prepared in accordance with IEA Doc.#QAS00200.NET.

Analytical methodologies and quality assurance protocols in use are based on the following guidelines:

"Methods of Organic Chemical Analysis of Municipal and Industrial Wastewater", Federal Register Vol. 49, No. 209, October 26, 1984;

"Test Methods for Evaluating Solid Waste", SW-846 Third Edition (with revisions), September 1986, USEPA;

"Standard Methods for the Examination of Water and Wastewater" 1992, 18th Edition;

"Methods for Chemical Analysis of Water and Wastes" March 1983, EMSL, EPA;

Organic Analysis: Multi-media, Multi-Concentration-IFB-CLP, January 1991, Document Number OLM01.9;

Organic Analysis: Multi-media, Multi-Concnetration-IFB-CLP, 1994,Document Number, OLMO3.0 (with revisions);

Inorganic Analysis: Multi-media, Multi-Concentration-IFB-CLP, 1992, Document Number ILM03.0;

"Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;

National Enforcement Investigation Center Policies and Procedures Manual, EPA-330/9/78/001-R, Revised May 1986

Methods for the Determination of Organic Compounds in Drinking Water, Supp I, July 1990, EPA-600/4-90/020;

Methods for the Determination of Organic Compounds in Drinking Water, Supp II, August 1992, EPA-600/R-92/129;

Methods for the Determination of Organic Compounds in Drinking Water, December 1988 (revised July 1991), EPA/4-88/039

Methods for the Determination of Metals in Environmental Samples, June 1991, EPA-600/4-91/010;

Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993, EPA-600/R-93/100;

TABLE 7.3.1

IEA-NJ ANALYTICAL CAPABILITIES

I. ORGANICS-GC/MS

Volatile Organics-524.2
Volatile Organics-8240B
Volatile Organics-CLP
Volatile Organics-8260A
Volatile Organics-Appendix IX
Volatile Organics-624
Volatile Organics-TCLP
Acid & Base/Neutrals-8270B
Acid & Base/Neutrals-CLP
Acid & Base/Neutrals-Appendix IX
Acid & Base/Neutrals-625
Acid & Base/Neutrals-TCLP

II. ORGANICS-GC

Organohalide Pesticides & PCBs-608
Organohalide Pesticides & PCBs-8080A
Organohalide Pesticides & PCBs-CLP
Organophosphate Pesticides-8140
Organohalide Pesticides & PCBs-Appendix IX
Organophosphate Pesticides-TCLP
Chlorinated Herbicides-Appendix IX
Chlorinated Herbicides-8150

III. INORGANIC METALS

ICP Metals (6010A/200.7)
Furnace Metals (7000A/600Series)
CLP Metals (ILMO3.0)
Drinking Water Metals

IV. INORGANIC WET CHEMISTRY

Alkalinity
Biochemical Oxygen Demand (BOD)
Chloride
Chlorine Residual
Chemical Oxygen Demand
Conductivity
Chromium (VI)
Cyanide - Amenable
Cyanide - Total
Cyanide (CLP)
Dissolved Oxygen
Flashpoint
Hydrocarbon analysis
Oil and Grease
Paint Filter Test
pH
Phenols
Phosphate
Corrosivity Characteristic
TCLP

Phosphorus
Settleable Solids
Silica
Specific Gravity
Sulfate
Sulfide
Sulfite
Sludge Volume Index
Tannins and Lignins
Total Dissolved Solids
Total Kjeldahl Nitrogen
Total Organic Carbon
Total Organic Halides
Total Solids
Total Suspended Solids
Turbidity
Volatile Solids
Ignitability Characteristics
EPTOX

Table 7.3.2 SUMMARY OF QC REQUIREMENTS FOR EPA VOLATILE ORGANIC ANALYSIS METHODS

Requirement	Drinking Water Analysis Method 524	Water and Wastewater Analysis Method 624	RCRA Solid Waste Analysis Methods 8240/8260	Superfund Hazardous Waste Analysis CLP SOW OLM03.0	NYSDEC
Tuning	25 ng BFB	50 ng BFB	50 ng BFB	50 ng BFB	50 ng BFB
Frequency	8 hrs	24 hours	12 hrs	12 hrs	12 hrs
Criteria	See following page	See following page	See following page	See following page	See following page
Initial Calibration	3-5 standards	3 standards	5 standards	5 standards	5 standards
Maximum % RSD	<20%	<35%	CCC <30%*	<20.5%*	<20.5%*
Minimum RRF	NS	NS	SPCC >0.250-0.300*	0.01-0.500*	0.01-0.500*
					10 compounds with max 100% RSD
Continuing Calibration					
Frequency	8 hrs	Daily	12 hrs	12 hrs	12 hrs
Maximum %D	±30%	QC Limits	CCC ±20%*	±25.0%*	±25.0%*
Minimum RRF	NS	NS	SPCC >0.250-0.300*	0.01-0.500*	0.01-0.500*
IS Area	±30% of last CC or ±50% of IC	NS	-50 to +100% of last CC	NS	NS
					10 compounds with max 100% RSD
QC Check Sample/LCS					
Frequency	Quarterly	Daily	Each batch or if MS % recovery not in QC limits	NS	Each cat. B SDG
Criteria	QC Limits*	QC Limits*	QC Limits*	QC Limits*	QC Limits*
Method Blank					
Frequency	Daily	Daily	12 hrs	12 hrs	12 hrs
Criteria	<MDL	In control	In control	<CRQL*	<CRQL*
Spikes	Blank spike	Matrix spike	Matrix spike	Matrix spike	Matrix spike
Frequency	Daily or 5%	5%	5%	5% or 1/SDG	5% or 1/SDG
% Recovery	80-120%	QC Limits*	QC Limits*	QC Limits*	QC Limits*
Duplicates	BS duplicate	Field duplicate	MS duplicate or sample duplicate	MS duplicate	MS duplicate MSB required*
Frequency	Quarterly	NS	5%	5% or 1/SDG	5% or 1/SDG
Precision	<20% RSD	NS	SD Limits*	RPD Limits*	RPD Limits*
Sample Analysis					
Holding time	14 days	14 days*	14 days*	10 days from receipt	7 days from receipt
Internal standards	1 @ 2-10 ug/L	3 @ 30 ug/L	3-4 @ 50 ug/L	3 @ 50 ug/L	3 @ 50 ug/L
Criteria	NS	Area -50 to +100T RT ±30 sec	Area -50 to +100T RT ±30 sec	Area -50 to +100T RT ±30 sec	Area -50 to +100T RT ±30 sec
Surrogate	2 @ 5 ug/L	3 @ 30 ug/L	3 @ 50 ug/L	3 @ 50 ug/L	3 @ 50 ug/L
Criteria	80-120%	See following page	See following page	See following page	See following page
Analyte ID	RT ±3x SD window 3 ions ±20%	RT ±30 sec 3 ions ±20%	RRT ±0.06 Ions >10% ±20%	RRT ±0.06 Ions >10% ±20%	RRT ±0.06 Ions >10% ±20%

*For complete information refer to method or protocol

SUMMARY OF VOLATILE SURROGATE RECOVERY LIMITS

Compound	Method 524 (%)	Method 624 (%)	Method 8240 Water (%)	Method 8240 Soil (%)	Method 8260 Water (%)	Method 8260 Soil (%)	CLP SOW Water (%)	CLP SOW Soil (%)
4-Bromofluorobenzene	80-120	86-115	86-115	74-121	86-115	72-121	86-115	59-113
1,2-Dichloroethane-d4	80-120	76-114	76-114	70-121	NS	NS	76-114	70-121
Toluene-d8	NS	86-110	86-110	81-117	88-110	81-117	88-110	84-138
Dibromofluoromethane	NS	NS	NS	NS	86-118	80-120	NS	NS

SUMMARY OF VOLATILE SPIKE RECOVERY LIMITS

Method Compound	Method 524 (%)	Method 624 (%)*	Method 8240 (%)*	CLP SOW Soil (%)	CLP SOW Water (%)
Benzene	80-120	66-142	66-142	66-142	66-142
Chlorobenzene	80-120	75-130	60-133	75-130	60-133
1,1-Dichloroethane	80-120	61-145	59-172	61-145	59-172
Toluene	80-120	76-125	59-139	76-125	59-139
Trichloroethene	80-120	71-120	62-137	71-120	62-137

*Pending in-house limits

SUMMARY OF INSTRUMENT TUNING REQUIREMENTS

BFB Ion Abundance Criteria	NYSDEC 1/91	Method 524 (%)	Method 624 (%)	Methods 8240/8260 (%)	CLP SOW OLM03.0 (%)
50 - % of mass 95	15-40	15-40	15-40	15-40	8.0-40.0
75 - % of mass 95	30-60	30-80	30-60	30-60	33.0-66.0
95	100	100	100	100	100.0
96 - % of mass 95	5-9	5-9	5-9	5-9	5.0-9.0
173 - % of mass 174	<2	<2	<2	<2	<2.0
174 - % of mass 95	>50	>50	>50	<50	50.0-120.0
175 - % of mass 174	5-9	5-9	5-9	5-9	4.0-9.0
176 - % of mass 174	95-101	95-101	95-101	95-101	95.0-101.0
177 - % of mass 176	5-9	5-9	5-9	5-9	5.0-9.0

TABLE 7.3.2 SUMMARY OF QC REQUIREMENTS FOR EPA SEMI-VOLATILE ORGANIC ANALYSIS METHODS

Requirement	Water and Wastewater Analysis Method 625	RCRA Solid Waste Analysis Method 8270	Superfund Hazardous Waste Analysis CLP SOW OLM03.0	NYSDEC
Tuning				
Frequency	50 ng DFTPP 24 hour	50 ng DFTPP 12 hrs	50 ng DFTPP 12 hrs	50 ng DFTPP 12 hrs
Criteria	See following page	See following page	See following page	See following page
Initial Calibration				
Maximum %RSD	3 standards <35%	5 standards CCC <30%*	5 standards <20.5%*	5 standards <20.5%*
Minimum RRF	NS	SPCC >0.050*	0.01-1.300*	0.01-1.300* 20 compounds Max 100% RSD
Continuing Calibration				
Frequency	Daily	12 hrs	12 hrs	12 hrs
Maximum %D	±20%	CCC ±30%*	±25%*	±25%*
Minimum RRF	NS	SPCC >0.050*	0.01-1.300*	0.01-1.300*
IS Area	NS	-50 to +100% of last CC	NS	NS 20 compounds Max 100% RSD
QC Check Sample/LCS				
Frequency	≤5%	If MS % recovery not in QC limits	Each SDG	Each SDG with cat. B
Criteria	QC Limits*	QC Limits*	QC Limits*	QC Limits*
Method Blank				
Frequency	1 per batch	1 per batch	1 per batch	1 per batch
Criteria	In control	In control	<CRQL*	<CRQL*
Spikes				
Frequency	Matrix spike 5%	Matrix spike 5%	Matrix spike 5% or 1/SDG	Matrix spike 5% or 1/SDG
% Recovery	QC Limits*	QC Limits*	QC Limits*	QC Limits*
Duplicates				
Frequency	Field duplicates	MS duplicate or sample duplicate	MS duplicate	MS duplicate MS blank
Precision	NS NS	5% SD Limits*	5% or 1/SDG RPD Limits*	5% or 1/SDG RPD Limits*
Sample Analysis				
Holding Time				
Water extraction	7 days	7 days	5 days from receipt	completed within 5 days from receipt
Soil extraction	NA	14 days	10 days from receipt	completed within 5 days from receipt
Analysis	40 days from extraction	40 days from extraction	35 days from extraction	35 days from extraction
Internal standards	3	6 @ 40 ug/L	6 @ 20 ug/L	6 @ 20 ug/L
Criteria	Area -50/+100% RT ±30 sec	Area -50/+100% RT ±30 sec	Area -50/+100% RT ±30 sec	Area -50/+100% RT ±30 sec
Surrogate	6 @ 100-150 ug/L	6 @ 100-150 ug/L	8 @ 100-150 ug/L	8 @ 100-150 ug/L
Criteria	See following page	See following page	See following page	See following page
Analyte ID	RRT ±0.06 Ions >10% ±20%	RRT ±0.06 Ions >10% ±20%	RRT ±0.06 Ions >10% ±20%	RRT ±0.06 Ions >10% ±20%

*For complete information refer to method or protocol

SUMMARY OF SEMI-VOLATILE SURROGATE RECOVERY LIMITS

Compound	Method 625 (%)	Method 8270 Water (%)	Method 8270 Soil (%)	NYSDEC '91 ASP CLP SOW OLMO3.0 Water (%)	NYSDEC '91 ASP CLP SOW OLMO3.0 Soil (%)
Nitrobenzene-d5	35-114	35-114	23-120	34-114	23-120
2-Fluorobiphenyl	43-116	43-116	30-115	43-116	30-115
p-Terphenyl-d14	33-141	33-141	18-137	33-141	18-137
Phenol-d6	10-94	10-94	24-113	10-110	24-113
2-Fluorophenol	21-100	21-100	25-121	21-110	25-121
2,4,6-Tribromophenol	10-123	10-123	19-122	10-123	19-122
1,2-Dichlorobenzene-d4	NS	NS	NA	16-110*	20-130*
2-Chlorophenol-d4	NS	NS	NA	33-110*	20-130*

SUMMARY OF SEMI-VOLATILE SPIKE RECOVERY LIMITS

Compound	Method 625 (%)	Method 8270 (%)	NYSDEC '91 ASP[1] CLP SOW OlMO3.0 Water (%)	NYSDEC '91 ASP CLP SOW OLMO3.0 Soil (%)
Acenaphthene	47-145	47-145	46-118	31-137
1,4-Dichlorobenzene	20-124	20-124	36-97	28-104
2,4-Dinitrotoluene	D-112	D-112	24-96	28-89
N-Nitroso-di-n-propylamine	D-230	D-230	41-116	41-126
Pyrene	52-115	52-115	26-127	35-142
1,2,4-Trichlorobenzene	44-142	44-142	39-98	38-107
4-Chloro-3-methylphenol	22-147	22-147	23-97	26-103
2-Chlorophenol	23-134	23-134	27-123	25-102
4-Nitrophenol	D-132	D-132	10-80	11-114
Pentachlorophenol	14-176	14-176	9-103	17-109
Phenol	5-112	5-112	12-110	26-90

SUMMARY OF GC/MS INSTRUMENT TUNING REQUIREMENTS

DFTPP Ion Abundance Criteria	NYSDEC	Method 625 (%)	Method 8270 (%)	CLP SOW OLMO3.0 (%)
51 - % of mass 198	30-60	30-60	30-60	30.0-80.0
68 - % of mass 69	<2	<2	<2	<2.0
70 - % of mass 69	<2	<2	<2	Present
127 - % of mass 198	40-60	40-60	40-60	25.0-75.0
197 - % of mass 198	<1	<1	<1	<1.0
198	100	100	100	100
199 - % of mass 198	5-9	5-9	5-9	5.0-9.0
275 - % of mass 198	10-30	10-30	10-30	10.0-30.0
365 - % of mass 198	>1	>1	>1	>0.75
441	<mass 443	<mass 443	<mass 443	<mass 443
442 - % of mass 198	40-110	>40	>40	40.0-110.0
443 - % of mass 442	17-23	17-23	17-23	15.0-24.0

TABLE 7.3.2 SUMMARY OF QC REQUIREMENTS FOR PESTICIDE/PCB ANALYSIS METHODS

Requirement	Water and Wastewater Analysis Method 608	RCRA SW-846 Solid Waste Analysis Method 8080	Superfund Hazardous Waste Analysis CLP SOW OLMO3.0	NYSDEC ASP 1991
Initial Calibration	3 standards	5 standards	3 standards (1 for multicomponent)	3 standards (1 for multicomponent)
Maximum % RSD	<10%	<20%	<10.0-15.0%*	<10.0-15.0%*
DDT/Endrin Breakdown	NS	<20%	<20.0%	<20.0%
Resolution	NS	NS	90-110%*	90-110%*
Continuing Calibration	Mid-level standard	Mid-level standard	Mid-level standard	Mid-level standard
Frequency	Daily	Daily	12 hrs	12 hrs
Maximum %D	±15%	±15%	±25.0%	±25.0%
RT Criteria	NS	NS	±0.05-0.07 min of mean RT	±0.05-0.07 min of mean RT
QC Check Sample/LCS				
Frequency	≤10%	If MS % recovery not in QC limits	NS	Each cat. B SDG
Criteria	QC Limits*	QC Limits*	QC Limits*	QC Limits*
Method Blank				
Frequency	1/batch	1/batch	1/batch	1/batch
Criteria	In control	In control	<CRQL	<CRQL
Spikes	Matrix spike	Matrix spike	Matrix spike	Matrix spike
Frequency	10%	5%	5% or 1/SDG	5% or 1/SDG
% Recovery	QC Limits*	QC Limits*	QC Limits*	QC Limits*
Duplicates	Field duplicate	MSD or sample duplicate	MSD	MSD/MS Blank
Frequency	NS	5%	5% or 1/SDG	5% or 1/SDG
Precision	NS	SD Limits*	RPD Limits*	RPD Limits*
Sample Analysis				
Holding Time				
Water extraction	7 days	7 days	5 days VTSR	Completed within 5 days VTSR
Soil extraction	NA	14 days	10 days VTSR	Completed within 5 days VTSR
Analysis	40 days	40 days	35 days	35 days
Analyte ID	RT within 3x SD of std. RT window	RT within 3x SD of std. RT window	RT ±0.05-0.07 min of std. RT on both columns; Conc. ±25.0%	RT ±0.05-0.07 min of std. RT on both columns; Conc. ±25.0%
Confirmation	2nd column for positive ID	2nd column for positive ID	2 column required; GC/MS if >10 ng/uL	2 column required; GC/MS if >10 ng/uL

SUMMARY OF PESTICIDE SURROGATE RECOVERY LIMITS					
Compound	**Method 608 (%)***	**Method 8080***	**CLP SOW OLMO3.0 Water (%)**	**CLP SOW OLMO3.0 Soil (%)**	**NYSDEC 1991**
Tetrachloro-m-xylene	60-150	60-150	60-150	60-150	60-150
Decachlorobiphenyl	NA	60-150	60-150	60-150	60-150
Dibutylchlorendate	60-150	NA	NA	NA	NA

*Pending In-House limits

SUMMARY OF PESTICIDE SPIKE RECOVERY LIMITS					
Compound	**Method 608 (%)***	**Method 8080 (%)***	**CLP SOW OLMO3.0 Water (%)**	**CLP SOW OLMO3.0 Soil (%)**	**NYSDEC ASP 1991**
gamma-BHC (Lindane)	56-123	46-127	56-123	46-127	46-127
Aldrin	40-120	34-132	40-120	34-132	34-132
Dieldrin	52-126	31-134	52-126	31-134	31-134
4,4'-DDT	38-127	23-134	38-127	23-134	23-134
Endrin	56-121	42-139	56-121	42-139	42-139
Heptachlor	40-131	35-130	40-131	35-130	35-130

*Pending In-House Limits

TABLE 7.3.2 SUMMARY OF QC REQUIREMENTS FOR EPA METALS ANALYSIS METHODS USING ATOMIC ABSORPTION (AA) SPECTROSCOPY

Requirement	Water and Wastewater Analysis Method 200.0	RCRA Solid Waste Analysis Method 7000	Superfund Hazardous Waste Analysis CLP SOW ILM03.0
Initial Calibration Frequency Criteria	3 standards and a blank Daily r ≥0.995	3 standards and a blank Daily r ≥0.995	3 standards and a blank Daily or every 24 hrs r ≥0.995
Calibration Verification Frequency Criteria	A standard at or near MCL After initial calibration and every 20 samples 90-110% recovery	Mid-range standard Every 10 samples ICV: 90-110% recovery CCV: 80-120% recovery	Mid-range standard Beginning, end, and every 10 samples or every 2 hrs 90-110% recovery Hg: 80-120% recovery
Detection Limits Standard Frequency Criteria	NS NS NS	NS NS NS	Standard at the CRDL or IDL Beginning of each sample run EPA QC limits
Calibration Blanks Frequency Criteria	After each calibration NS	After each calibration NS	Beginning, end, and every 10 samples or every 2 hrs All analytes ≤ CRDL
Preparation Blanks Frequency Criteria	Each digestion batch NS	Each digestion batch NS	1 per SDG or digestion batch All analytes ≤ CRDL
QC Check Sample/LCS Frequency Criteria	NS NS	1 per batch NS	1 per matrix per SDG or digestion batch 80-120% recovery
Matrix Spike Samples Frequency Criteria	10% or 1 per batch NS	5% or 1 per batch NS	5% or 1 per SDG per matrix per level (predigestion) 75-125% recovery
Duplicate Samples Frequency Criteria	10% or 1 per batch NS	5% or 1 per batch NS	5% or 1 per SDG per matrix per level (predigestion) ≤20% RPD for values ≥5 x CRDL ±1 x CRDL for values <5 x CRDL
Furnace Quality Control Frequency Criteria	MSA as needed NS	MSA as needed Serial dilution: 1 per batch per matrix MSA: r≥0.995 5¥ dilution within ±10%	Duplicate injections on all; Post digestion spikes on all samples, blanks, and LCS; MSA as needed Duplicate injections: ≤20% RSD/CV Spikes: 85-115% recovery MSA: r≥0.995

TABLE 7.3.2 SUMMARY OF QC REQUIREMENTS FOR EPA METALS ANALYSIS METHODS USING INDUCTIVELY COUPLED PLASMA (ICP) SPECTROSCOPY

Requirement	Water and Wastewater Method 200.7	RCRA Solid Waste Analysis Method 6010	Superfund Hazardous Waste Analysis CLP SOW ILM03.0
Initial Calibration Frequency	1 standard and a blank 8 hour	1 standard and a blank Daily	1 standard and a blank Daily
Calibration Verification Frequency Criteria	Mid-range standard Every 10 samples 95-105% recovery	Mid-range standard Every 10 samples and at end 90-110% recovery	Mid-range standard Beginning, end, and every 10 samples or every 2 hours 90-110% recovery
Other Standards Frequency Criteria	Highest mixed standard Before sample analyses 95-105% recovery	Highest mixed standard Before sample analyses 95-105% recovery	Standard at 2 x CRDL or IDL Beginning and end of each run or 2 every 8 hrs EPA QC Limits
Interference Check Sample Frequency Criteria	Beginning, end, and periodic intervals ±1.5 x SD of mean value	Beginning and end of each run or every 8 hours 80-120% recovery	Beginning and end of each run or 2 every 8 hrs 80-120% recovery
Calibration Blanks Frequency Criteria	Every 10 samples Within ± MDL	Every 10 samples and at end ±3 x SD of mean value	Beginning, end, and 10% of samples or every 2 hrs All analytes ≤CRDL
Preparation Blanks Frequency Criteria	1 per batch All analytes ≤CRDL	1 per batch All analytes ≤CRDL	1 per batch per matrix All analytes ≤CRDL
QC Check Sample/LCS Frequency Criteria	1 per batch per matrix LCSW 80-120% LCSS 80-120%	1 per batch per matrix LCSW 80-120% LCSS 80-120%	1 per batch per matrix LCSW 80-120% LCSS 80-120%
Matrix Spike Samples Frequency Criteria	Every 20 samples per matrix 80-120% recovery	Every 20 samples per matrix 80-120% recovery	Every 20 samples per matrix 80-120% recovery
Duplicate Samples Frequency Criteria	5% or 1 per batch ≤20% RPD for values >10 x IDL	5% or 1 per batch ≤20% RPD for values >10 x IDL	5% or 1 per SDG per matrix per level (predigestion) ≤20% RPD for values ≥5 x CRDL ±1 x CRDL for values <5 x CRDL
Serial Dilution Frequency Criteria	1 per batch Dilution within ±5%	1 per batch 4 x dilution within ±10%	1 per SDG per matrix per level 5 x dilution within ±10%

TABLE 7.3.2 SUMMARY OF QC REQUIREMENTS FOR EPA MERCURY ANALYSIS METHODS USING COLD VAPOR ATOMIC ABSORPTION (AA) SPECTROSCOPY

Requirement	Water and Wastewater Analysis Method 245.1/245.5	RCRA Solid Waste Analysis Method 7470/7471	Superfund Hazardous Waste Analysis CLP SOW ILM03.0
Method Detection Limit	0.2 ug/L	0.2 ug/L	CRDL: 0.2 ug/L
Holding Time	28 days	28 days	26 days
Initial Calibration Frequency Criteria	6: blank and 5 standards Daily r ≥0.995	6: blank and 5 standards Daily and every hour of analysis r ≥0.995	6: blank and 5 standards Daily or every 24 hours r ≥0.995
Calibration Verification Frequency Criteria	A standard at or near MCL After initial calibration and every 20 samples 90-110% Recovery	Mid-range standard Every 10 samples 80-120% Recovery	Independent standard CCV: diff. conc. than ICV, or at near the mid-range ICV: After initial calibration CCV: 10% or every 2 hours 80-120% Recovery
Calibration Blanks Frequency Criteria	Beginning, end, and every 10 samples or every 2 hours ≤CRDL	Beginning, end, and every 10 samples or every 2 hours ≤CRDL	Beginning, end, and every 10 samples or every 2 hours ≤CRDL
Preparation Blanks Frequency Criteria	1 per digestion batch NS	1 per digestion batch NS	1/SDG/digestion batch ≤CRDL
QC Check Sample/LCS Frequency Criteria	Blind performance sample 1 per year (Optional: 1 per quarter) 80-120% Recovery	Independent standard Every 15 samples 80-120% Recovery	EPA standard 1/SDG/batch (solid samples only) 80-120% Recovery
Matrix Spike Samples Frequency Criteria	5% or 1/SDG/matrix/level 75-125% Recovery	5% or 1/SDG/matrix/level 75-125% Recovery	5% or 1/SDG/matrix/level 75-125% Recovery
Duplicate Samples Frequency Criteria	10% or 1 per batch ≤ 20% RPD	5% or 1 per batch ≤20%RPD	5% or 1/SDG/matrix/level ≤20% RPD
Other Method Criteria Frequency Criteria	Method of standard addition As needed NS	Method of standard addition As needed NS	Standard at the CRDL or IDL Beginning of each sample run EPA control limits

TABLE 7.3.2 SUMMARY OF QC REQUIREMENTS FOR EPA CYANIDE ANALYSIS METHODS

Requirement	Water and Wastewater Analysis Method 335.2	RCRA Solid Waste Analysis Method 9010/9010A	Superfund Hazardous Waste Analysis CLP SOW ILM03.0
Method Detection Limit	Titration: 1 mg/L Colorimetric: 0.01 mg/L	Titration: 0.1 mg/L Colorimetric: 0.01 mg/L	CRDL: 10 ug/L
Holding Time	14 days (24 hours when sulfide is present)	14 days	12 days from sample receipt
Initial Calibration[1] Frequency	5 standards and a blank Monthly	5 standards and a blank Monthly	5 standards and a blank (one standard at the CRDL) Daily
Calibration Verification[2] Frequency Criteria	NS NS NS	Mid-range standard Every 15 samples 85-115% Recovery	CCV: Mid-range standard Beginning, end, and every 10 samples or 2 hours 85-115% Recovery
Other Standards (Distilled) Frequency Criteria	Midlevel standard 1 each per batch 90-110% Recovery	Midlevel standard 1 each per batch 90-110% Recovery	Mid-level standard 1 per batch 85-115% Recovery
Calibration Blanks Frequency Criteria	Colorimetric: 1 per batch Use in initial calibration	Colorimetric: 1 per batch Use in initial calibration	Colorimetric: Beginning, end and every 10 samples or 2 hours ≤CRDL
Preparation Blanks Frequency Criteria	Titration: 1 per batch (or daily) Colorimetric: Not specified Titration: Use in calculation Colorimetric: Not specified	Titration: 1 per batch (or daily) Colorimetric: Not specified Titration: Use in calculation Colorimetric: Not specified	Titration: 1 per batch (or daily) Colorimetric: 1 per batch Titration: Use in calculation Colorimetric: ≤CRDL
Laboratory Control Standard Frequency Criteria	NS NS NS	Independent check standard 1 per batch 85-115% Recovery	Distilled independent standard (ICV) 1 per batch 85-115% Recovery
Matrix Spike Samples Frequency Criteria	1 per batch to check distillation efficiency NS	Matrix spike and matrix spike duplicate per batch NS	1 per matrix per concentration level per batch 75-125% Recovery
Duplicate Samples Frequency Criteria	1 matrix spike duplicate per batch NS	1 matrix spike duplicate per batch NS	1 per matrix per concentration level per batch ≤20% RPD for values >5 x CRDL
Other Method Criteria	Verify sample pH ≥12; Check for oxidizing agents and sulfides	Verify sample pH ≥12; Check for oxidizing agents and sulfides	Verify sample pH ≥12; Check for oxidizing agents and sulfides

KEY TO CHART	
BS	Blank Spike
CC	Continuing Calibration
CCC	Calibration Check Compounds
CCV	Continuing Calibration Verification
CRDL	Contract-Required Detection Limit
CRQL	Contract-Required Quantitation Limit
CV	Coefficient of Variation
D	Detected
IC	Initial Calibration
ICV	Initial Calibration Verification
IDL	Instrument Detection Limit
IS	Internal Standard
LCS	Laboratory Control Sample
MCL	Maximum Contaminant Level
MDL	Method Detection Limit

KEY TO CHART	
MS	Matrix Spike
MSA	Method of Standard Additions
NA	Not Applicable
NS	Not Specified
%D	Percent Difference
%Rec.	Percent Recovery
PQL	Practical Quantitation Limit
r	Correlation Coefficient
RF	Response Factor
RPD	Relative Percent Difference
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RT	Retention Time
SD	Standard Deviation
SDG	Sample Delivery Group
SPCC	System Performance Check Compounds

NOTES

(1) Calibration standards must be distilled for EPA Methods 335.2 and 9010/9010A when sulfides are present in the samples.

(2) CLP SOW specifies that the initial calibration verification standard (ICV) be distilled and analyzed as the laboratory control standard (LSC).

7.4 Standard Operating Procedures

All laboratory activities, from sample receipt to analysis to final report generation, must adhere to the laboratory Standard Operating Procedures (SOPs) which have been developed to provide quality environmental data with adequate documentation to be of known quality and hence of maximum use to our clients. All SOPs provide complete documentation as to how each sample is measured for each parameter. Reference corporate document QAS00200.NET for the IEA corporate format for generating SOPs. Each SOP shall have a unique code in accordance with the IEA corporate document control procedure as outlined in the corporate SOP on document control.

On a regular basis the QA Manager will review data to check for compliance to SOPs. Additionally the QA Manager will review SOPs to ensure they meet the requirements of the methodologies and applicable regulations. If it is found that the document does not meet the requirements, the discrepancy is forwarded to the group/section leader through the corrective action process. (reference SOP on Corrective Action Reports -QAS00500.NJ).

In addition to method SOPs, at minimum the laboratory is required to have on file SOPs for the following operations. Many of these SOPs have been generated by the IEA corporate QA department.

Sample Receipt, Logging and Disposal
Chain-of-Custody Procedures
Sample Storage
Security of Samples and Laboratory Facility
Purity of Standards and Standards Preparation Documentation
Maintaining Laboratory Records and Logbooks
Sample Analysis and Data Control Systems
Sample Bottle and Glassware Cleaning Procedures
Laboratory Waste Disposal

An example listing of laboratory SOPs is presented in Section 7 of the Appendix. A complete list of all laboratory SOPs is available upon request.

7.5 Chain-of-Custody

Samples are physical evidence and are handled at IEA according to certain procedural safeguards. For the purposes of legal proceedings, a demonstration to the court that the laboratory is a secure area may be all that is required for the analyzed evidence to be admitted. However, in some cases, the court may require a presentation of the hand-to-hand custody of the samples while they were at the laboratory. In the event that a client requires such a comprehensive chain-of-custody demonstration, upon special request, IEA is capable of producing documentation that traces the in-house custody of the samples from the time of receipt to completion of analysis.

The National Enforcement Investigations Center (NEIC) of EPA defines custody of evidence in the following ways:

- It is in your actual possession; or
- It is in your view, after being in your physical possession; or
- It was in your possession and then you locked or sealed it up to prevent tampering; or it is in a secure area

At IEA-NJ, chain of custody begins with shipment of the sample bottles and coolers. IEA-NJ has a printed external chain-of-custody form that accompanies each sample shipment. An example of this form is found in Section 2 of the appendix.

Upon receipt of the samples in the laboratory the sample custodian and the sample control group are responsible for obtaining all necessary shipping documentation and verification of all data entered into the laboratory sample custody records. The internal chain of custody form is generated at this point.

All samples and projects entering the laboratory are identified with a job/project number. Individual samples are then identified using the job number and sample counter. The samples are then stored according to the requirements of the analytical protocols (refrigeration).

Preliminary sample receipt notifications are distributed to each department to notify department of sample arrival and facilitate the analysis of parameters with short holding times. Each department has a system of tracking sample analysis throughout their respective departments.

All documentation received with samples is reviewed by the sample custodian at the time of receipt. The project manager then reviews the paperwork again at the time of log-in to the LIMS computer system. If there are any discrepancies noted by the sample custodian, a corrective action report is filled out and submitted to the project manager. The client is then contacted for resolution.

The specific procedures and requirements for receiving samples are specified in the SOP for sample control - "Sample Receipt/Control" (Doc# SMS00404.NJ). IEA's chain-of-custody record is designed to meet the legal requirements of federal, state and local government agencies and the courts of law. The record covers:

- Labeling of sample bottles, packing the shipping container and transferring the shipping container under seal to the custody of a shipper;
- Outgoing shipping manifests;
- The chain-of-custody form completed by the person(s) breaking the shipping container seal, taking the sample, resealing the shipping container and transferring custody to a shipper;
- Incoming shipping manifests;
- Breaking the shipping container's reseal;
- Storing each labeled sample bottle in a secured area;
- Disposition of each sample to an analyst or technician; and
- The use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

For each link in this process the records indicate the following:

- The person with custody; and
- The time and date each person accepted or relinquished custody.

IEA has implemented the following standard operating procedures with regard to laboratory chain-of-custody:

- Samples are stored in a secure area;
- Non-employee access to the laboratories are controlled through the use of limited access points at each facility. Outside personnel can access the facility either through the front receptionist or the sample receipt area. Other access doors to the laboratory are maintained in a secure manner at all times;
- All visitors to each facility are required to sign-in at the reception area and must be escorted by an IEA representative at all times while in the laboratory;
- Refrigerators, freezers, and other sample storage areas are kept locked, when not in use;
- The designated sample custodian and supervisory personnel control access to the sample storage area(s); and
- Samples remain in secured sample storage until removed for sample preparation or analysis; and
- Upon special request, all transfers of samples into and out of storage are documented through an internal chain-of-custody procedure. This procedure is not normally employed in daily operations but is available upon special request by the client.

7.6 Analytical Calibration Standards

The calibration standards used for instruments and equipment are described in the specific analytical methods, or instrument manufacturers' operational guides. All standard preparations are recorded in a bound "Standards Preparation Log Book" with the lot number, method of preparation, date and analyst's initials. This log provides the internal documentation which traces the internal working standards to primary and secondary (purchased) stocks.

The stock solutions are all kept in a daily monitored 4° C refrigerator with the exception of the organic stock solutions which are kept in a 0° C freezer. Stock calibration standards are coded in the "Prep Log" mentioned above with the analyte, concentration, date prepared, initials, and referenced to the book and page where a description of the preparation can be found and traced. No samples are maintained in the same areas as the standards.

Records on the traceability of the standards are maintained by the department supervisors . These records include sources, dates of receipt, lot numbers (if Applicable) and expiration dates (if applicable).

Table 7.6.1 provides an overview of the standard sources, types and preparation by instrument group.

Metals Calibration Standards

Primary source standards are obtained from Inorganic Ventures and prepared as needed. Secondary (alternate source) standards are obtained form SPEX. No standard will be used after 6 months from receipt or preparation.

Inorganic Calibration Standards

Most calibration standards described in the methodology used ACS Reagent Grade materials. Some reference materials are available from NIST to standardize titrating solutions. Stock solutions are prepared every three months while diluted working standards are prepared daily at the time of analysis. Spike solution preparation is also documented in the solution/standard log book.

Organic Calibration Standards

Pure compounds for organic calibration materials are available through EPA EMSL in Cincinnati, EPA in Research Triangle Park, EPA Las Vegas, Supelco, Inc., Restek, Inc. and Accustandard, Inc. Organic stocks are prepared every six months and diluted working standards are prepared weekly. Stock non-volatile solutions can be prepared every six months with working standards made weekly. Most organic spike solutions are prepared from neat solutions and documented.

pH Calibration Standards

Calibration materials which are certified by the manufacturer to be standardized against NIST Standards are commercially available and are used by the laboratory. Three standards - 4,7, and 10 are used daily to calibrate the pH meters.

Weighing Calibration Standards

Analytical balances are calibrated annually. Continuing calibration is performed on a weekly or daily basis using class "S" weights.

Oven Calibration Standards

Daily calibration by monitoring oven temperature with a thermometer calibrated annually with a NIST Certified Thermometer.

Conductivity Calibration Standard

Conductivity solutions are described in Standard Methods, 15th edition, Section 502 and are measured on a daily basis.

Refrigerators

All refrigerators are checked daily for temperature stability and recorded in a logbook. Yearly, the refrigerator thermometers are calibrated against an NIST thermometer.

TABLE 7.6.1 STANDARD SOURCES AND PREPARATION

Inst. Group	Source	Form Received	Storage	Preparation from Source	Laboratory Stock Storage	Preparation Frequency
GC/MS	Restek, Inc. EPA	Neat Solutions > 1000 ppm	Frozen Frozen	Primary stocks are prepared from source stocks Intermediate stocks are prepared from primary or source stocks Working stocks are prepared from intermediates	Frozen Refrigerator N/A	Semi-annual Monthly Weekly
GC	Restek, Inc. EPA RTP	Neat Solutions >1000 ppm	Frozen Frozen	Primary stocks are prepared from source stocks Intermediate stocks are prepared from primary or source stocks Working stocks are prepared from intermediates	Frozen Refrigerator N/A	Semi-annual Weekly Weekly
Atomic Absorption ICP;	Inorganic Ventures SPEX	Solutions of 1000 and 10000ppm	Room temp.	Primary stocks (1 - 10 ppm) are prepared from source Intermediate stocks (1ppb - 1 ppm) Working stocks	0.15% HNO_3 at room temperature 0.15% HNO_3 at room temperature 0.15% HNO_3 at room temperature	Annually As needed Daily

7.7 Instrument Calibration Procedures

The proper calibration of instrumentation and equipment is a key element in the quality of the analysis done by the laboratory. Each type of instrumentation and each EPA approved method has specific requirements for the calibration procedures, depending on the analytes of interest and the medium of the sample.

The calibration protocols for IEA-NJ must meet or exceed the minimum method criteria requirements. If a method calibration requirement is more stringent than those listed in the Quality Assurance Plan, the more stringent will be followed in each case.

Documentation and records on calibrations are maintained in instrument logs and also with the data sets of the samples which are analyzed and related to them. In addition, laboratory department managers monitor the results of the calibration program to ensure the proper implementation at the analyst level.

8.0 DATA PROCESSING

8.1 Introduction

Data processing is defined as the mechanisms employed for collecting, reviewing, transcribing, reporting and storing of analytical data and related information.

Because of the critical relationship between instrument calibration, the accuracy of the analytical data generated, and specific method protocols that determine data quality, IEA maintains strict controls on the calibration procedures for the various types of analytical equipment. Each type of instrumentation is calibrated prior to sample analysis according to method criteria. Specific criteria for the instrument calibrations must be met before samples may be processed. Corrective action must be taken to remedy any out of control situations.

8.2 Collection

Data in the environmental laboratory may take several forms. Some are manually generated, while others are automated computer outputs. Some examples of typical data are:

Field measurements or observations made on-site during the sample collection effort as part of a monitoring program.

Information provided on chain-of-custody forms such as sampler, sampling date, sample location, sample identification, weather observations and custody transfer information.

Recordkeeping information such as instrument run logs, standards traceability, sample preparation logbooks and balance calibrations which represent information not normally required for inclusion in client reports.

Analytical data produced by various instrumentation such as GC/MS units, gas chromatographs, atomic absorption spectrophotometers, and automated analyzers. This includes various associated outputs such as chromatograms, strip chart recordings and computer tape readouts.

Records of standard calibration curves as well as associated quality control data such as method blanks, matrix spikes, matrix spike duplicate, replicate and QC check samples.

Consistent data collection is achieved through the existence and use of standard operating procedures at each facility. For example, chain-of-custody forms are routinely checked for completeness and if omissions occur, the sampler is contacted for the missing information.

Laboratory data sheets or logbooks have a standard format to ensure that all pertinent information is recorded consistently. These items are regularly monitored to ensure compliance with established requirements.

Outputs from all instruments are monitored for readability and consistency. If clarity is less than desired, corrective actions are undertaken to rectify the output based on instrument manufacturers' recommendations.

The following sections will describe the general procedures which are employed at the IEA-NJ laboratory. More specific detail can be found in the standard operating procedures.

Gas Chromatography

Data from the Gas Chromatographs is collected through interfaces and processed by a Hewlett Packard computer system (HP-1000) with RTE-A operating system and 3550A LAS software. Data is reviewed at the bench level by the analyst. If all required QC is met then the data is reviewed for chromatographic scaling and dilutions. If necessary reintegrations and rescalings are done using the LAS system. The binary result files are then converted to ASCII report files of retention times and peak areas for transfer to LIMS for quantitation and data report forms generation.

GC/Mass Spectrometry

GC/MS data is collected utilizing Hewlett Packard 1000 RTE or DOS chemstation computer systems with Aquarius or Environquant software. This software allows for the comparison of sample target and non-target spectra against reference library spectra. The most recent NIST/EPA mass spectral library supported by the system must be used. Data is reviewed by the analyst. If the data meets QC requirements, then binary data files are sent to the LIMS for data report forms generation.

Trace Metals

ICAP metals are analyzed by a Thermo-Jarrel Ash 61 or 61E Trace ICP. Data is collected on the ICP and the absorbance values are transferred to the LIMS. Data is reviewed by the analyst for compliance with method protocols. Samples are reanalyzed if necessary. This data is then transferred via software to generate metals data reporting forms.

The data for Furnace metals and Mercury are collected in the same procedure mentioned above for Trace metals.

Classical Chemistry

Routine wet chemistry analyses have pre-printed logbooks, such as distillation logs and digestion logs. The less frequent analyses are recorded in analysts' notebooks. Raw data is then entered into the LIMS computer for data calculation. This includes the calibration curve data which may have been previously entered. These results are then entered into LIMS. Any raw data produced is stored in a central file. Quality control data is manually calculated. Results data is reported off LIMS in the required format.

8.3 Review

Data review can be defined as the process whereby data is accepted or rejected based on specific criteria in order to ensure that the data are adequate for the intended purpose. In most cases, the criteria is defined by the particular analytical method.

Data review is performed prior to release of the data to the client. It is performed as soon as possible after data acquisition in order to provide sufficient time for corrective action if required.

There are numerous policies and standard procedures which have been implemented to ensure that data of known quality is continually generated by the IEA-NJ laboratory.

Each analytical SOP details the type and frequency of quality control checks. This includes such items as analysis of client reference standards, matrix spikes, blanks, the use of internal standards and surrogate spikes, etc. All calibrations are checked before sample analysis can begin. If the analytical system does not pass the initial QC limits, then the system is determined to be "out of control", and the cause of the problem must be determined and corrected before measurements can continue. Once the problem is corrected, QC measurements are repeated to verify the calibration. If the system is still out of control, the system is re-examined until the problem is corrected. General requirements are listed below:

Organics

- A minimum of one method blank is analyzed per 20 samples (or batch) per matrix, per concentration level or extraction procedure. A method blank is required every 12 hours for volatile analysis (SW846/CLP) or every 24 hours (624). Blanks and samples are analyzed on the same instrumentation. Pesticides/PCB's also require instrument blanks.

- Holding blanks are placed in volatile refrigerators on a weekly basis. For EPA CLP SOW volatile analysis, holding blanks are analyzed once per SDG.

- A matrix spike/matrix spike duplicate is analyzed at a frequency of one per 20 samples per matrix, per concentration level or per SDG, whichever is more frequent.
- Prior to sample processing, surrogates are added to all samples and method blanks. GC/MS analyses also require the use of internal standards.
- Multi-level initial calibration curves are performed with continuing calibration standards analyzed every 12 hours. Recalibration is required if criteria cannot be met.
- GC/MS system tuning is verified every 12 hours.

Inorganics

- Multi-level calibration is performed on required instrumentation and verified as required.
- Calibration and prep blanks are analyzed at required frequencies.
- A matrix spike and sample duplicate are analyzed every 20 samples/SDG per matrix type.
- A Laboratory Control Sample is analyzed every 20 samples or per batch.
- Multi-level calibrations are performed for all wet chemistry methods and verified as required (if applicable).
- Method blanks are analyzed at required frequencies.

The precision and accuracy control limits employed by IEA are based primarily on limits contained in the published methods or required by the U.S. Environmental Protection Agency's Contract Laboratory Program (CLP). When warranted by IEA's historical data, more restrictive control limits are set than those cited by the method or the CLP.

When the CLP protocol is not applicable to analysis of samples, the precision and accuracy requirements for each analytical method are included in the individual laboratory Standard Operating Procedure (SOPs).

At a minimum, all data will be subject to supervisory review. Sensitive data requires higher level review and release. All releases must be in writing. Oral or Faxed preliminary releases are prohibited unless prior permission of the appropriate supervisor(s) is granted.

Each analytical group in the laboratory is responsible for generating the data for all analyses the group performs. In general the data must first meet all the specific QA/QC associated with the SOP that was used for the analysis prior to any release of the data. The analytical group leader (supervisor) is responsible for the final verification of the data from the analysis.

The laboratory Quality Assurance Manager periodically examines data packages at random to ascertain that the data package meets the requirements as stated in the SOP. These findings are transmitted to laboratory management via progress reports.

8.4 Data and Report Storage

Unless specified otherwise by the client, all analytical data and associated information is stored for a minimum period of five years. Local state data storage requirements may vary from the corporate requirement and must be met by the laboratory if they are more stringent.

Stored information may consist of hardcopy or electronic data stored on a magnetic media.

All hardcopy information is stored at the laboratory that generated the data or off-site at a commercial document storage facility equipped with a professional security system.

All electronic data is stored on-site at the laboratory that generated the data or off-site at a commercial document storage facility equipped with a professional security system and a controlled environment suitable for storage of magnetic media.

Access to archived information is controlled by the Reports Production Department.

At IEA-NJ, reports for the current year are filed in the data management area in filing cabinets or in the Archive Room. All data is stored in numbered boxes. The number of the box is recorded into the cross reference logs for ease of retrieval. All jobs must be signed out with the Reports Production Department.

8.5 Transcription

Whenever possible, manual data transcription is avoided through the use of electronic data transfer within the laboratories. In cases where manual transcription is employed, information is checked and verified by the supervisor or designee within the department.

It may not be possible to totally eliminate transcription related errors, however, section 4.6.9, paragraphs A and D, list procedures which are designed to minimize their occurrence and impact on data quality.

8.6 Data Reduction

Data reduction includes all processes that change either the form of expression (i.e., the units of measure) or the quantity of data values (rounding). It often involves statistical and mathematical analysis of data and usually results in a reduced subset of the original data set. Data reduction is performed either manually by the analyst or by computer systems interfaced to the analytical instruments. Whenever such procedures are employed within the laboratory network, mathematical procedures have been verified for accuracy of computation.

The data associated with each analysis is hardcopied for permanent storage either through the printing of computer files or through hand entry into bound laboratory notebooks. All notebook entries are dated and signed by the analyst.

All organic parameter results will be reported in ug/L for aqueous samples and ug/Kg dry weight for soil/sediment samples. Inorganic result units vary according to the methodology.

It is laboratory policy that any and all problems related to client samples and the measurement of client samples be documented in the Conformance/Nonconformance Summary of the final laboratory report which goes to the client. The mechanism for documenting problems which shall be included in the Conformance/Nonconformance Summary is described in Section 10.0. It is the responsibility of the data management group to see that information on PDR's is included in the final Report.

After final review by the laboratory manager, the data is placed in Reports Production for final assembly of the data package.

9.0 DATA QUALITY ASSESSMENT

Data quality is assessed based on five main characteristics:

Precision
Accuracy
Completeness
Representativeness
Comparability

Each of these characteristics have been previously defined in section 2.2 of this document.

Laboratory Quality Assurance Objectives

Precision:

The objective of the network laboratories concerning precision is to equal or exceed the precision demonstrated in the published analytical method on similar samples. Relative Percent Difference (RPD) is used as the measure of precision sample duplicates. The formula utilized to calculate RPD is as follows:

Relative Percent Difference (RPD)

$$RPD = \frac{(\text{Sample Result - Duplicate Result})}{\text{Mean of Sample and Duplicate Results}} \times 100$$

Note: RPD is expressed as the absolute value obtained from the above formula.

Accuracy:

The objective of the network laboratories concerning accuracy is to equal or exceed the accuracy demonstrated in the published analytical method on similar samples. Accuracy is determined on matrix spikes and/or blank spikes and is calculated as follows:

$$\text{Percent Recovery} = \frac{\text{(Observed-Sample) Concentration}}{\text{Spiked Concentration}} \times 100$$

Completeness:

IEA's objective for completeness is to be able to provide analytical data for 100 % of samples received intact and have sufficient sample volume for conducting re-analysis if initial analysis does not meet QC acceptance criteria.

Representativeness:

Representativeness of the analytical data is primarily a function of the sampling procedures and techniques employed in the field. As such, the sampling plan must be designed to provide representative samples to the laboratory. Once received at the laboratory, samples are homogenized in an effort to yield representative data on the sample submitted for analysis.

Comparability:

IEA's objective for comparability is that all data be fully comparable with data from other network laboratories. This is accomplished through use of the following practices:

- Demonstrate traceability of standards to NIST or EPA sources
- Use of standard and approved methodologies
- Standardized units of measure
- Standardized QC acceptance criteria
- Participation in interlaboratory studies to demonstrate laboratory performance

9.1 Content of Analytical Reports

Laboratory customers have a wide variety of analytical needs. In order to meet these varied requirements, the laboratory offer several levels of data reporting options ranging from very simple format to an extreme level of documentation. Table 9.1.1 presents the contents of various levels of reports offered by the laboratory. Custom reporting beyond those listed is usually available but may require additional cost. The information provided in Table 9.1.1 is a summary only. In some cases, individual methods may not include the indicated items.

Table 9.1.1 Report Content Options

IEA NJ
628 ROUTE 10
WHIPPANY, NJ 07981
PHONE: (201) 428-8181
FAX: (201) 428-5222

REPORT DELIVERABLES - PAGE 2

	IEA's Data Summary Level 1	*NJ Tier II Level II*	*NJDEP Reduced*	*NJDEP Reg. Format*	*EPA CLP*	*Effective 1992 NY-Cat--A*	*Effective 1992 NY-Cat-- B*
ORGANICS STANDARDS DATA							
Initial Calibration (Form VI)			X	X	X		X
Continuing Calibration (Form VII)			X	X	X		X
Initial Calibration Chromatograms				X	X		X
Initial Calibration Quant Reports				X	X		X
Continuing Calibration Chromatograms				X	X		X
Continuing Calibration Quant Reports				X	X		X
ORGANICS RAW QC DATA							
Tuning Spectra and Mass Listing				X	X		X
Method Blank Data Summary (Form I)	X	X	X	X	X	X	X
Method Blank TIC Summary (Form I)	X	X	X	X	X	X	X
Method Blank Chromatograms		X	X	X	X		X
Method Blank Quant Reports		X		X	X		X
Inst. Blank Data Summary (Form I)				X	X		X
Inst. Blank Chromatograms				X	X		X
Inst. Blank Quant Reports				X	X		X
Spectra (Target and TIC)				X	X		X
MS/MSD Data Summary (Form I)				X	X		X
MS/MSD Chromatograms				X	X		X
MS/MSD Quant Reports				X	X		X

NY Cat B includes Blank Spike and IDLs
Level 1 is equivalent to IEA's customized "Data Summary Package"
Level 2 is equivalent to a NJDEP Tier II Deliverable (prior to 1992)

IEA NJ
628 ROUTE 10
WHIPPANY, NJ 07981
PHONE: (201) 428-8181
FAX: (201) 428-5222

REPORT DELIVERABLES - PAGE 3

	IEA's Data Summary Level I	*NJ Tier II Level II*	*NJDEP Reduced*	*NJDEP Reg. Format*	*EPA CLP*	*Effective 1992 NY-Cat--A*	*NY-Cat-- B*
LABORATORY LOGS							
Extraction Logs				X	X		X
Instrument Logs				X	X		
METALS SAMPLE DATA							
Data Summary (Form I)	X	X	X	X	X	X	X
METALS STANDARD DATA							
Int. & Cont. Cal. Verification (Form IIA)			X	X	X		X
Blanks, Reagents (Form III)		X	X	X	X		X
METALS QC SUMMARY							
Matrix Spike (Form V Part 1)		X	X	X	X		X
Post Digestion Spike (Form V Part 2)			X	X	X		X
Matrix Dup (Form VI)		X	X	X	X		X
QC Samples (Form I)		X	X	X	X		X
Standards Additions (Form VIII)			X	X	X		X
Serial Dilutions (Form IX)			X	X	X		X
LCS (Form VII)			X	X	X		X
ICP Interference Check (Form IV)			X	X	X		X
METALS RAW QC DATA							
Cover Page				X	X		X
IDLs (Form X)				X	X		X
Prep Logs (Form XIII)				X	X		X
Raw Data				X	X		X

NY Cat B includes Blank Spike and IDLs
Level 1 is equivalent to IEA's customized "Data Summary Package"
Level 2 is equivalent to a NJDEP Tier II Deliverable (prior to 1992)

IEA NJ
628 ROUTE 10
WHIPPANY, NJ 07981
PHONE: (201) 428-8181
FAX: (201) 428-5222

REPORT DELIVERABLES - PAGE 4

	IEA's Data Summary Level 1	*NJ Tier II Level II*	*NJDEP Reduced*	*NJDEP Reg. Format*	*EPA CLP*	*Effective 1992 NY-Cat--A*	*Effective 1992 NY-Cat-- B*
LABORATORY LOGS							
Digestion, Prep and Mercury Logs				X	X		X
WET CHEM SAMPLE DATA							
Data Summary	X	X	X	X		X	X
WET CHEM STANDARDS DATA							
Int. & Cont. Calibration				X			X
Raw Data				X			X
WET CHEM RAW QC DATA							
Raw Data Sheets				X			X
Summary				X			X
QC Summary		X	X	X			X
pH and Percent Solids Logs				X	X		
Subcontractor's Report	X	X	X	X			X
Distillation Logs				X			X

NY Cat B includes Blank Spike and IDLs
Level 1 is equivalent to IEA's customized "Data Summary Package"
Level 2 is equivalent to a NJDEP Tier II Deliverable (prior to 1992)

10.0 Corrective Action

10.1 Introduction

The Problem Documentation Report form (PDR) presented in Section 7 of the Appendix, provides a routine written communication vehicle to describe most types of problems which may occur throughout the laboratory or as a result of a customer inquiry. Problems described in the Conformance/Nonconformance Summary may be supported by a PDR.

Corrective actions can be initiated at several operational levels; however they must always involve the QA Manager. Corrective actions are reviewed, documented and distributed to the appropriate personnel through the QA department. Responses are returned to QA for review and redistributed in a specified time frame.

Examples of three types of corrective actions which may be initiated are as follows:

Sample problems

Individual samples or matrix problems may cause documented corrective actions such as re-extraction, reanalysis, cleanups or dilutions.

QC problems

Corrective action may occur on entire batches of samples when QC criteria cannot be achieved.

Systematic problems

Specific project issues and procedural issues may require corrective actions. These are handled by laboratory management and the QA department.

The QA Manager will monitor and log the progress of PDRss and will report in the QA Monthly Report the status of major corrective actions taken in the past month. It is the QA Manager's responsibility to see that laboratory problems are documented and solved in a timely manner. This system is outlined in the SOP for Corrective Action Reports - QAS00500.NJ.

10.2 System Audit

A system audit is an inspection and review of the entire data generation and support system of a laboratory. Activities related to the established requirements in the quality assurance program are reviewed for compliance. A typical system audit includes an evaluation of the following:

- Assessment of degree of compliance with the quality assurance program
- Continuing compliance with corrective actions identified in a previous audit of the facility
- Calibration procedures and documentation
- Sample handling procedures including chain-of-custody
- Experience of laboratory personnel
- Existence and routine use of standard operating procedures
- Analytical data review and validation procedures
- Data storage and recordkeeping

A system audit is performed by the on-site quality assurance manager at each facility annually. In addition to the above, a system audit is also conducted by the corporate quality assurance staff at each laboratory annually. The audits are staggered so that each facility is audited semi-annually, either by the local QA manager or the corporate QA staff.

As previously indicated, all system audits are conducted utilizing a comprehensive standardized checklist (IEA Doc.# QAS00300.NET). Copies of the system audits conducted by the QA managers are submitted to the appropriate laboratory director/manager and corporate QA for review.

The auditor will identify any deficiencies in the audit report which is to be generated within a week of the actual audit. The laboratory director/manager is required to respond, in writing, no later than 30 days from issuance of the audit report. The response must address each of the items contained in the audit. If corrective action cannot be taken immediately, the anticipated date of compliance must be presented. If the auditor identifies issues which are significant (in their opinion), a follow-up audit can be conducted prior to the regularly scheduled audit.

A summary of the audit report findings is included in the quality assurance status report provided to management by the corporate quality assurance director.

10.3 Performance Audits

A performance audit is a quantitative check on the accuracy and/or precision of analytical data.

IEA network laboratories participate in a number of contracts and certification programs (see Table 5.4.1). Many of the certification programs employ rigorous performance evaluations which take the form of proficiency samples submitted to the laboratories on a regular basis. The following represents typical examples of routine proficiency programs.

All network laboratories are active participants in EPA Water Pollution (WP) and Water Supply (WS) proficiency programs which issue performance check samples on a semi-annual frequency.

IEA-NJ participates in a number of contracts and certification programs. Many of these programs employ performance evaluations which take the form of proficiency samples submitted to the laboratory on a regular basis.

IEA-NJ also participates in the NYSDOH proficiency testing program for Potable Water, Hazardous Waste and CLP. The lab currently analyzes quarterly organic PE samples from EPA for the CLP program.

In addition to participating in the above performance evaluation programs, the corporate quality assurance staff conducts additional performance evaluation studies.

Periodically, performance evaluation samples are submitted to each laboratory for parameters which are not addressed in other performance evaluation programs (ie. TCLP testing). In this type of testing the laboratory is aware the samples are performance check samples but the "true" concentrations are unknown. The results are submitted to corporate QA for evaluation and a report is issued on the findings. Corrective actions are taken if required, as a result of these test findings.

10.4 Independent Audits

IEA network laboratories are routinely audited by state and federal agencies for compliance with government regulations. In addition, several industrial clients conduct systems and performance audits of the facilities prior to project plan approval.

10.5 Subcontracted Services

IEA network laboratories occasionally choose to send selected analyses to a subcontract laboratory outside of the IEA organization. The most common reason for utilization of a subcontract facility is that the procedure is not routinely performed by an IEA network laboratory and the subcontractor has greater experience in day-to-day execution of the method. In such cases, although an IEA lab could in all likelihood conduct the analysis, it is more cost effective for both IEA and the client to utilize a subcontract lab as necessary. All subcontract laboratories utilized by IEA on a continuing basis require approval of the QA department prior to use. The QA manager is responsible for defining the analytical requirements to be met by the subcontract lab. For instance, the QA manager and the subcontracting lab must agree on the specific quality control to be performed with the samples submitted for analysis. Acceptance limits for items such as method blanks and matrix spiking must be determined.

IEA's clients are notified whenever another IEA laboratory or a subcontract laboratory is to be utilized for any portion of the analytical requirements. Although all analytical data appears in the IEA report, all data produced by another IEA laboratory or a subcontract laboratory is identified. In specific cases, states (ie. New Jersey) may have specialized requirements concerning the reporting of subcontracted analyses. In such cases, the laboratory will comply with the stated requirements. Subcontractors are not utilized when specifically restricted in a client's quality assurance project plan.

APPENDIX, Section 1

PROFESSIONAL PROFILES
OF
KEY PERSONNEL

The following professional profiles are presented alphabetically and represent the key quality assurance and laboratory management personnel for the network organization. Additional professional profiles are available for review during a site visit to any of our laboratory facilities.

PROFESSIONAL PROFILE
Kyle E. Dolbow, Ph.D.

TITLE: Vice President Director of Operations, IEA Officer

ACADEMIC ACCOMPLISHMENTS:

College of Wooster, Wooster, OH	B.A. Chemistry
Massachusetts Institute of Technology, Cambridge, MA	Ph.D. Chemistry

SUMMARY OF EXPERIENCE:

Dr. Dolbow has over sixteen years experience in the areas of mass spectroscopy and gas chromatography. In addition to that, his graduate work involved the construction of a plasma emission spectrometer and its use to determine trace metal concentration in sea water. He was employed by Hewlett Packard as that company's Eastern Region expert in all mass spectral techniques, including negative chemical ionization and liquid chromatography / mass spectrometry, and gas chromatography. In that position he taught courses to personnel from environmental laboratories on all aspects to environmental GC and GC/MS analyses including USEPA Methods. On a consulting basis, he also wrote custom software for environmental laboratories using HP 1000 RTE/6 GC/MS data systems. Since 1986, he has been in the successful start-up and operations of York Laboratories of New Jersey, Inc. and its smooth integration into the IEA, Inc. network of companies in 1990.

PROFESSIONAL EXPERIENCE:

1986 To Present	**IEA, Inc., Whippany, New Jersey**
Position	Director of Operations
1974 to 1986	**Hewlett Packard Company**
Position	Product Specialist/Systems Engineer
1981 to 1984	**Exxon Chemical Company**
Position	Analytical Group Leader
1980 to 1981	**Exxon Chemical Company**
Position	Staff Chemist
1979 to 1980	**Exxon Chemical Company**
Position	Senior Chemist
1976	**College of William and Mary, Williamsburg, VA**
Position	Assistant Professor of Chemistry

PROFESSIONAL PROFILE
Brian Wood

TITLE: Laboratory Manager

ACADEMIC ACCOMPLISHMENTS:

University of Buffalo	B.S. Chemistry
Polytechnic Institute of New York	M.S. Chemistry (Candidate)

SUMMARY OF EXPERIENCE:

Mr. Wood has over nineteen years of experience as a chemist and laboratory manager in analytical and environmental chemistry. He is experienced with EPA, CLP, ASTM, and NIOSH protocols and is proficient with a variety of chromatography, spectroscopy and chemical testing instruments. Mr. Wood has managed chemists and technicians; managed budgets for lab instruments, supplies, and project specific budgets. He has participated in manufacturer's training courses in GC/MS, GC and AA. Also participated in OSHA approved health and safety training.

PROFESSIONAL EXPERIENCE:

1991 - Present **IEA, Inc., Whippany New Jersey**

Position Laboratory Manager

Position Organics Manager

1989 - 1991 **Walter B. Satterthwaite**

Position Director of Chemistry Services

1988 - 1989 **Nanco Environmental Services**

Position Group Manager

1978 - 1988 **Malcolm Pirnie, Inc.**

Position Laboratory Operations Manager

1976 - 1978 **Lawler, Matusky & Skelly Engineers**

Position Chemist

PROFESSIONAL PROFILE
Kevin J. Gorman

TITLE: QA Manager, IEA-New Jersey

ACADEMIC ACCOMPLISHMENTS:

University of Massachusetts, Amherst, MA B.S. Zoology

SUMMARY OF EXPERIENCE:

Mr. Gorman has over twelve years experience as a chemist, developmental manager and consultant in analytical and environmental chemistry. He is experienced with EPA, CLP and SW846 protocols and proficient with a variety of chromatography, spectroscopy and chemical testing instruments. Mr. Gorman has managed chemists and has also managed his own business which provided information on data validation and training. Mr. Gorman has participated in instrument training courses in GC, GC/MS and Data Systems provided by Hewlett Packard. Also participated in various management training courses. Completed several graduate courses in the environmental chemistry field.

PROFESSIONAL EXPERIENCE:

1993 to Present **IEA, Inc. - New Jersey**

Position QA Manager

1990 to 1993 **Laboratory Information & Data Services, Inc.**

Position President

1986 to 1990 **IEA, Inc. - New Jersey**

Position GC/MS Manager/Technical Manager

1984 to 1986 **Industrial Corrosion Management**

Position GC and Organic Extraction Supervisor

PROFESSIONAL PROFILE
Michael A. Stone

TITLE: Field Services Manager, Health & Safety Officer

ACADEMIC ACCOMPLISHMENTS:

Fort Lewis College, Durango, Colorado B.S. Geology

CERTIFICATION:

Mr. Stone currently is certified in New Jersey for Underground Storage Tank Closure and Subsurface Evaluation. In addition, he has completed OSHA-40 Hour Training (29 CFR 1910.120) and 40 Hour Radiation Safety Officer Training

SUMMARY OF EXPERIENCE:

Mr. Stone has over ten years of diversified technical experience focusing on environmental and geotechnical consulting, specializing in the designing soil and groundwater sampling plans, preparing site evaluations including recommendations and designing soil clean up programs with post excavation documentation. In addition, he is involved with all phases of groundwater development including the evaluation of chemical contamination, well logging, drilling supervision and groundwater contour mapping. Mr. Stone acts as a liaison with regulatory agencies such as Division of Hazardous Waste Management, Industrial Site Evaluation Element, Division of Responsible Party Site Remediation, Bureau of Underground Storage Tanks, Division of Water Resources and Bureau of Industrial Discharge Permits

PROFESSIONAL EXPERIENCE:

1991 to Present **IEA, Inc., Whippany, New Jersey**

Position Project Manager/Field Services Group Manager

Position Project Manager

Position Project Geologist

1984 to 1991 **Melick-Tully and Associates, Inc., Somerset, New Jersey**

Position Geologist/Field Technician

1983 to 1984 **NOR-PAC Exploration Services, Inc.**

Position Resident Geologist

PROFESSIONAL PROFILE
Barrett Jody Price

TITLE: Systems Manager

ACADEMIC ACCOMPLISHMENTS:

Boston University — B.A. Archaeology, Anthropology Minor

SUMMARY OF EXPERIENCE:

Mr. Price has over 5 years experience with data base applications from data entry to actual development. Major projects have included development of an automated data handling system for Organics, diskette deliverable program (Agency standard format) for the USEPA, automated sample management using a pre-assigned batch system, installation of UNIX based Oracle development systems and data handling duplication for Wet Chemistry.

PROFESSIONAL EXPERIENCE:

1994 to present — **IEA, Inc., Whippany, New Jersey**

Position — Systems Manager

1990 to 1993 — **IEA, Inc., Whippany, New Jersey**

Position — Programmer/Analyst

PROFESSIONAL PROFILE
Michael J. Gemma

TITLE: Client Service Manager; Senior Project Manager

ACADEMIC ACCOMPLISHMENTS:

William Paterson College of New Jersey BS Geography

SUMMARY OF EXPERIENCE:

Mr. Gemma has over 4 years experience of related experience in the environmental field both in the client services and field services. Mr. Gemma is presently involved with the management of the client service team: Project Management, Sample Control and Bottle Prep Departments. He has been directly involved with all facets of managing projects through the laboratory. Mr. Gemma possesses 40 Hour OSHA Training Certificate, New Jersey UST Certified for Subsurface Evaluation and Immunoassay Field Method Training. He has supervised site reconnaissance to delineate and remediate contaminated soils and has been involved in all facets of UST and fuel spill investigations and installation of monitoring wells.

PROFESSIONAL EXPERIENCE:

1991 to Present	**IEA, Inc., Whippany, New Jersey**
Position	Client Service Manager
Position	Project Manager
Position	Field Services Technician
Position	Sample Control Technician

PROFESSIONAL PROFILE
Mark V. Acierno

TITLE: GC/MS Volatiles Group Leader

ACADEMIC ACCOMPLISHMENTS:

Stockton State College, Pomona, New Jersey B.S. Environmental Studies

SUMMARY OF EXPERIENCE:

Mr. Acierno has over five years experience in Inorganics (classical wet chemistry and metals) and two years experience in Organics (GC/MS Volatiles). He has experience in running and maintaining the following instruments: Perkin Elmer 1310 IR, Perkin Elmer Flame AA, Leeman Lab PS 2000 Mercury Analyzer, Thermal Jerrall Ash ICP 61, Hewlett Packard 5995 (RTE Data System), Hewlett Packard 5972 (Chem Station). Mark has trained and supervised over thirty analysts during his employment at IEA.

PROFESSIONAL EXPERIENCE:

1990 to Present	**IEA, Inc., Whippany New Jersey**
Position	Volatile Organic Group Leader
Position	Metals Group Leader
Position	Volatile Organic Analyst
Position	Inorganics Group Leader
Position	Metals Analyst
Position	Classical Chemist
1987 to 1990	**Natural Sciences and Mathematics Laboratory**
Position	Night Shift Supervisor
Position	Laboratory Assistant
1987 to 1990	**Resident Assistant, Stockton State College**

PROFESSIONAL PROFILE
Suyi Luo

TITLE: GC/MS Semivolatiles Group Leader

ACADEMIC ACCOMPLISHMENTS:

New Jersey Institute of Technology, Newark, NJ	M.S. Environmental Science (Toxicology Option)
South China Institute of Technology, Guangzhou, China	B.S. Applied Chemistry

SUMMARY OF EXPERIENCE:

Ms. Luo has over ten years experience in the areas of gas chromatography, mass spectroscopy and trace organic analysis. She was a research assistant for trace organic analysis in fish and food at NJIT for two years. Since 1988, she has been a GC/MS analyst, and later GC/MS supervisor at IEA/NJ. She has experience in VOA/BNA analysis and data interpretation, new compound testing and method development.

PROFESSIONAL EXPERIENCE:

1988- present **IEA, Inc., Whippany, New Jersey**

Position Semivolatiles (GC/MS) Group Leader

Position Senior GC/MS Analyst

1988 **ICM Laboratories, Randolph, New Jersey**

Position Analyst

1986- 1988 **Air Pollution Research Lab**

Position Assistant Researcher

1981-1986 **South China Institute of Technology**

Position Assistant Researcher

PROFESSIONAL PROFILE
Claus Herrmann

TITLE: GC Group Leader

ACADEMIC ACCOMPLISHMENTS:

East Stroudsburg University, East Stroudsburg, PA B.S. Biology & Environmental Science

SUMMARY OF EXPERIENCE:

Mr. Herrmann has over nine years of experience in organic extractions and over five years as GC analyst. Over the course of twelve years he has had the opportunity to take part in some of the more diverse areas of environmental studies including facility planning, animal population studies and sewage treatment opportunities.

PROFESSIONAL EXPERIENCE:

1990- Present **IEA, Inc., Whippany, New Jersey**

GC Group Leader

1988 - 1990 **York Laboratories, Whippany, New Jersey**

Extractions Group Leader

1986-1988 **Enviro-Lab, Inc.**

Analytical Service Rep.

1982-1986 **East Stroudsburg University**

Internships

1981-1982 **Dyckerhoff and Widmann**

Surveying Engineer's Assistant

PROFESSIONAL PROFILE
Eric Halterman

TITLE: Metals Group Leader

ACADEMIC ACCOMPLISHMENTS:

Richard Stockton State College, Pomona, New Jersey B.S. Marine Biology
Rowan College of New Jersey, Glassboro, New Jersey Matriculated in Chemistry Program

SUMMARY OF EXPERIENCE:

Mr. Halterman has over three years experience in environmental testing. Two years in metals (ICP, GFAA and CVAA); one year in wet chemistry. As metals analyst, Mr. Halterman has used instrumentation as follows: Fisons ARL 3410 ICP, Thermal Jarrell Ash 61E, Perkin Elmer 5100 Graphite Furnace, Spectrophysics Manual Cold Vapor Mercury Analyzer. He also has specialized training in ICP, GFAA, CVAA, Ion Chromatography, Ion Selective Probes and titration analysis. Performs most of the wet chemistry analysis and also does data review. Supervises staff of seven. Mr. Halterman is a member of the American Chemical Society.

PROFESSIONAL EXPERIENCE:

1995 to Present **IEA, Inc. - New Jersey**

Position Metals Group Leader

Position Wet Chemistry Group Leader

1993 to 1995 **American Environmental Network, New Jersey**

Position Wet Chemist/Metals Analyst

1992 **NJ DEP - Fish, Game and Wildlife**

Position Field Technician

PROFESSIONAL PROFILE
Christine Mannino

TITLE: Wet Chemistry Group Leader

ACADEMIC ACCOMPLISHMENTS:

Cook College, Rutgers University, N. Brunswick,NJ B.S. Environmental Science

SUMMARY OF EXPERIENCE:

Ms. Mannino has two years experience as an analyst in the Wet Chemistry department and is currently Group Leader. During her two years, she has performed various, including, but not limited to: cyanide, phenols, residue, TCLP extractions and demand tests on on soils, waters, sludges and samples with complex matrices. Prior to Ms. Mannino becoming group leader, sh had substituted for Group Leader when this person was unavailable. She also has some experience on HPLC analyzing a detergent-type matrix. Ms. Mannino is currently taking Calculus III and Physical Chemistry in order to apply to master's program in Chemistry.

PROFESSIONAL EXPERIENCE:

1993 to Present **IEA, Inc., Whippany, New Jersey**

Position Wet Chemistry Group Leader

Position Wet Chemistry Analyst

1992 to 1993 **Unilever Research, Edgewater, New Jersey**

Position Research Chemist

PROFESSIONAL PROFILE
John P. Doeffinger

TITLE: Sample Control Group Leader

ACADEMIC ACCOMPLISHMENTS:

Bloomfield College, Bloomfield, NJ B.S. Biology

SUMMARY OF EXPERIENCE:

Mr. Doeffinger presently supervises two sample control technicians and three drivers. Supervises and schedules sample pickups and bottle preparations. Also performs percent solids and pH determinations. He is directly responsable for the timeliness of the sample log-in procedure as well as the generation of laboratory work lists and is responsible for the notification to the lab staff of all rush work and short holding time tests. Mr. Doeffinger is responsible for the storage of samples while project is in progress through the disposition of samples with hazardous waste disposal company. As organics extractions group leader, Mr. Doeffinger supervised up to seven technicians on two shifts. Over his five years in this department, Mr. Doeffinger has experience in extracting semivolatiles, PCBs, pesticides and herbicides in a variety of matrices. Mr. Doeffinger has completed the OSHA 40 Training and Management Training courses. He is also assistant health and safety officer at IEA/NJ.

PROFESSIONAL EXPERIENCE:

1990- Present **IEA, Inc., Whippany, New Jersey**

Sample Control Group Leader

Organic Extraction Group Leader

1989-1990 **York Laboratories, Whippany, New Jersey**

Organic Extraction Team Leader

Organic Extraction Analyst

PROFESSIONAL PROFILE
Heidi Lucas Terwilliger

TITLE: Reports Production Supervisor

ACADEMIC ACCOMPLISHMENTS:

The Pennsylvania State University, University Park, PA B.S. Mechanical Engineering

SUMMARY OF EXPERIENCE:

Ms. Terwilliger has over five years experience in the Reports Production Department. She is responsible for reviewing, compiling and correcting data packages into final deliverables formats such as CLP, NYSDEC ASP, NJ Regulatory/Reduced and many client specific deliverables. Ms. Terwilliger has completed DMR and Laboratory QC Forms for regulatory agencies. As a supervisor of three, she is responsible for logging data into the system from the laboratory and scheduling of outgoing reports. She handles tracking of final reports throughout the laboratory as well as archiving of completed data packages.

CONTINUING PROFESSIONAL DEVELOPMENT:

Ms. Terwilliger has participated in Zenger Miller - Frontline Leadership Training and Skill Path, Inc. Management Skills for New Supervisors training programs. She has also taken part in Safety Training, Project Management and general laboratory training in Spectral Interpretation, Spectroscopy A, Hexavalent Chromium, Cyanide, Sulfides, Mercury, ICP, AA, pH, Solids, PHCs and Phenols.

PROFESSIONAL EXPERIENCE:

1991 to Present **IEA, Inc. - New Jersey**

Position Reports Production Supervisor

Position Reports Production Team Leader

Position Reports Production Technician

PROFESSIONAL PROFILE
Grace Chang

TITLE: Project Manager

ACADEMIC ACCOMPLISHMENTS:

University of the West Indes, Jamaica B.S. Chemistry

SUMMARY OF EXPERIENCE:

Ms. Chang has over five years experience as Project Manager. In this capacity, she serves as liaison between clients and the laboratory. Ms. Chang manages projects from the initial bottle order to the completion of the data package. She is direct communication with bottle preparation and sample control departments ensuring that bottle orders and samples are logged in correctly. Ms. Chang also has experience as a data reviewer and in report production. Ms. Chang was Group Leader of the Reports Production department and has experience compiling data packages of various types. In addition, she maintained direct contact between project managers and analytical groups to ensure completeness and accuracy of reports. Ms. Chang has participated in training courses such as Selling Environmental Laboratory Services, Statistical and Management Tools of Quality Control, Supervision and control and Time Management.

PROFESSIONAL EXPERIENCE:

1991 to Present **IEA, Inc., Whippany, New Jersey**

Position Project Manager

Position Reports Production Group Leader

1989 to 1991 **United States Testing Company, Hoboken, New Jersey**

Position Metals Data Reviewer

1981 to 1988 **Jamaica Bureau of Standards**

Position Scientific Standards Officer III

PROFESSIONAL PROFILE
Leslie Clarke

TITLE: Senior Project Manager

ACADEMIC ACCOMPLISHMENTS:

Cornell University	B.S. Biology
Adelphi University	Litigation Certificate

SUMMARY OF EXPERIENCE:

Ms. Clarke currently serves as the Senior Project Manager with project assignments of technical difficulty and/or high profile. She is the direct liaison between the client and laboratory with involvement in quoting, bottle order requests and technical issues. In the past, Ms. Clarke has directed the Quality Assurance Group and managed USEPA Superfund sites involving a number of Fortune 500 companies and managed the analytical contract with NJDEP. Involvement also included development of site specific and quality assurance project plans as well as a quality assurance role for the marketing department. Ms. Clarke has also had direct experience as an analyst. Ms. Clarke has had formal training in GC/MS, ACS Seedpak1 and Total Quality Management.

PROFESSIONAL EXPERIENCE:

1995 to Present **IEA, Inc., Whippany, New Jersey**

Position Senior Project Manager

1987 to 1995 **PACE, Inc., Edison, New Jersey (Formally ETC Corp. prior to 8/3/94**

Position Technical Project Manager

Position Quality Assurance Manager

Position Project Manager

1985 to 1987 **Nytest, Port Washington, Long Island, NY**

Position Assistant Supervisor

Position Analyst

PROFESSIONAL PROFILE
Leanne Schlobach

TITLE: Project Manager

ACADEMIC ACCOMPLISHMENTS:

Trenton State College B.S. Biology, in progress

SUMMARY OF EXPERIENCE:

Ms. Schlobach has several years experience in the project management of a variety of accounts - from Fortune 500 industrial accounts such as major chemical companies, pharmeceuticals and refineries to nationally known consulting firms. She has successfully managed multi-faceted, complex programs spanning several years duration, at times working with several consultants on the same program. Her involvement in each program is from the set-up of initial bottle order to the completion of the data package. She is in direct communication with bottle prep, sample control and various lab group leaders ensuring that the o verall program runs smoothly through the laboratory. In her role as Group Leader / Sample Control, Ms. Schlobach's responsiblities included sample receipt, log-in, the generation of laboratory work lists, notification to the lab staff of all rush work and short holding time tests and proper sample storage.

CONTINUING PROFESSIONAL DEVELOPMENT:

Ms. Schlobach has taken several IEA sponsered courses in Sales Training. In addition, she has also taken part in Safety 4Training, Project Management Training and a six week training course in Mass Spectral Interpretation.

PROFESSIONAL EXPERIENCE:

1991 to Present **IEA, Inc., Whippany, New Jersey**

Position Project Manager

Position Group Leader - Sample Control

Position Sample Control Technician

PROFESSIONAL PROFILE
Tanja Hageman

TITLE: Systems Analyst I

ACADEMIC ACCOMPLISHMENTS:

Rutgers University, N. Brunswick,NJ B.A. History

SUMMARY OF EXPERIENCE:

Ms. Hageman has three years experience inthe environmental industry preparing regulatory documents, including RCRA Facility Investigation Work Plans, Closure Plans and Regulatory Compliance documents. Ms. Hageman has one year of field experience in refinery situation; almost two years of experience using GIS/Key software.

PROFESSIONAL EXPERIENCE:

1996 to Present **IEA, Inc., Whippany, New Jersey**

Position Systems Analyst

1994 to 1995 **ES&E, Inc. Edison, New Jersey**

Position Technician

1993 to 1994 **Chevron USA Products Company, Perth Amboy, New Jersey**

Position Project Assistant

1991 to 1992 **Chevron USA Products Company, Perth Amboy, New Jersey**

Position Project Assistant

APPENDIX, Section 2

IEA CHAIN-OF-CUSTODY FORM

IEA OF NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428-8181

CHAIN CUSTODY

FIELD BOOK: _____ Pg ____ of ____

(1) Client:

(2) Project Name/no.:

(3) Client Contact:

(4) IEA Contact:

(5) TAT: 1wk, 2wk, 3wk, OTHER _____

(6) Proj. Type: NJPDES, NPDES, ISRA, CLP, CERCLA, RCRA, UST, ACO, MOA, OTHER _____

(7) Protocol: CLP, SW846, EPA 600, DW, OTHER _____

(8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other _____

(14) Bill To

PO#

(15) ANALYSIS REQUIRED

For Lab Use Only

LABID

Job No.
Quote No.
# of Coolers:
Cooler Temp. (s)
Custody Seal # (s)
Date Due:

*PM NON-CONFORMANCE

Preserved: Temp:
Container: Volume:
Broken: Initials:
Holding Time:
Other:

Logged By:

(9) Client ID (10 CHAR) (10) Date (11) Time (12) Mtx

(13) # OF CONTAINERS

DESCRIPTION

(16) COMMENTS: **(Please include hazards on site.)**

(17)

	Print Name and Company	Signature	Custody Seal # (s)	Date/Time
Sampled By:				/
Received By:				/
Relinquished By:				/
Received By:				/
Relinquished By:				/
Received By:				/

Mtx = Matrix of Sample. (AI=Air, AQ=Aqueous, LE=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SE=Sediment, SL=Sludge, SO=Soil)

(Copies: White and yellow copies should accompany samples to IEA. The pink copy should be retained by the client.) See reverse for directions.

APPENDIX, Section 3

IEA NETWORK SAMPLE PRESERVATION
AND
HOLDING TIME REQUIREMENTS

Metals in Water					
Parameter[3]	Technique	Method	Holding Time	Container	Preservation
Aluminum	flame	202.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	202.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7020	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Antimony	flame	204.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	204.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7040	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7041	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Arsenic	furnace	206.2	6 Months	500 ml P,G	HNO3 to pH<2
	AA, hydride	206.3	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	AA, hydride	7061	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7060	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Barium	flame	208.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	208.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7080	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7081	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Beryllium	flame	210.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	210.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7090	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7091	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Boron	colorimetric	212.3	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2

Metals in Water-Continued...					
Parameter [5]	Technique	Method	Holding Time	Container	Preservation
Cadmium	flame	213.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	213.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7130	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7131	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Calcium	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	215.1	6 Months	500 ml P,G	HNO3 to pH<2
	titrimetric	215.2	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7140	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Chromium	flame	218.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	218.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7190	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7191	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Chromium Hexavalent	Coprecipitation	7195	24 Hours	500 ml P,G	Cool, 4 C.
	colorimetric	7196	24 Hours	500 ml P,G	Cool, 4 C.
	flame	7197	24 Hours	500 ml P,G	Cool, 4 C.
	DPP	7198	24 Hours	500 ml P,G	Cool, 4 C.
Cobalt	flame	219.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	219.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7200	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7201	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2

Metals in Water-Continued...					
Parameter [5]	Technique	Method	Holding Time	Container	Preservation
Copper	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7210	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7211	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Iron	flame	236.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	236.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7380	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7381	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Lead	flame	239.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	239.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7420	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7421	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Magnesium	flame	242.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	239.2	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7450	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7421	6 Months	500 ml P,G	HNO3 to pH<2
Manganese	flame	243.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	243.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7460	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7461	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Mercury	cold vapor-manual	245.1	28 Days	500 ml P,G	HNO3 to pH<2
	cold vapor-automated	245.2	28 Days	500 ml P,G	HNO3 to pH<2
	cold vapor-manual	7470	28 Days	500 ml P,G	HNO3 to pH<2

Metals in Water-Continued...					
Parameter [1]	Technique	Method	Holding Time	Container	Preservation
Molybdenum	flame	246.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	246.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7480	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7481	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Nickel	flame	249.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	249.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7520	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7521	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Potassium	flame	258.1	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7610	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Selenium	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	270.2	6 Months	500 ml P,G	HNO3 to pH<2
	AA, hydride	270.3	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7740	6 Months	500 ml P,G	HNO3 to pH<2
	AA, hydride	7741	6 Months	500 ml P,G	HNO3 to pH<2
Silica	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
Silver	flame	272.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	272.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7760	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7761	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2

Metals in Water-Continued...					
Parameter [5]	Technique	Method	Holding Time	Container	Preservation
Sodium	flame	273.1	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7770	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Thallium	flame	279.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	279.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7840	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7841	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Tin	flame	282.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	282.2	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7870	6 Months	500 ml P,G	HNO3 to pH<2
Titanium	flame	283.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	283.2	6 Months	500 ml P,G	HNO3 to pH<2
Vanadium	flame	286.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	286.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7910	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7911	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2
Zinc	flame	289.1	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	289.2	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	200.7	6 Months	500 ml P,G	HNO3 to pH<2
	flame	7950	6 Months	500 ml P,G	HNO3 to pH<2
	furnace	7951	6 Months	500 ml P,G	HNO3 to pH<2
	ICP	6010	6 Months	500 ml P,G	HNO3 to pH<2

Wet Chemistries in Water					
Parameter [3]	Technique	Method	Holding Time	Container	Preservation
Acidity	titrimetric	305.1	14 Days	100 ml P,G	Cool 4 C.
Alkalinity	titrimetric	310.1	14 Days	100 ml P,G	Cool 4 C.
Biochemical Oxygen Demand (BOD)	5 days, 20 C.	405.1	48 Hours	1000 ml P,G	Cool 4 C.
Bromide	titrimetric	320.1	28 Days	100 ml P,G	none required
Chemical Oxygen Demand (COD)	titrimetric, mid-level	410.1	28 Days	50 ml P,G	Cool 4 C, H2SO4 to pH <2
	titrimetric, low-level	410.2	28 Days	50 ml P,G	Cool 4 C, H2SO4 to pH <2
	titrimetric, high-level	410.3	28 Days	50 ml P,G	Cool 4 C, H2SO4 to pH <2
	automated-colorimetric	410.4	28 Days	50 ml P,G	Cool 4 C, H2SO4 to pH <2
Chloride	colorimetric	325.2	28 Days	50 ml P,G	none required
	colorimetric	9250	28 Days	50 ml P,G	none required
	titrimetric	9252	28 Days	50 ml P,G	none required
	colorimetric	9257	28 Days	50 ml P,G	none required
Cyanide	amenable to chlorine	335.1	14 Days [2]	500 ml P,G	Cool 4 C, NaOH to pH > 12 Ascorbic Acid [1]
	spectrophotometric	335.2	14 Days [2]	500 ml P,G	Cool 4 C, NaOH to pH > 12 Ascorbic Acid [1]
	Total, UV	335.3	14 Days [2]	500 ml P,G	Cool 4 C, NaOH to pH > 12 Ascorbic Acid [1]
	colorimetric	9012	14 Days [2]	500 ml P,G	Cool 4 C, NaOH to pH > 12 Ascorbic Acid [1]
Fluoride	distillation	340.1	28 Days	500 ml P,G	none required
	ion selective electrode	340.2	28 Days	500 ml P,G	none required
	colorimetric	340.3	28 Days	500 ml P,G	none required
Hardness, Total	colorimetric	130.1	6 Months	100 ml P,G	HNO3 to pH <2
	titrimetric	130.2	6 Months	100 ml P,G	HNO3 to pH <2
Iodide	titrimetric	345.1	24 Days	100 ml P,G	Cool 4 C.
Methylene Blue Active Substances	colorimetric	425.1	48 Hours	500 ml P,G	Cool 4 C.
Nitrogen Ammonia	colorimetric,phenate	350.1	28 Days	500 ml P,G	Cool 4 C, H2SO4 to pH <2
	distillation	350.2	28 Days	500 ml P,G	Cool 4 C, H2SO4 to pH <2
	ion selective electrode	350.3	28 Days	500 ml P,G	Cool 4 C, H2SO4 to pH <2

Wet Chemistries in Water-Continued...					
Parameter [5]	Technique	Method	Holding Time	Container	Preservation
Nitrogen-TKN	colorimetric,phenate	351.1	28 Days	500 ml P,G	Cool 4 C, H2SO4 to pH <2
	block digestor	351.2	28 Days	500 ml P,G	Cool 4 C, H2SO4 to pH <2
	colorimetric	351.3	28 Days	500 ml P,G	Cool 4 C, H2SO4 to pH <2
	ion selective electrode	351.4	28 Days	500 ml P,G	Cool 4 C, H2SO4 to pH <2
Nitrate	colorimetric, brucine	352.1	48 Hours	100 ml P,G	Cool 4 C.
	colorimetric, brucine	9200	48 Hours	100 ml P,G	Cool 4 C.
Nitrate-Nitrite	colorimetric, hydrazine	353.1	28 Days	100 ml P,G	Cool 4 C, H2SO4 to pH <2
	cadmium reduction, auto	353.2	28 Days	100 ml P,G	Cool 4 C, H2SO4 to pH <2
	cadmium reduction, manual	353.3	28 Days	100 ml P,G	Cool 4 C, H2SO4 to pH <2
Nitrite	spectrophotometric	354.1	48 Hours	100 ml P,G	Cool 4 C.
Oil & Grease, Total	gravimetric	413.1	28 Days	1000 ml G only	Cool 4 C, HCL or H2SO4 to pH <2
	IR	413.2	28 Days	1000 ml G only	Cool 4 C, HCL or H2SO4 to pH <2
	gravimetric	9070	28 Days	1000 ml G only	Cool 4 C, HCL or H2SO4 to pH <2
	gravimetric-sludge	9071	28 Days	1000 ml G only	Cool 4 C, HCL or H2SO4 to pH <2
Petroleum Hydrocarbons	IR	418.1	14 Days	1000 ml G only	Cool 4 C, HCL to pH <2
pH	electrode	150.1	in-field	50 ml P,G	not applicable
	electrode	9040	in-field	50 ml P,G	not applicable
	test paper	9041	in-field	50 ml P,G	not applicable
Phenolics, T-Recoverable	spectrophotometric	420.1	28 Days	500 ml G only	Cool 4 C, H2SO4 to pH <2
	colorimetric	420.2	28 Days	500 ml G only	Cool 4 C, H2SO4 to pH <2
	4AAP, Manual, Distillation	9065	28 Days	500 ml G only	Cool 4 C, H2SO4 to pH <2
	4AAP, Auto, Distillation	9066	28 Days	500 ml G only	Cool 4 C, H2SO4 to pH <2
	MBTH, Distillation	9067	28 Days	500 ml G only	Cool 4 C, H2SO4 to pH <2
Phosphorus, Ortho	colorimetric, auto	365.1	48 Hours	50 ml P,G	Filter immediately, Cool 4 C
	colorimetric, single	365.2	48 Hours	50 ml P,G	Filter immediately, Cool 4 C
	colorimetric-dual	365.3	48 Hours	50 ml P,G	Filter immediately, Cool 4 C
	total, auto, block digester	365.4	48 Hours	50 ml P,G	Filter immediately, Cool 4 C

Wet Chemistries in Water-Continued...					
Parameter [3]	Technique	Method	Holding Time	Container	Preservation
Phosphorus, Total	colorimetric, auto	365.1	28 Days	50 ml P,G	Cool 4 C, H2SO4 to pH <2
	colorimetric, single	365.2	48 Hours	50 ml P,G	Cool 4 C, H2SO4 to pH <2
	colorimetric-dual	365.3	48 Hours	50 ml P,G	Cool 4 C, H2SO4 to pH <2
	total, auto, block digester	365.4	48 Hours	50 ml P,G	Cool 4 C, H2SO4 to pH <2
Residue (Solids)	filterable (TDS)	160.1	7 Days	100 ml P,G	Cool 4 C.
	non-filterable (TSS)	160.2	7 Days	100 ml P,G	Cool 4 C.
	total (TS)	160.3	7 Days	100 ml P,G	Cool 4 C.
	volatile	160.4	7 Days	100 ml P,G	Cool 4 C.
	settleable	160.5	48 Hours	100 ml P,G	Cool 4 C.
Specific Conductance	meter	120.1	28 Days	100 ml P,G	Cool 4 C.
	meter	9050	28 Days	100 ml P,G	Cool 4 C.
Sulfate	ion chromatography	300.0	28 Days	50 ml P,G	Cool 4 C.
	colorimetric	375.1	28 Days	50 ml P,G	Cool 4 C.
	gravimetric	375.3	28 Days	50 ml P,G	Cool 4 C.
	turbidimetric	375.4	28 Days	50 ml P,G	Cool 4 C.
	colorimetric	9035	28 Days	50 ml P,G	Cool 4 C.
	colorimetric	9036	28 Days	50 ml P,G	Cool 4 C.
	turbidimetric	9038	28 Days	50 ml P,G	Cool 4 C.
Sulfide	titrimetric	376.1	7 Days	500 ml P,G	Cool 4 C, ZnAc/NaOH to pH>9
	colorimetric	376.2	7 Days	500 ml P,G	Cool 4 C, ZnAc/NaOH to pH>9
	colorimetric	9030	7 Days	500 ml P,G	Cool 4 C, ZnAc/NaOH to pH>9
Total Organic Carbon (TOC)	combustion or oxidation	415.1	28 Days	50 ml P,G	Cool 4 C, HCL or H2SO4 to pH <2
	combustion or oxidation	9060	28 Days	50 ml P,G	Cool 4 C, HCL or H2SO4 to pH <2
Total Organic Halides (TOX)	titrimetric	9020	28 Days	1000 ml G only [4] No Headspace	Cool 4 C, H2SO4 to pH <2 [5] Sodium Sulfite
Turbidity	nephelometric	180.1	48 Hours	100 ml P,G	Cool 4 C

Parameters by Gas Chromatography in Water					
Parameter [5]	Technique	Method	Holding Time	Container	Preservation
Halogenated Volatile Organics	gas chromatography	601	14 Days	3x40 ml vials	Cool 4 C.,Thiosulfate [6]
	gas chromatography	8010	14 Days	3x40 ml vials	Cool 4 C.,Thiosulfate [6]
Non-Halogenated Volatile Organics	gas chromatography	8015	14 Days	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
Purgeable Aromatics	gas chromatography	602	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
	gas chromatography	8020	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
Acrolein & Acrylonitrile	gas chromatography	603	14 Days	3x40 ml vials	Cool 4 C., HCL to pH 5, Thiosulfate [6]
	gas chromatography	8030	14 Days	3x40 ml vials	Cool 4 C., HCL to pH 5, Thiosulfate [6]
Phenols	gas chromatography	604	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	gas chromatography	8040	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
Phthalate Esters	gas chromatography	606	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	gas chromatography	8060	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
Nitrosamines	gas chromatography	607	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
Organochlorine Pesticides and PCB's	gas chromatography	608	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	gas chromatography	8080	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
Polynuclear Aromatic Hydrocarbons (PNA's)	gas chromatography/LC	610	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	gas chromatography	8100	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	HPLC	8310	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]

Parameters by Gas Chromatography in Water-Continued...					
Parameter [5]	Technique	Method	Holding Time	Container	Preservation
Haloethers	gas chromatography	611	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
Chlorinated Hydrocarbons	gas chromatography	612	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	gas chromatography	8120	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
Organophosphorus Pesticides	gas chromatography	8140	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
Chlorinated Herbicides	gas chromatography	8150	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]

Parameters by GC/MS in Water					
Parameter [3]	Technique	Method	Holding Time	Container	Preservation
Purgeables	GC/MS-624 list	624	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
	Priority Pollutant list	624	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
	Hazardous Substance list	624	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
	Target Compound list (TCL)	624	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
	Appendix IX list	624	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
	Priority Pollutant list	8240	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
	Hazardous Substance list	8240	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
	Target Compound list (TCL)	8240	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]
	Appendix IX list	8240	7/14 Days [7]	3x40 ml vials	Cool 4 C., HCL to pH<2, Thiosulfate [6]

Parameters by GC/MS in Water					
Parameter [3]	Technique	Method	Holding Time	Container	Preservation
Base-Neutral & Acid Extractables	625 list	625	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Priority Pollutant list	625	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Hazardous Substance list	625	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Target Compound list (TCL)	625	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Appendix IX list	625	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Priority Pollutant list	8250	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Hazardous Substance list	8250	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Target Compound list (TCL)	8250	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Appendix IX list	8250	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Priority Pollutant list	8270	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Hazardous Substance list	8270	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Target Compound list (TCL)	8270	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]
	Appendix IX list	8270	ext.-7 Days anal.-40 Days	1 L, Amber G	Cool 4 C.,Thiosulfate [6]

Metals in Soil					
Parameter [3]	Technique	Method	Holding Time	Container	Preservation
Aluminum	flame	7020	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Antimony	flame	7040	6 Months	100 g P,G	Cool 4 C.
	furnace	7041	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Arsenic	ICP	6010	6 Months	100 g P,G	Cool 4 C.
	furnace	7060	6 Months	100 g P,G	Cool 4 C.
	AA, hydride	7061	6 Months	100 g P,G	Cool 4 C.
Barium	flame	7080	6 Months	100 g P,G	Cool 4 C.
	furnace	7081	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Beryllium	flame	7090	6 Months	100 g P,G	Cool 4 C.
	furnace	7091	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Boron	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Cadmium	flame	7130	6 Months	100 g P,G	Cool 4 C.
	furnace	7131	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Calcium	flame	7140	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Chromium	flame	7190	6 Months	100 g P,G	Cool 4 C.
	furnace	7191	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.

Metals in Soil-Continued...					
Parameter [3]	Technique	Method	Holding Time	Container	Preservation
Cobalt	flame	7200	6 Months	100 g P,G	Cool 4 C.
	furnace	7201	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Copper	flame	7210	6 Months	100 g P,G	Cool 4 C.
	furnace	7211	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Iron	flame	7380	6 Months	100 g P,G	Cool 4 C.
	furnace	7381	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Lead	flame	7420	6 Months	100 g P,G	Cool 4 C.
	furnace	7421	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Magnesium	flame	7450	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Manganese	flame	7460	6 Months	100 g P,G	Cool 4 C.
	furnace	7461	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Mercury	cold vapor-manual	7470	28 Days	100 g P,G	Cool 4 C.
	cold vapor-manual	7471	28 Days	100 g P,G	Cool 4 C.
Molybdenum	flame	7480	6 Months	100 g P,G	Cool 4 C.
	furnace	7481	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Nickel	flame	7520	6 Months	100 g P,G	Cool 4 C.
	furnace	7521	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Potassium	flame	7610	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Selenium	ICP	6010	6 Months	100 g P,G	Cool 4 C.
	furnace	7740	6 Months	100 g P,G	Cool 4 C.
	AA, hydride	7741	6 Months	100 g P,G	Cool 4 C.

Metals in Soil-Continued...					
Parameter [3]	Technique	Method	Holding Time	Container	Preservation
Silver	flame	7760	6 Months	100 g P,G	Cool 4 C.
	furnace	7761	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Sodium	flame	7770	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Thallium	flame	7840	6 Months	100 g P,G	Cool 4 C.
	furnace	7841	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Tin	flame	7870	6 Months	100 g P,G	Cool 4 C.
Vanadium	flame	7910	6 Months	100 g P,G	Cool 4 C.
	furnace	7911	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.
Zinc	flame	7950	6 Months	100 g P,G	Cool 4 C.
	furnace	7951	6 Months	100 g P,G	Cool 4 C.
	ICP	6010	6 Months	100 g P,G	Cool 4 C.

Wet Chemistries in Soil					
Parameter [1]	Technique	Method	Holding Time	Container	Preservation
Cyanide	spectrophotometric	9010	14 Days	100 g P,G	Cool 4 C.
	colorimetric	9012	14 Days	100 g P,G	Cool 4 C.
Sulfate	colorimetric	9035	28 Days	100 g P,G	Cool 4 C.
	colorimetric	9036	28 Days	100 g P,G	Cool 4 C.
	turbidimetric	9038	28 Days	100 g P,G	Cool 4 C.
Sulfide	colorimetric	9030	-	100 g P,G	Cool 4 C.

Parameters by Gas Chromatography in Soil					
Parameter [3]	Technique	Method	Holding Time	Container	Preservation
Halogenated Volatile Organics	gas chromatography	8010	14 Days	3x40 ml vials[6]	Cool 4 C.
Non-Halogenated Volatile Organics	gas chromatography	8015	14 Days	3x40 ml vials[6]	Cool 4 C.
Purgeable Aromatics	gas chromatography	8020	14 Days	3x40 ml vials[6]	Cool 4 C.
Acrolein & Acrylonitrile	gas chromatography	8030	14 Days	3x40 ml vials[6]	Cool 4 C.
Phenols	gas chromatography	8040	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.
Phthalate Esters	gas chromatography	8060	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.
Nitrosamines	gas chromatography	8070	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.
Organochlorine Pesticides and PCB's	gas chromatography	8080	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.
Polynuclear Aromatic Hydrocarbons (PNA's)	gas chromatography	8100	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.
	HPLC	8310	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.
Chlorinated Hydrocarbons	gas chromatography	8120	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.
Organophosphorus Pesticides	gas chromatography	8140	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.
Chlorinated Herbicides	gas chromatography	8150	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.

Parameters by GC/MS in Soil					
Parameter [3]	Technique	Method	Holding Time	Container	Preservation
Volatile organics	packed column	8240	14 Days	3x40 ml vials[6]	Cool 4 C.
	capillary column	8260	14 Days	3x40 ml vials[6]	Cool 4 C.
Base-Neutral & Acid Extractables	semi-vol packed	8250	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.
	semi-vol capillary	8270	ext.-14 Days anal.-40 Days	100 g ,G	Cool 4 C.

Footnotes

[1] If residual chlorine is present in the sample, 0.6 g of ascorbic acid is utilized. Ascorbic acid is only used if residual chlorine is present.

[2] Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

[3] The following information is based upon EPA requirements as outlined in Table II, Part 136, Title 40 of the Code of Federal Regulations, July 1991. This reference should be consulted if further clarification is desired. Various state agencies have differing requirements for both holding times and preservation from those listed above. In such cases, the local requirements supercede the EPA information.

[4] All samples should be collected in bottles with teflon septa and be protected from light. If this is not possible, use 250 ml bottles fitted with teflon lined caps. Samples should contain no headspace.

[5] If samples contain residual chlorine, it must be removed in the field by adding sulfite to the sample bottle (5 mg sodium sulfite crystals per liter of sample).

[6] If samples contain residual chlorine, 0.008% sodium thiosulfate must be added at the time of sampling and should only be used if residual chlorine is present.

[7] If samples do not receive pH adjustment, the holding time is 7 days. With pH adjustment, the holding time is 14 days.

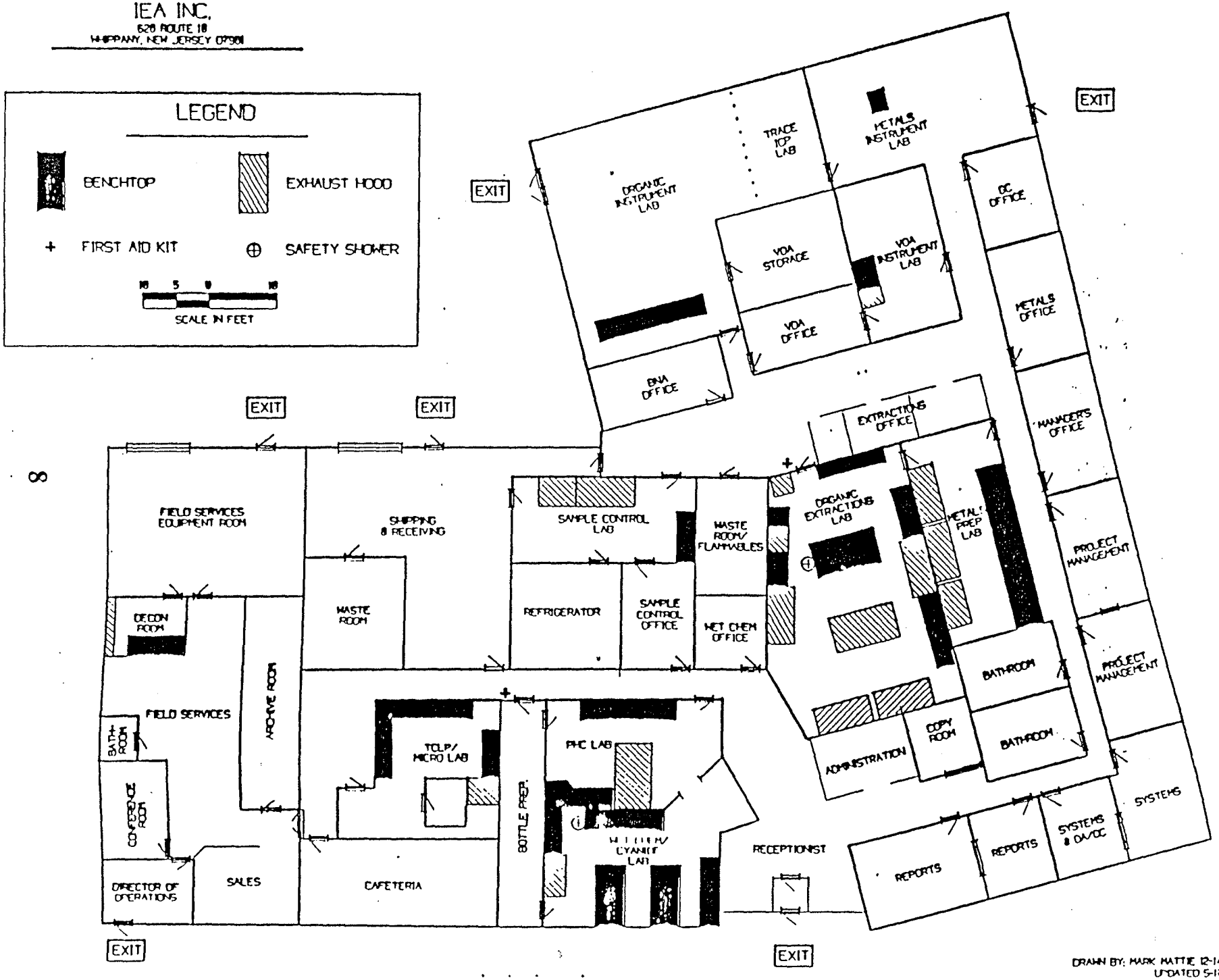
[8] Alternatively, wide mouth glass jars designed for volatile samples may be utilized with teflon lined caps.

APPENDIX, Section 4

LABORATORY FLOOR PLAN

FLOOR PL .N

IEA INC.
628 ROUTE 18
HAMPPANY, NEW JERSEY 07901

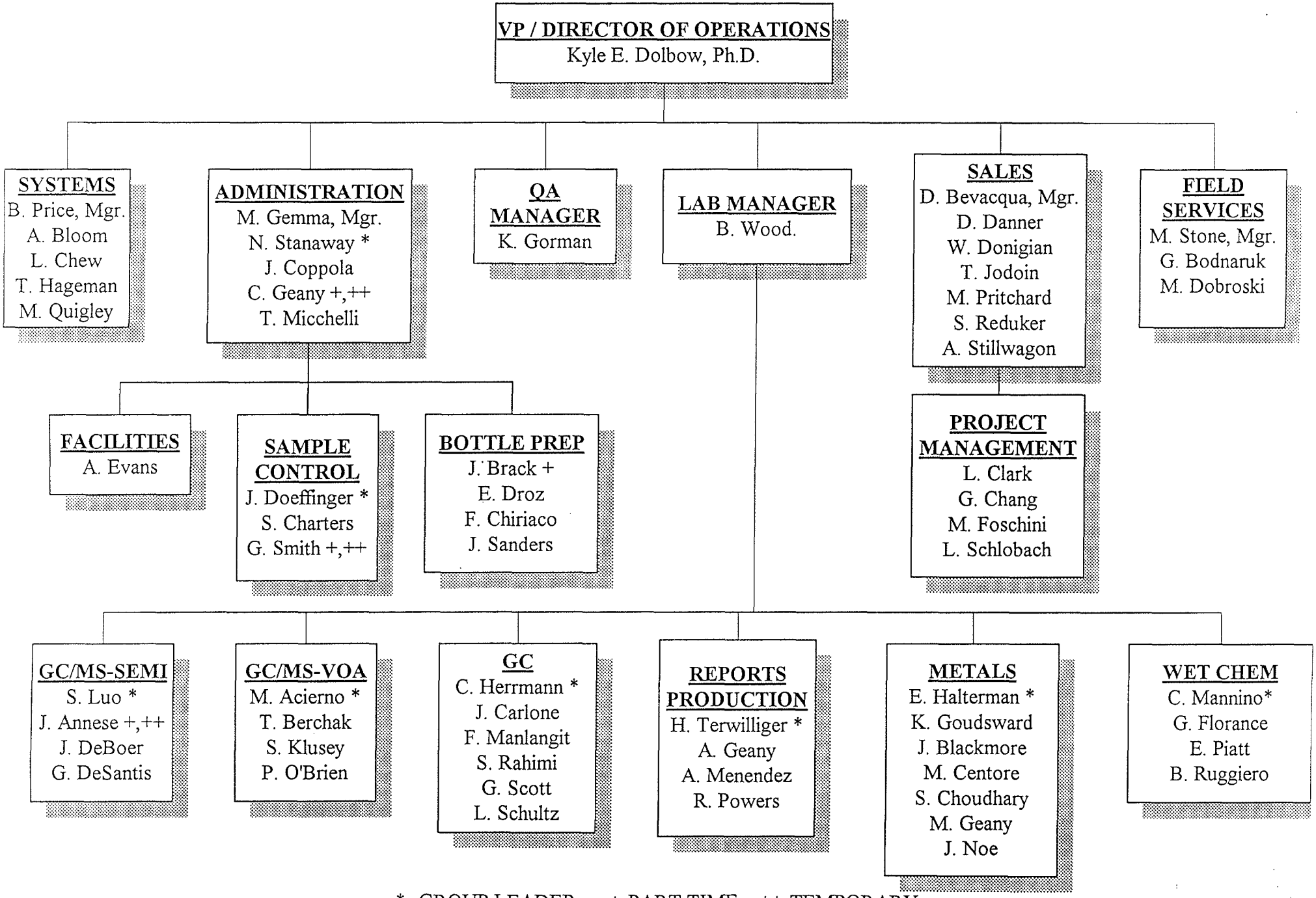


APPENDIX, Section 5

ORGANIZATIONAL CHART

IEA NJ ORGANIZ .TIONAL CHART

April 3, 1996



*- GROUP LEADER +-PART TIME ++-TEMPORARY

APPENDIX, Section 6

CORRECTIVE ACTION FORM

Reported By:_____
Date:_____ Time:_____
Group Leader:_____

PROBLEM DOCUMENTATION REPORT

Category of Problem:_____

Client:_____ Job/Case:_____ Sample Number(s):_____

Description of Problem:

_____

_____

_____

_____

_____

Recommendation:

_____

_____

Corrective Action Taken:

_____

_____

_____

_____

Is this a recurring problem? YES/NO
Should SOP be modified or updated? YES/NO
Note problem and corrective action in job Narrative? YES/NO

Response required from:_____
Response required no later than:_____

Distribution: Mandatory: **Lab President Lab Director QA Officer Org Mgr**
Additional/Other:_____

Signature of Respondent:_____ Date:_____ Time:___

Date response distributed to those circled above:_____

APPENDIX, Section 7

EXAMPLE LISTING OF LABORATORY

STANDARD OPERATING PROCEDURES (SOPs)

SUMMARY OF IEA/NJ STANDARD OPERATING PROCEDURES

TITLE	SOP DOCUMENT
Qualtiy Assurance Plan	QAP00100.NJ
Chain of Custody	QAS00100.NJ
SOP	QAS00200.NJ
Data Validation	QAS00300.NJ
Ethic Policy	QAS00400.NJ
Problem Documentation	QAS00500.NJ
Report Production	QAS00600.NJ
Documenting Form DC-2	QAS00700.NJ
Organization of CSF (CLP Protocol)	QAS00800.NJ
Sample Security	QAS00900.NJ
Sample Tracking	QAS01000.NJ
Traceability and Assay Studies	QAS01100.NJ
Error Correction	QAS01200.NJ
Maintaining Laboratory Notebooks	QAS01201.NET
Data Deliverables	QAS01300.NJ
Ethical Practices in the Laboratory	QAS01500.NJ
Periodic Review and Audit	QAS01600.NJ
Employee Training	QAS01601.NET
Telephone Log	QAS01800.NJ
Monitoring Fume Hoods	QAS01900.NJ
Work Exchange between Network Labs	QAS01900.NET
Control Charts	QAS02000.NJ
QA Reports to Management	QAS02100.NJ
Significant Figures/Rounding	QAS02100.NET
Balance Calibration	QAS02200.NJ
Conducting Electronic File Transfers to & From Corp. QA	QAS02200.NET
Glassware Cleaning	QAS02300.NJ
QAP Approval	QAS02400.NJ
Waste Handling	GES00100.NJ
Document Control	GES00200.NJ
Arming/Disarming Alarm System	GES00300.NJ
Calibration of Field Meters	FSS00100.NJ
GC/MS Data Reduction	SYS00100.NJ
GC Data Reduction	SYS00200.NJ
Data Management & Handling	SYS00300.NJ

SUMMARY OF IEA/NJ STANDARD OPERATING PROCEDURES, Con't

TITLE	SOP DOCUMENT
% Solids	SMS00100.NJ
CLP Sample Receipt	SMS00200.NJ
Bottle Prep/Shipment	SMS00300.NJ
Sample Receipt/Sample Control	SMS00400.NJ
pH in Water by 150.1	CVS00100.NJ
Total Dissolved Solids by 160.1	CVS00200.NJ
Total Suspended Solids by 160.2	CVS00300.NJ
Alkalinity by 310.1	CVS00400.NJ
Cyanide by 335.2M	CVS00500.NJ
Oil & Grease 413.2	CVS00600.NJ
Phenols by 420.1	CVS00700.NJ
PHCs in Water by 418.1	CVS00800.NJ
PHCs in Solids by 418.1M	CVS00900.NJ
COD by 410.2	CVS01000.NJ
Oil & Grease by 413.1	CVS01100.NJ
TCLP Extraction by 1311	CVS01200.NJ
Acid Soluable & Acid Insoluable Sulfides	CVS01300.NJ
Cyanide Swipe Test	CVS01400.NJ
TCLP for NonVolatiles	CVS01501.NJ
Sulfate in Water by 375.4	CVS01700.NJ
Sulfate in Soil by 9038	CVS01800.NJ
BOD	CVS01901.NJ
Chloride by 325.3	CVS02000.NJ
Paint Filter Test	CVS02100.NJ
TCLP Volatiles	CVS02400.NJ
Hexavalent Chromium (NJ Method)	CVS02600.NJ
Phenols by 9065	CVS02700.NJ
Cyanide (9010A)	CVS02800.NJ
Chloride by 9252	CVS02900.NJ
Semivolatiles by CLP	MSS00101.NJ
Semivolatiles by 625	MSS00401.NJ
Semivolatiles by 8270	MSS00602.NJ
Semivolatiles by NYSDEC ASP Protocol	MSS00900.NJ

SUMMARY OF IEA/NJ STANDARD OPERATING PROCEDURES, Con't

TITLE	SOP DOCUMENT
Volatiles by CLP	MSS00202.NJ
Volatiles by 624	MSS00301.NJ
Volatiles by 524,2	MSS00500.NJ
Volatiles by 8240A	MSS00702.NJ
Volatiles by NYSDEC ASP Protocol	MSS00800.NJ
Volatiles by 8260	MSS01000.NJ
ICP Metals by CLP	MES00100.NJ
Mercury by SW-846	MES00202.NJ
Perkin-Elmer 5100 GFAA by CLP	MES00300.NJ
Metals Digestion for ICP by 200.7	MES00400.NJ
Metals Digestion for ICP by SW-846	MES00701.NJ
Perkin-Elmer 5100 GFAA by SW-846	MES00800.NJ
Metals Digestion for GFAA for SW-846	MES00900.NJ
ICP Metals for NYSDEC	MES01100.NJ
GFAA Metals for NYSDEC	MES01200.NJ
Metals Digestion for 600 Series	MES01300.NJ
Metals Digestion for GFAA by 600 Series	MES01400.NJ
ICP Metals by SW-846	MES01500.NJ
Mercury by 245.1/245.2	MES01600.NJ
Pesticides/PCBs by CLP	GCS00101.NJ
Pestidices/PCBs by ASP	GCS00200.NJ
Pesticides/PCBs by 608	GCS00201.NJ
Pesticides/PCBs by 8080	GCS00300.NJ
Pesticides/PCBs by Appendix IX	GCS00400.NJ
Chlorinated Herbicides by 8151	GCS00600.NJ
TPH-Gasoline Range Organics	GCS00700.NJ
TPH-Diesel Range Organics	GCS00800.NJ
CLP Extraction of Organic Samples	SPS00101.NJ
Organic Extraction & Cleanup for 600 Series	SPS00200.NJ
Organic Extraction & Cleanup for Waters,SW-846	SPS00300.NJ
Organic Extraction & Cleanup for Solids,SW-846	SPS00400.NJ
Organic Extraction NYSDEC ASP Protocol	SPS00500.NJ
Radiation Screening	RAS02901.NJ
Radioactivity Swipe Tests	RAS03200.NJ
Tracking and Collection of Mixed Waste	RAS04500.NJ
Disposal of Mixed Waste	RAS04800.NJ

APPENDIX, Section 8

LISTING OF ANALYTICAL METHODS

AND ASSOCIATED DETECTION LIMITS

Purpose:	Metals Detection Limit and MDL Study
Location:	IEA - New Jersey
Instrument:	ICAP 61
Units:	ug/L

Analysis:	CLP			SW846	600 Series		SW846
Matrix:	all			Water	Water		Soil
Effective Date:	3/5/96			3/8/96	3/8/96		3/8/96
Expiration Date:	6/5/96			3/8/97	3/8/97		3/8/97
Analyte	IDL	Linear Range	CRDL	MDL	MDL	CRDL	MDL
Aluminum	20.42	500000*	200 [1]	25.73	30.20	200	22.30
Antimony	50.00	100000	100 [1]	34.09	70.85	100	52.96
Arsenic	39.97	10000*	100 [123]	44.78	29.96	200	66.08
Barium	0.69	10000*	20	0.91	0.91	100	0.78
Beryllium	0.05	10000	5 [1]	0.07	0.09	5	0.09
Cadmium	2.54	25000	10 [23]	3.27	6.67	10	5.01
Calcium	25.44	500000	1000	115.34	148.93	1000	99.18
Chromium	3.55	10000*	10	4.96	3.23	10	3.52
Cobalt	3.78	100000	50	4.12	2.41	50	3.17
Copper	2.84	100000	10	3.31	3.09	100	1.99
Iron	52.79	500000	100	99.26	47.43	1000	57.61
Lead	37.80	10000*	100 [123]	61.33	42.18	1000	30.56
Magnesium	34.03	500000	1000	58.16	59.39	1000	61.85
Manganese	0.86	45000	15	1.67	0.33	15	1.26
Nickel	8.21	100000	20 [2]	12.20	13.94	1000	12.10
Potassium	538.64	100000	1000	313.85	374.74	1000	676.58
Selenium	43.79	20000	100 [123]	41.26	61.83	100	43.22
Silver	2.83	1000*	10 [2]	6.82	7.37	100	6.32
Sodium	56.90	100000	2000	114.93	93.97	2000	119.84
Vanadium	1.77	100000	50	4.53	4.46	100	2.64
Zinc	2.01	10000*	50 [2]	37.61	18.77	100	5.40
Boron	5.65	10000*	100	28.52	24.99	100	9.98
Molybdenum	4.21	10000*	10	6.99	6.81	10	5.57
Tin	27.22	20000	50	39.79	48.28	50	75.71
Titanium	0.63	50000	10	0.83	1.12	10	0.88

* Linear range is highest calibration standard
reruns expected for these analytes

[1] Exceeds Drinking Water Criteria
[2] Exceeds Surface Water Criteria
[3] Exceeds Ground Water Quality Criteria

Purpose: Metals Detection Limit and MDL Study
Location: IEA - New Jersey
Instrument: Trace ICP
Units: ug/L

				SW846	600 Series		SW846
Analysis:	CLP						
Matrix:	all			Water	Water		Soil
Effective Date:	1/7/96			3/8/96	3/8/96		3/8/96
Expiration Date:	4/7/96			3/8/97	3/8/97		3/8/97
Analyte	IDL	Linear Range	CRDL	MDL	MDL	CRDL	MDL
Aluminum	17.20	800000	200 [1]	29.64	18.06	200	9.99
Antimony	1.76	10000	6	2.53	2.17	100	1.10
Arsenic	2.93	10000	8	3.02	4.39	200	2.82
Barium	0.09	10000	20	0.29	0.33	100	0.41
Beryllium	0.21	5000	4	0.20	0.34	5	0.10
Cadmium	0.17	5000	4	0.25	0.40	10	0.17
Calcium	4.64	500000	1000	76.05	138.55	1000	149.82
Chromium	3.58	50000	10	0.31	0.69	10	0.58
Cobalt	0.31	100000	50	0.24	0.42	50	0.41
Copper	0.76	20000	10	0.98	1.66	100	1.06
Iron	17.10	900000	100	94.91	32.51	1000	45.23
Lead	0.86	100000	3	1.86	1.72	1000	0.66
Magnesium	5.12	500000	1000	39.25	27.28	1000	46.29
Manganese	0.19	10000	15	0.98	1.02	15	0.85
Nickel	0.76	20000	10	0.42	0.65	1000	1.37
Potassium	115.00	100000	1000	60.99	38.96	1000	86.76
Selenium	1.92	10000	5	3.00	4.79	100	2.29
Silver	0.39	2000	2	0.27	0.46	100	0.32
Sodium	590.00	100000	2000	475.73	365.68	2000	359.09
Thallium	3.82	10000	10 [1]	7.37	7.07	20	7.37
Vanadium	0.35	100000	50	0.32	0.52	100	0.32
Zinc	0.35	20000	20	18.12	3.01	100	7.34
Boron			100	14.48	49.45	100	5.52
Molybdenum	1.10		10	1.76	2.41	10	0.92
Tin			10	3.46	2.07	10	5.09
Titanium	0.34		10	0.23	0.40	10	0.23

[1] Exceeds Drinking Water Criteria
[2] Exceeds Surface Water Criteria
[3] Exceeds Ground Water Quality Criteria

Purpose: Metals Detection Limit and MDL Study
Location: IEA - New Jersey
Units: ug/L

Instrument: GFAA 6398
Analysis: CLP
Matrix: all
Effective Date: 3/4/96
Expiration Date: 6/4/96

Analyte	IDL	Linear Range	CRDL	SW846 Water MDL	SW846 Soil MDL	600 Series Water MDL
Arsenic	0.62	100	10	0.44	0.32	0.44
Lead	0.75	75	3	0.58	0.54	0.56
Selenium	1.00	75	5	0.43	0.49	0.53
Thallium	0.85	100	10	0.60	2.42	1.37

Instrument: GFAA 6211
Analysis: CLP
Matrix: all
Effective Date: 3/4/96
Expiration Date: 6/4/96

Analyte	IDL	Linear Range	CRDL	SW846 Water MDL	SW846 Soil MDL	600 Series Water MDL
Arsenic	2.28	100	10	NA	0.66	1.67
Lead	0.48	75	3	0.79	NA	NA
Selenium	0.92	75	5	0.38	NA	NA
Thallium	0.60	100	10	0.84	NA	NA

Instrument: HG
Analysis: CLP
Matrix: all
Effective Date: 3/4/96
Expiration Date: 6/4/96

Analyte	IDL	Linear Range	CRDL	SW846 Water MDL	SW846 Soil MDL	600 Series Water MDL
Mercury	0.20	7.5	0.2	0.12	0.14	0.12

Purpose	VOA Soil Method Detection tudy
Location	IEA-New Jersey
Matrix	Soil
Method	Method 8240A (with megabore column)
Date	March 6, 1995
Analyst	Patrick O'Brien
Instrument ID	MSA
Spreadsheet ID.	MSA84696.WB2

		Spike Conc. ug/KG	Laboratory Sample Identification Number MDL002 #1	MDL00 #2	MDL00 #3	MDL00 #4	MDL00 #5	MDL00 #6	MDL008 #7	Mean Conc.	Mean % Rec	Sample S.D.	Calculated MDL
1	Dichlorodifluoromethane	5.00	2.20	1.90	1.91	1.79	1.87	1.73	1.83	1.89	38	0.15	0.5
2	Chloromethane	5.00	4.72	4.91	4.70	4.72	5.15	5.08	4.89	4.88	98	0.18	0.6
3	Vinyl Chloride	5.00	4.29	4.56	4.48	4.42	4.81	4.67	4.62	4.55	91	0.17	0.5
4	Bromomethane	5.00	5.82	6.56	6.06	5.80	6.53	6.36	6.21	6.19	124	0.31	1.0
5	Trichlorofluoromethane	5.00	3.82	3.78	3.62	3.90	3.56	3.75	4.04	3.78	76	0.16	0.5
6	Chloroethane	5.00	6.79	7.23	7.07	6.81	7.82	7.41	7.18	7.19	144	0.36	1.1
7	1,1-Dichloroethene	5.00	4.51	4.69	4.45	4.61	4.93	4.71	4.63	4.65	93	0.16	0.5
8	Freon	5.00	4.70	4.85	4.95	4.73	6.23	4.71	4.86	3.88	4.89	104	0.69
9	Carbon Disulfide	5.00	4.59	5.03	4.77	4.72	5.25	5.03	4.98	4.91	98	0.23	0.7
10	Acetone	5.00	5.65	5.79	4.51	7.69	6.35	4.50	6.11	5.80	116	1.11	3.5
11	Methylene Chloride	5.00	6.01	6.61	6.35	6.42	6.50	6.70	6.63	6.46	129	0.23	0.7
12	T-Butyl Alcohol	5.00	4.37	4.88	3.94	5.08	4.61	3.82	4.12	4.40	88	0.48	1.5
13	Methyl-T-butyl ether	5.00	4.93	5.49	4.49	5.71	5.02	4.09	4.30	4.86	97	0.60	1.9
14	trans-1,2-Dichloroethene	5.00	4.58	5.26	4.67	4.79	5.16	4.91	4.93	4.90	98	0.25	0.8
15	Acrolein	5.00	3.45	3.51	1.90	5.28	2.91	1.95	1.91	2.99	60	1.24	3.9
16	Acrylonitrile	5.00	3.65	4.16	2.80	5.49	3.37	2.35	2.63	3.49	70	1.08	3.4
17	cis-1,2-Dichloroethene	5.00	4.64	5.21	4.93	4.83	5.01	4.99	5.03	4.95	99	0.18	0.6
18	Diisopropylether	5.00	5.00	5.67	5.04	5.62	5.55	4.71	4.79	5.20	104	0.41	1.3
19	Vinyl Acetate	5.00	4.66	5.38	4.60	5.33	5.01	4.53	4.94	4.92	98	0.34	1.1
20	1,1-Dichloroethane	5.00	4.88	5.33	5.04	4.99	5.35	5.23	5.19	5.14	103	0.18	0.6
21	Chloroform	5.00	5.04	5.55	5.10	5.14	5.42	5.18	5.35	5.25	105	0.19	0.6
22	1,2-Dichloroethane	5.00	4.90	5.41	4.68	5.02	4.97	4.71	5.05	4.96	99	0.24	0.8
23	2-butanone	5.00	3.25	3.70	1.60	4.80	1.87	1.87	4.41	3.07	61	1.31	4.1
24	1,1,1-trichloroethane	5.00	4.77	5.06	4.82	4.91	4.97	4.91	4.88	4.90	98	0.10	0.3
25	Carbon tetrachloride	5.00	4.81	5.03	4.75	4.93	4.95	4.89	4.86	4.89	98	0.09	0.3
26	Benzene	5.00	4.93	5.10	4.92	5.10	5.09	4.90	5.01	5.01	100	0.09	0.3
27	Trichloroethene	5.00	4.78	5.04	4.62	4.88	5.01	4.92	4.90	4.88	98	0.14	0.4
28	1,2-Dichloropropane	5.00	4.93	5.51	4.76	4.99	4.99	4.81	5.14	5.02	100	0.25	0.8
29	Bromodichloromethane	5.00	5.31	6.54	4.74	5.23	4.98	4.86	5.68	5.33	107	0.62	1.9
30	cis-1,3-Dichloropropene	5.00	5.05	5.97	4.47	4.92	4.69	4.52	5.21	4.98	100	0.52	1.6
31	trans-1,3-Dichloropropene	5.00	5.36	6.84	4.31	5.03	4.53	4.55	5.65	5.18	104	0.88	2.8
32	1,1,2-Trichloroethane	5.00	6.23	8.20	4.58	5.61	4.75	5.15	6.70	5.89	118	1.27	4.0
33	Dibromochloromethane	5.00	6.30	8.89	4.60	5.74	4.96	5.49	7.18	6.17	123	1.47	4.6
34	4-Methyl-2-Pentanone	5.00	7.36	9.19	4.92	8.62	5.98	6.31	8.82	7.31	146	1.63	5.1
35	Toluene	5.00	5.02	5.52	4.82	5.11	5.05	4.91	5.24	5.10	102	0.23	0.7
36	Tetrachloroethene	5.00	4.90	5.26	4.75	4.91	5.09	4.84	4.97	4.96	99	0.17	0.5
37	2-Hexanone	5.00	6.64	8.41	4.11	8.80	5.29	5.64	8.17	6.72	134	1.79	5.6
38	2-Chloroethylvinylether	5.00	4.41	5.30	4.42	4.85	4.57	4.90	5.05	4.79	96	0.33	1.1
39	Chlorobenzene	5.00	5.48	7.24	4.99	5.34	5.28	5.32	6.19	5.69	114	0.78	2.4
40	Ethylbenzene	5.00	4.96	6.15	4.78	5.05	4.96	4.83	5.31	5.15	103	0.47	1.5
41	m,p-Xylene	10.00	10.23	12.60	9.61	10.08	9.94	10.01	11.29	10.54	105	1.05	3.3
42	o-Xylene	5.00	5.20	6.86	4.66	4.98	4.86	4.90	6.20	5.38	108	0.82	2.6
43	Styrene	5.00	5.43	7.91	4.64	5.22	4.85	5.20	6.49	5.68	114	1.15	3.6
44	Bromoform	5.00	7.37	10.84	4.58	7.20	5.38	6.79	9.40	7.37	147	2.17	6.8
45	1,1,2,2-Tetrachloroethane	5.00	8.86	12.06	5.11	9.24	6.41	8.04	11.15	8.70	174	2.46	7.7
46	m-Dichlorobenzene	5.00	5.22	5.84	4.91	5.30	5.00	4.63	5.01	5.13	103	0.38	1.2
47	p-Dichlorobenzene	5.00	4.88	5.30	4.73	5.14	4.82	4.42	4.58	4.84	97	0.31	1.0
48	o-Dichlorobenzene	5.00	5.39	5.97	4.74	5.29	4.87	4.44	4.86	5.08	102	0.51	1.6
49	1,2-Dibromoethane	5.00	4.40	4.54	4.03	4.97	4.24	3.72	3.88	4.25	85	0.43	1.3
50	Cyclohexane	5.00	7.23	7.07	3.85	11.05	5.89	3.92		5.57	111	3.46	10.9
51	1,2,4-Trimethylbenzene	5.00	4.95	5.49	4.67	4.96	4.67	4.26	5.96	4.99	100	0.57	1.8
52	Hexachlorobutadiene	5.00	5.13	6.16	5.43	5.47	5.20	4.65	4.93	5.28	106	0.48	1.5
51	Naphthalene	5.00	4.67	4.52	3.73	4.43	3.43	3.46	4.18	4.06	81	0.52	1.6

All concentrations shown as ug/kg

Purpose	VOA Drinking Water Method Detection Limit Study
Location	IEA-New Jersey
Matrix	Water
Method	Method 524.2
Date	January 18, 1996
Analyst	Patrick O'Brien
Instrument ID	MSA
Spreadsheet ID.	A524961P.WB2

		Spike Conc. ug/l	Laboratory Sample Identification Number MDL010 #1	MDL011 #2	MDL012 #3	MDL013 #4	MDL014 #5	MDL015 #6	MDL016 #7	Mean Conc.	Mean % Rec.	Sample S.D.	Calculated MDL
1	Dichlorodifluoromethane	1.00	0.93	0.87	0.89	0.92	0.78	0.79	0.82	0.86	86	0.06	0.19
2	Chloromethane	1.00	0.98	0.91	0.94	0.96	0.90	0.96	0.97	0.95	95	0.03	0.10
3	Vinyl Chloride	1.00	0.90	0.84	0.87	0.89	0.81	0.84	0.86	0.86	86	0.03	0.10
4	Bromomethane	1.00	1.02	0.96	0.99	1.00	0.98	1.10	1.09	1.02	102	0.05	0.17
5	Chloroethane	1.00	0.92	0.88	0.93	0.91	0.90	1.00	0.97	0.93	93	0.04	0.13
6	Trichlorofluoromethane	1.00	0.90	0.85	0.87	0.90	0.78	0.80	0.83	0.85	85	0.05	0.15
7	1,1-Dichloroethene	1.00	0.88	0.84	0.87	0.90	0.82	0.88	0.86	0.86	86	0.03	0.08
8	Methylene Chloride	1.00	0.86	0.79	0.86	0.83	0.82	0.94	0.96	0.87	87	0.06	0.20
9	trans-1,2-Dichloroethene	1.00	0.88	0.82	0.86	0.88	0.82	0.91	0.91	0.87	87	0.04	0.12
10	1,1-Dichloroethane	1.00	0.91	0.87	0.91	0.90	0.85	0.97	0.98	0.91	91	0.05	0.15
11	2,2-Dichloropropane	1.00	0.85	0.77	0.84	0.82	0.77	0.82	0.83	0.81	81	0.03	0.10
12	cis-1,2-Dichloroethene	1.00	0.85	0.81	0.82	0.84	0.79	0.90	0.89	0.84	84	0.04	0.13
13	Bromochloromethane	1.00	0.77	0.70	0.70	0.76	0.68	0.87	0.89	0.77	77	0.08	0.26
14	Chloroform	1.00	0.90	0.87	0.89	0.91	0.85	1.00	0.99	0.92	92	0.06	0.18
15	1,1,1-Trichloroethane	1.00	0.91	0.87	0.90	0.93	0.85	0.91	0.90	0.90	90	0.03	0.08
16	Carbon Tetrachloride	1.00	0.90	0.91	0.88	0.90	0.80	0.85	0.92	0.88	88	0.04	0.13
17	1,1-Dichloropropene	1.00	0.89	0.86	0.89	0.90	0.83	0.88	0.89	0.88	88	0.02	0.08
18	Benzene	1.00	0.89	0.82	0.87	0.88	0.83	0.94	0.94	0.88	88	0.05	0.15
19	1,2-Dichloroethane	1.00	0.73	0.74	0.73	0.73	0.69	0.86	0.87	0.76	76	0.07	0.22
20	Trichloroethene	1.00	0.93	0.90	0.90	0.90	0.86	0.96	0.96	0.92	92	0.04	0.11
21	1,2-Dichloropropane	1.00	0.83	0.79	0.80	0.82	0.76	0.88	0.92	0.83	83	0.05	0.17
22	Dibromomethane	1.00	0.78	0.72	0.69	0.70	0.67	0.87	0.89	0.76	76	0.09	0.28
23	Bromodichloromethane	1.00	0.86	0.79	0.81	0.83	0.77	0.94	0.96	0.85	85	0.07	0.23
24	cis-1,3-Dichloropropene	1.00	0.75	0.68	0.71	0.70	0.67	0.82	0.83	0.74	74	0.07	0.21
25	Toluene	1.00	0.87	0.81	0.85	0.85	0.81	0.91	0.91	0.86	86	0.04	0.13
26	trans-1,3-Dichloropropene	1.00	0.87	0.78	0.81	0.81	0.76	0.92	0.90	0.84	84	0.06	0.19
27	1,1,2-Trichloroethane	1.00	0.72	0.70	0.66	0.66	0.65	0.83	0.83	0.72	72	0.08	0.25
28	Tetrachloroethene	1.00	0.90	0.85	0.90	0.90	0.83	0.91	0.90	0.88	88	0.03	0.10
29	1,3-Dichloropropane	1.00	0.73	0.67	0.68	0.76	0.66	0.82	0.84	0.74	74	0.07	0.23
30	Dibromochloromethane	1.00	0.84	0.72	0.75	0.79	0.70	0.89	0.89	0.80	80	0.08	0.25
31	1,2-Dibromoethane	1.00	0.69	0.64	0.63	0.66	0.65	0.73	0.79	0.68	68	0.06	0.18
32	Chlorobenzene	1.00	0.86	0.78	0.80	0.82	0.77	0.90	0.92	0.84	84	0.06	0.18
33	1,1,1,2-Tetrachloroethane	1.00	0.88	0.77	0.81	0.83	0.74	0.91	0.92	0.84	84	0.07	0.22
34	Ethylbenzene	1.00	0.89	0.83	0.87	0.88	0.82	0.93	0.91	0.88	88	0.04	0.13
35	m,p-Xylene	2.00	1.69	1.56	1.65	1.64	1.52	1.78	1.76	1.66	83	0.10	0.30
36	o-Xylene	1.00	0.80	0.73	0.78	0.78	0.72	0.85	0.85	0.79	79	0.05	0.16
37	Styrene	1.00	0.75	0.65	0.69	0.72	0.67	0.79	0.80	0.72	72	0.06	0.18
38	Bromoform	1.00	0.79	0.78	0.73	0.80	0.58	0.82	0.80	0.76	76	0.08	0.26
39	Isopropylbenzene	1.00	0.88	0.71	0.83	0.83	0.77	0.86	0.86	0.82	82	0.06	0.19
40	Bromobenzene	1.00	0.83	0.65	0.77	0.78	0.68	0.87	0.87	0.78	78	0.09	0.27
41	1,1,2,2-Tetrachloroethane	1.00	0.82	0.66	0.78	0.86	0.59	0.91	0.78	0.77	77	0.11	0.35
42	1,2,3-Trichloropropane	1.00	0.84	0.99	0.77	0.97	0.64	0.92	0.83	0.85	85	0.12	0.38
43	n-Propylbenzene	1.00	1.11	1.05	1.08	1.04	0.99	1.08	1.02	1.05	105	0.04	0.13
44	2-Chlorotoluene	1.00	1.19	0.92	1.15	1.07	1.08	1.27	1.22	1.13	113	0.12	0.37
45	4-Chlorotoluene	1.00	1.06	0.92	1.01	1.00	0.92	1.08	1.07	1.01	101	0.07	0.21
46	1,3,5-Trimethylbenzene	1.00	1.04	0.96	1.00	0.99	0.94	1.06	1.03	1.00	100	0.04	0.14
47	tert-Butylbenzene	1.00	1.08	0.87	1.05	1.02	0.96	1.06	1.03	1.01	101	0.07	0.23
48	1,2,4-Trimethylbenzene	1.00	1.02	0.95	0.95	0.94	0.86	1.01	1.00	0.96	96	0.06	0.17
49	sec-Butylbenzene	1.00	1.05	0.87	1.00	0.98	0.92	1.00	1.00	0.97	97	0.06	0.19
50	1,3-Dichlorobenzene	1.00	1.04	0.87	0.96	0.96	0.86	1.08	1.03	0.97	97	0.08	0.27
51	4-Isopropyltoluene	1.00	0.97	0.85	0.95	0.93	0.85	0.97	0.93	0.92	92	0.05	0.16
52	1,4-Dichlorobenzene	1.00	1.02	0.86	0.94	0.97	0.87	1.06	1.04	0.97	97	0.08	0.25
53	1,2-Dichlorobenzene	2.00	1.73	2.20	2.09	1.92	2.05	1.95	1.84	1.97	98	0.16	0.50
54	n-Butylbenzene	1.00	0.89	0.45	0.87	0.85	0.77	0.87	0.86	0.79	79	0.16	0.49
55	1,2-Dibromo-3-chloropropane	2.00	1.24	1.73	1.46	0.91	1.24	1.38	0.87	1.26	63	0.30	0.95
56	1,2,4-Trichlorobenzene	1.00	0.56	0.45	0.46	0.48	0.37	0.53	0.51	0.48	48	0.06	0.20
57	Hexachlorobutadiene	1.00	1.02	0.95	1.03	1.01	0.93	1.10	1.05	1.01	101	0.06	0.18
58	Naphthalene	1.00	0.64	0.42	0.25	0.36	0.28	0.40	0.43	0.40	40	0.13	0.40
59	1,2,3-Trichlorobenzene	1.00	0.45	0.34	0.38	0.39	0.30	0.41	0.42	0.38	38	0.05	0.16

Purpose	VOA Water Method Detection Limit Study
Location	IEA-New Jersey
Matrix	Water
Method	EPA Method 624 (624 List + Miscellaneous Compounds)
Date	January 31, 1996
Analyst	Pat O'Brien
Instrument ID	MSI
Spreadsheet ID.	MSI62496.WB2

		Spike Conc. ug/l	Laboratory Sample Identification Number I2685 #1	I2686 #2	I2687 #3	I2688 #4	I2689 #5	I2690 #6	I2691 #7	Mean Conc.	Mean % Rec.	Sample S.D.	Calculated MDL	NJDEP GWQC
1	Dichlorodifluoromethane	2.00	0.48	0.47	0.48	0.47	0.40	0.49	0.44	0.46	23	0.03	0.10	
2	chloromethane	2.00	1.52	0.89	1.48	1.67	1.37	1.55	1.32	1.40	70	0.25	0.79	10
3	vinyl chloride	2.00	1.07	1.08	1.11	1.10	0.96	1.14	0.94	1.06	53	0.08	0.24	5
4	Bromomethane	2.00	0.96	0.83	1.03	1.01	0.78	0.93	0.90	0.92	46	0.09	0.29	
5	Chloroethane	2.00	1.80	1.53	1.84	2.09	1.88	1.89	1.78	1.83	92	0.17	0.52	2
6	Trichlorofluoromethane	2.00	0.72	0.73	0.71	0.69	0.62	0.70	0.63	0.69	34	0.04	0.14	
7	Acrolein	2.00	1.73	1.54	1.60	1.69	1.62	1.70	1.46	1.62	81	0.10	0.30	700
8	Carbon Disulfide	2.00	0.82	1.00	0.94	1.08	1.38	1.37	1.16	1.11	55	0.21	0.67	
9	Acetone	2.00	1.52	1.52	1.63	1.60	1.39	1.81	1.46	1.56	78	0.14	0.43	
10	1,1-dichloroethene	2.00	0.96	0.60	0.90	0.92	0.64	0.90	0.38	0.76	38	0.22	0.69	2
11	Methylene chloride	2.00	1.72	1.72	1.64	1.71	1.74	1.84	1.55	1.70	85	0.09	0.28	70
12	t-1,2-dichloroethene	2.00	1.17	1.16	1.21	1.18	1.07	1.16	1.06	1.14	57	0.06	0.18	100
13	Acrylonitrile	5.00	2.16	4.68	1.10	1.62	3.15	1.12	2.00	2.26	45	1.28	4.01	10
14	t- Butyl alcohol	2.00	1.53	1.48	1.65	1.51	1.22	1.50	1.02	1.42	71	0.22	0.68	
15	methyl t-butyl ether	2.00	1.75	1.78	1.74	1.79	1.74	1.87	1.64	1.76	88	0.07	0.22	
16	1,1-dichloroethane	2.00	1.46	1.39	1.41	1.41	1.26	1.40	1.23	1.37	68	0.09	0.27	6
17	Diisopropylether	2.00	1.65	1.63	1.64	1.64	1.56	1.74	1.47	1.62	81	0.08	0.26	2
18	cis-1,2-dichloroethene	2.00	1.29	1.25	1.26	1.26	1.17	1.32	1.14	1.24	62	0.06	0.20	
19	Vinyl acetate	2.00	1.73	1.71	1.70	1.74	1.68	1.68	1.51	1.68	84	0.08	0.24	300
20	2-butanone	2.00	1.79	1.84	1.94	1.90	1.80	1.90	1.80	1.85	93	0.06	0.19	30
21	1,2-dibromoethane	2.00	1.48	1.43	1.46	1.50	1.46	1.45	1.31	1.44	72	0.06	0.19	
22	Chloroform	2.00	1.41	1.41	1.44	1.42	1.29	1.38	1.27	1.37	69	0.07	0.21	2
23	1,1,1-trichloroethane	2.00	2.42	2.19	2.13	1.79	1.72	1.65	1.42	1.90	95	0.35	1.11	1
24	Carbon tetrachloride	2.00	0.70	0.67	0.70	0.69	0.62	0.69	0.63	0.67	34	0.03	0.10	1
25	Benzene	2.00	1.36	1.33	1.36	1.33	1.23	1.31	1.20	1.30	65	0.06	0.20	
26	1,2-dichloroethane	2.00	1.81	1.77	1.79	1.80	1.73	1.84	1.63	1.77	88	0.07	0.22	1
27	Trichloroethene	2.00	1.37	1.29	1.34	1.30	1.14	1.21	1.09	1.25	62	0.10	0.33	10
28	1,2-dichloropropane	2.00	1.55	1.53	1.51	1.49	1.40	1.50	1.33	1.47	74	0.08	0.25	3
29	Bromodichloromethane	2.00	1.18	1.19	1.18	1.22	1.15	1.20	1.08	1.17	59	0.05	0.14	1
30	2-chloroethyl vinyl ether	2.00	0.84	0.54	0.57	0.58	0.58	0.44	0.55	0.59	29	0.12	0.38	
31	cis-1,3-dichloropropene	2.00	0.90	0.94	0.95	1.02	1.04	1.14	1.00	1.00	50	0.08	0.25	
32	trans-1,3-dichloropropene	2.00	0.94	1.00	1.03	1.09	1.09	1.15	1.05	1.05	53	0.07	0.22	4
33	1,1,2-trichloroethane	2.00	1.51	1.48	1.53	1.53	1.49	1.52	1.40	1.49	75	0.05	0.14	
34	Dibromochloromethane	2.00	1.03	1.07	1.07	1.03	1.05	1.11	0.97	1.05	52	0.04	0.14	400
35	Bromoform	2.00	0.79	0.79	0.80	0.84	0.82	0.79	0.75	0.80	40	0.03	0.09	2
36	4-methyl-2-pentanone	2.00	1.56	1.55	1.53	1.58	1.54	1.57	1.46	1.54	77	0.04	0.12	1
37	Toluene	2.00	1.35	1.36	1.36	1.35	1.22	1.33	1.17	1.31	65	0.08	0.24	1000
38	Tetrachloroethene	2.00	0.92	0.94	0.96	0.94	0.84	0.94	0.85	0.91	46	0.05	0.15	4
39	2-hexanone	2.00	1.33	1.30	1.35	1.35	1.37	1.36	1.27	1.33	67	0.04	0.11	0.05
40	Chlorobenzene	2.00	1.31	1.35	1.36	1.35	1.24	1.36	1.19	1.31	65	0.07	0.21	700
41	Ethylbenzene	2.00	1.23	1.23	1.29	1.25	1.13	1.25	1.11	1.21	61	0.07	0.21	
42	m,p-Xylene	4.00	2.57	2.56	2.65	2.62	2.34	2.58	2.33	2.52	63	0.13	0.41	100
43	o-Xylene	2.00	1.29	1.27	1.28	1.29	1.17	1.27	1.11	1.24	62	0.07	0.22	600
44	Styrene	2.00	1.16	1.16	1.19	1.20	1.11	1.18	1.04	1.15	57	0.06	0.18	75
45	1,1,2,2-tetrachloroethane	2.00	1.53	1.55	1.51	1.53	1.51	1.58	1.37	1.51	76	0.07	0.21	600
46	m-Dichlorobenzene	2.00	1.26	1.31	1.35	1.35	1.24	1.35	1.18	1.29	65	0.07	0.21	
47	p-Dichlorobenzene	2.00	1.32	1.35	1.37	1.39	1.28	1.44	1.23	1.34	67	0.07	0.22	
48	o-Dichlorobenzene	2.00	1.31	1.34	1.39	1.39	1.29	1.40	1.23	1.34	67	0.06	0.20	
49	1,2,4-trimethylbenzene	2.00	1.20	1.21	1.27	1.22	1.14	1.24	1.10	1.20	60	0.06	0.18	1
50	Naphthalene	2.00	0.54	0.99	1.16	1.20	1.14	1.16	1.09	1.04	52	0.23	0.73	1

All concentrations shown as ug/L

Exa Format for Reporting of IEA MDLs

Purpose Water Method Detection Limit Study
Location IEA-New Jersey
Matrix Water
Method EPA METHOD 625
Date June 2, 1995
Analyst Donghui Hong
Instrument MSD
Spreadshee M6251995.WB2

		Spike Conc. ug/L	D3443	D3444	D3445	D3446	D3447	D3448	D3449	Mean Conc.	Mean % Rec.	Sample S.D.	Calculated MDL
1	N-Nitrosodimethylamine	2.50	1.48	1.35	1.53	1.87	1.40	1.43	1.74	1.54	62	0.19	0.60
2	Phenol	5.00	1.80	2.26	2:24	2.12	2.19	1.77	2.33	2.10	42	0.23	0.71
3	bis(2-Chloroethyl)ether	2.50	1.86	1.93	1.94	2.34	2.15	2.29	2.45	2.14	85	0.23	0.73
4	2-Chlorophenol	5.00	3.13	3.86	3.84	3.50	3.89	2.83	4.20	3.61	72	0.48	1.51
5	1,3-Dichlorobenzene	2.50	1.25	1.49	1.53	1.81	1.66	1.88	1.96	1.65	66	0.25	0.79
6	1,4-Dichlorobenzene	2.50	1.41	1.60	1.51	1.81	1.68	1.74	1.91	1.67	67	0.17	0.54
7	Benzyl alcohol	2.50	1.75	2.21	2.08	1.97	1.81	2.23	2.37	2.06	82	0.23	0.72
8	1,2-Dichlorobenzene	2.50	1.35	1.57	1.56	1.94	1.79	1.89	2.09	1.74	70	0.26	0.81
9	2-Methylphenol	5.00	1.46	1.67	1.51	1.67	1.65	1.19	1.77	1.56	31	0.19	0.61
10	bis(2-chloroisopropyl)ether	2.50	1.66	2.02	2.04	2.15	1.92	2.14	2.33	2.04	81	0.21	0.66
11	4-Methylphenol	5.00	1.43	1.51	1.50	1.75	1.42	1.17	1.68	1.49	30	0.19	0.59
12	n-Nitroso-di-n-propylamine	2.50	1.57	1.77	1.43	1.95	1.69	1.98	2.30	1.81	73	0.29	0.91
13	Hexachloroethane	2.50	0.92	1.03	1.25	1.52	1.47	1.40	1.90	1.36	54	0.33	1.03
14	Nitrobenzene	2.50	1.65	2.01	1.75	2.15	1.71	2.34	2.46	2.01	80	0.32	1.01
15	Isophorone	2.50	1.61	1.76	1.83	1.80	1.71	2.05	2.01	1.82	73	0.16	0.50
16	2-Nitrophenol	5.00	2.21	2.75	2.78	1.75	2.65	2.10	3.31	2.51	50	0.52	1.64
17	2,4-Dimethylphenol	5.00	2.53	3.11	2.71	3.48	3.22	2.81	3.72	3.08	62	0.43	1.35
18	bis(2-Chloroethoxy)methan	2.50	1.72	1.90	2.00	2.12	1.94	2.30	2.21	2.03	81	0.20	0.62
19	2,4-Dichlorophenol	5.00	2.52	3.11	3.17	2.38	3.18	2.48	3.65	2.93	59	0.47	1.49
20	1,2,4-Trichlorobenzene	2.50	1.34	1.51	1.57	1.55	1.69	1.93	1.91	1.64	66	0.22	0.68
21	Naphthalene	2.50	1.68	1.86	1.84	1.96	1.85	2.38	2.18	1.96	79	0.24	0.75
22	4-Chloroaniline	2.50	1.40	1.80	1.56	1.50	1.65	2.01	2.04	1.71	68	0.25	0.78
23	Hexachlorobutadiene	2.50	1.00	1.05	1.42	1.64	1.52	1.66	1.66	1.42	57	0.28	0.90
24	4-Chloro-3-methylphenol	5.00	3.15	3.55	3.55	3.56	3.24	2.64	4.14	3.40	68	0.46	1.45
25	2-Methylnaphthalene	2.50	1.50	1.61	1.75	1.93	1.66	2.04	1.84	1.76	70	0.19	0.59
26	Hexachlorocyclopentadiene	2.50	0.46	0.36	0.41	0.64	0.82	0.75	0.75	0.60	24	0.19	0.59
27	2,4,6-Trichlorophenol	5.00	2.01	2.46	2.86	1.37	2.87	1.81	3.16	2.36	47	0.65	2.06
28	2,4,5-Trichlorophenol	5.00	1.12	1.47	1.54	0.83	1.65	1.24	1.67	1.36	27	0.31	0.98
29	2-Chloronaphthalene	2.50	1.55	1.95	1.72	1.96	1.97	2.08	2.05	1.90	76	0.19	0.60
30	2-Nitroaniline	2.50	0.93	1.12	0.97	0.98	1.26	1.07	1.30	1.09	44	0.15	0.46
31	Dimethylphthalate	2.50	0.86	0.91	0.73	1.02	1.21	1.05	1.16	0.99	40	0.17	0.53
32	Acenaphthylene	2.50	1.43	1.73	1.60	1.74	1.70	1.81	1.82	1.69	68	0.14	0.43
33	2,6-Dinitrotoluene	2.50	0.86	0.88	0.89	0.91	0.86	0.64	1.02	0.87	35	0.11	0.36
34	3-Nitroaniline	2.50	0.72	0.98	0.92	0.90	0.85	0.78	0.90	0.86	35	0.09	0.28
35	Acenaphthene	2.50	1.79	2.17	2.00	1.96	2.01	2.23	2.25	2.06	82	0.17	0.52
36	2,4-Dinitrophenol	5.00	0.45	0.40	0.58	1.15	0.94	0.70	1.07	0.76	15	0.30	0.94
37	4-Nitrophenol	5.00	0.62	0.69	0.78	0.29	0.94	0.58	0.98	0.70	14	0.23	0.74
38	Dibenzofuran	2.50	1.78	2.05	2.13	2.11	1.98	2.23	2.17	2.06	83	0.15	0.47
39	2,4-Dinitrotoluene	2.50	0.58	0.77	0.83	0.67	0.64	0.55	0.85	0.70	28	0.12	0.38
40	Diethylphthalate	2.50	1.20	1.23	1.17	1.27	1.73	1.52	1.73	1.41	56	0.25	0.78
41	Fluorene	2.50	1.66	2.08	1.83	1.92	1.89	2.21	2.16	1.96	79	0.20	0.62
42	1,2-Diphenyl hydrazine	2.50	1.76	2.18	1.86	1.92	1.96	2.29	2.01	2.00	80	0.18	0.58
43	4-Chlorophenyl-phenylethe	2.50	1.72	2.10	2.02	2.09	2.03	2.32	2.17	2.06	83	0.18	0.57
44	4-Nitroaniline	2.50	0.96	0.98	0.66	0.79	0.79	1.17	1.35	0.96	38	0.24	0.75
45	4,6-Dinitro-2,methylphenol	5.00	0.57	1.26	1.40	0.82	1.55	0.94	1.72	1.18	24	0.42	1.31
46	n-Nitrosodiphenylamine	2.50	1.69	1.95	1.88	2.11	1.77	1.94	2.05	1.91	77	0.15	0.46
47	4-Bromophenyl-phenylethe	2.50	1.57	1.71	1.57	1.72	1.68	1.87	1.73	1.69	68	0.10	0.32

Ex Format for Reporting of IEA MDLs

48	Hexachlorobenzene	2.50	1.60	2.08	1.93	1.99	1.91	2.25	2.25	2.00	80	0.23	0.71
49	Carbazole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00
50	Pentachlorophenol	5.00	1.33	1.88	2.29	1.04	2.66	1.59	2.77	1.94	39	0.66	2.08
51	Phenanthrene	2.50	2.09	2.41	2.33	2.38	2.18	2.42	2.33	2.31	92	0.12	0.39
52	Anthracene	2.50	1.83	2.07	1.99	2.13	1.90	1.92	2.14	2.00	80	0.12	0.38
53	Di-n-butylphthalate	2.50	2.55	2.50	2.28	2.66	2.61	2.04	2.20	2.41	96	0.23	0.73
54	Fluoranthrene	2.50	1.81	2.16	2.01	2.01	2.00	2.02	2.00	2.00	80	0.10	0.32
55	Benzidine	25.00	35.19	43.50	39.08	47.63	44.42	53.10	52.32	45.03	180	6.58	20.69
56	Pyrene	2.50	1.87	2.36	2.19	2.22	2.12	2.35	2.14	2.18	87	0.17	0.52
57	Butylbenzylphthalate	2.50	1.25	1.22	1.25	1.12	1.42	1.35	1.62	1.32	53	0.16	0.51
58	Benzo[a]anthracene	2.50	2.16	2.42	2.34	2.37	2.39	2.53	2.42	2.38	95	0.11	0.35
59	3,3'-Dichlorobenzidine	25.00	27.90	30.70	29.01	29.62	28.77	31.53	32.06	29.94	120	1.53	4.82
60	Chrysene	2.50	1.65	1.70	1.78	1.80	1.67	1.96	1.65	1.74	70	0.11	0.35
61	bis(2-Ethylhexyl)phthalate	2.50	2.66	2.60	2.25	2.36	2.35	2.10	2.57	2.41	97	0.20	0.64
62	Di-n-octylphthalate	2.50	1.25	1.30	1.31	1.32	1.33	1.25	1.52	1.33	53	0.09	0.29
63	Benzo[b]fluoranthene	2.50	1.38	1.65	1.78	1.96	1.72	1.89	1.81	1.74	70	0.19	0.60
64	Benzo[k]fluoranthene	2.50	1.68	2.16	1.58	1.79	1.70	1.89	1.70	1.79	71	0.19	0.60
65	Benzo[a]pyrene	2.50	1.35	1.50	1.44	1.62	1.57	1.67	1.69	1.55	62	0.13	0.39
66	Indeno[1,2,3-cd]pyrene	2.50	1.19	1.48	1.42	1.48	1.43	1.70	1.54	1.46	59	0.15	0.48
67	Dibenz[a,h]anthracene	2.50	1.32	1.66	1.56	1.67	1.60	1.83	1.65	1.61	65	0.15	0.48
68	Benzo[g,h,i]perylene	2.50	1.29	1.52	1.54	1.56	1.49	1.90	1.48	1.54	62	0.18	0.57

Purpose	Water Method Detection Limit Study
Location	IEA-New Jersey
Matrix	Water
Method	SW846 BNA Method 8270A
Date	June 2, 1995
Analyst	Donghui Hong
Instrument	MSD
Spreadsheet	BNWA1995.WB2

	Spike Conc. ug/L	D3443	D3444	D3445	D3446	D3447	D3448	D3449	Mean Conc.	Mean % Rec.	Sample S.D.	Calculated MDL
1 N-Nitrosodimethylamine	2.50	1.47	1.34	1.52	1.86	1.39	1.42	1.73	1.53	61	0.19	0.60
2 Phenol	5.00	1.79	2.25	2.23	2.11	2.19	1.77	2.32	2.09	42	0.22	0.70
3 bis(2-Chloroethyl)ether	2.50	1.82	1.89	1.90	2.29	2.10	2.24	2.39	2.09	84	0.22	0.70
4 2-Chlorophenol	5.00	3.15	3.88	3.87	3.53	3.92	2.85	4.23	3.63	73	0.49	1.53
5 1,3-Dichlorobenzene	2.50	1.26	1.50	1.54	1.83	1.68	1.90	1.98	1.67	67	0.25	0.80
6 1,4-Dichlorobenzene	2.50	1.41	2.19	1.51	1.82	1.69	1.75	1.91	1.75	70	0.26	0.81
7 Benzyl alcohol	2.50	1.74	2.19	2.06	1.95	1.80	2.21	2.35	2.04	82	0.22	0.71
8 1,2-Dichlorobenzene	2.50	1.34	1.56	1.55	1.93	1.78	1.89	2.08	1.73	69	0.26	0.82
9 2-Methylphenol	5.00	1.40	1.61	1.46	1.61	1.59	1.15	1.71	1.50	30	0.19	0.59
10 bis(2-chloroisopropyl)ether	2.50	1.68	2.05	2.07	2.18	1.96	2.17	2.36	2.07	83	0.21	0.67
11 4-Methylphenol	5.00	1.38	1.47	1.46	1.70	1.38	1.14	1.63	1.45	29	0.18	0.58
12 n-Nitroso-di-n-propylamine	2.50	1.54	1.74	1.40	1.91	1.66	1.94	2.25	1.78	71	0.28	0.89
13 Hexachloroethane	2.50	0.90	1.00	1.22	1.48	1.43	1.37	1.85	1.32	53	0.32	1.00
14 Nitrobenzene	2.50	1.67	2.03	1.76	2.17	1.72	2.36	2.48	2.03	81	0.32	1.02
15 Isophorone	2.50	1.62	1.76	1.84	1.81	1.72	2.06	2.02	1.83	73	0.16	0.50
16 2-Nitrophenol	5.00	2.32	2.89	2.92	1.84	2.79	2.21	3.48	2.64	53	0.55	1.72
17 2,4-Dimethylphenol	5.00	2.53	3.11	2.71	3.47	3.22	2.81	3.71	3.08	62	0.42	1.33
18 bis(2-Chloroethoxy)methan	2.50	1.71	1.89	1.99	2.10	1.93	2.29	2.19	2.01	81	0.20	0.62
19 2,4-Dichlorophenol	5.00	2.57	3.18	3.24	2.44	3.25	2.54	3.73	2.99	60	0.48	1.52
20 1,2,4-Trichlorobenzene	2.50	1.33	1.51	1.57	1.54	1.68	1.93	1.90	1.64	65	0.22	0.68
21 Naphthalene	2.50	1.68	1.86	1.84	1.96	1.85	2.37	2.18	1.96	79	0.23	0.74
22 4-Chloroaniline	2.50	1.35	1.74	1.51	1.45	1.59	1.94	1.96	1.65	66	0.24	0.75
23 Hexachlorobutadiene	2.50	0.99	1.05	1.41	1.63	1.51	1.65	1.65	1.41	57	0.28	0.89
24 4-Chloro-3-methylphenol	5.00	3.05	3.43	3.43	3.45	3.13	2.55	4.01	3.29	66	0.45	1.41
25 2-Methylnaphthalene	2.50	1.43	1.53	1.67	1.85	1.58	1.94	1.76	1.68	67	0.18	0.57
26 Hexachlorocyclopentadiene	2.50	0.46	0.36	0.41	0.64	0.82	0.75	0.75	0.60	24	0.19	0.59
27 2,4,6-Trichlorophenol	5.00	2.10	2.57	1.69	1.43	1.82	1.89	1.84	1.91	38	0.36	1.12
28 2,4,5-Trichlorophenol	5.00	1.19	2.48	1.64	0.89	1.76	1.82	1.78	1.65	33	0.51	1.59
29 2-Chloronaphthalene	2.50	1.60	2.01	1.77	2.02	2.04	2.14	2.11	1.96	78	0.20	0.62
30 2-Nitroaniline	2.50	0.97	1.27	1.01	1.02	1.31	1.11	1.35	1.15	46	0.16	0.50
31 Dimethylphthalate	2.50	0.87	0.92	0.74	1.03	1.23	1.07	1.18	1.01	40	0.17	0.55
32 Acenaphthylene	2.50	1.45	1.76	1.62	1.77	1.73	1.84	1.85	1.72	69	0.14	0.44
33 2,6-Dinitrotoluene	2.50	0.89	1.01	0.91	0.94	0.89	0.66	1.05	0.91	36	0.12	0.39
34 3-Nitroaniline	2.50	0.76	1.04	0.98	0.95	0.90	0.83	0.95	0.92	37	0.09	0.30
35 Acenaphthene	2.50	1.84	2.23	2.05	2.01	2.07	2.29	2.31	2.11	85	0.17	0.54
36 2,4-Dinitrophenol	5.00	0.53	0.47	0.68	1.35	1.11	0.82	1.26	0.89	18	0.35	1.11
37 4-Nitrophenol	5.00	0.62	0.70	0.79	0.80	0.95	0.59	0.99	0.78	16	0.15	0.48
38 Dibenzofuran	2.50	1.97	2.27	2.35	2.33	2.19	2.47	2.40	2.28	91	0.16	0.52
39 2,4-Dinitrotoluene	2.50	0.61	0.80	0.87	0.71	0.67	0.58	0.89	0.73	29	0.12	0.39
40 Diethylphthalate	2.50	1.22	1.25	1.19	1.29	1.76	1.55	1.76	1.43	57	0.25	0.80
41 Fluorene	2.50	1.70	2.12	1.87	1.96	1.93	2.26	2.21	2.01	80	0.20	0.63
42 1,2-Diphenyl hydrazine	2.50	1.80	2.23	1.90	1.96	2.00	2.34	2.05	2.04	82	0.19	0.59
43 4-Chlorophenyl-phenylethe	2.50	1.77	2.16	2.08	2.15	2.09	2.39	2.23	2.12	85	0.19	0.59
44 4-Nitroaniline	2.50	0.89	0.91	0.61	0.73	0.73	1.08	1.26	0.89	35	0.22	0.71
45 4,6-Dinitro-2,methylphenol	5.00	0.64	1.42	1.58	0.92	1.74	1.06	1.94	1.33	27	0.47	1.48
46 n-Nitrosodiphenylamine	2.50	1.78	2.05	1.97	2.21	1.86	2.03	2.15	2.01	80	0.15	0.48
47 4-Bromophenyl-phenylethe	2.50	1.68	1.83	1.68	1.83	1.80	2.00	1.85	1.81	72	0.11	0.35

IE BNA WATER MDL 1995

48	Hexachlorobenzene	2.50	1.71	2.23	2.06	2.13	2.04	2.41	2.40	2.14	86	0.24	0.76
49	Carbazole	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0	0.00	0.00
50	Pentachlorophenol	5.00	1.39	1.96	2.39	1.09	2.79	1.66	2.90	2.03	41	0.70	2.18
51	Phenanthrene	2.50	2.31	2.23	2.14	2.30	2.04	2.07	2.31	2.20	88	0.12	0.37
52	Anthracene	2.50	1.89	2.14	2.05	2.20	1.96	1.99	2.21	2.06	83	0.12	0.39
53	Di-n-butylphthalate	2.50	2.64	2.59	2.36	2.75	2.70	2.11	2.28	2.49	100	0.24	0.76
54	Fluoranthrene	2.50	1.88	2.24	2.09	2.08	2.08	2.10	2.08	2.08	83	0.10	0.33
55	Benzidine	25.00	27.46	33.94	30.49	37.16	34.66	41.43	40.82	35.14	141	5.13	16.14
56	Pyrene	2.50	2.38	3.01	2.79	2.83	2.70	3.00	2.73	2.78	111	0.21	0.67
57	Butylbenzylphthalate	2.50	1.48	1.45	1.48	1.33	1.69	1.60	1.93	1.57	63	0.20	0.62
58	Benzo[a]anthracene	2.50	2.63	2.94	2.85	2.89	2.91	3.09	2.95	2.89	116	0.14	0.44
59	3,3'-Dichlorobenzidine	25.00	36.71	40.39	38.17	38.98	37.86	41.49	42.18	39.40	158	2.02	6.33
60	Chrysene	2.50	1.63	1.67	1.76	1.77	1.65	1.93	1.63	1.72	69	0.11	0.34
61	bis(2-Ethylhexyl)phthalate	2.50	2.97	2.90	2.51	2.64	2.62	2.34	2.87	2.69	108	0.23	0.72
62	Di-n-octylphthalate	2.50	1.37	1.42	1.43	1.44	1.46	1.36	1.66	1.45	58	0.10	0.31
63	Benzo[b]fluoranthene	2.50	1.43	1.71	1.85	2.03	1.79	1.96	1.88	1.81	72	0.20	0.62
64	Benzo[k]fluoranthene	2.50	1.68	2.16	1.58	1.79	1.70	1.89	1.70	1.79	71	0.19	0.60
65	Benzo[a]pyrene	2.50	1.28	1.43	1.37	1.54	1.49	1.59	1.60	1.47	59	0.12	0.37
66	Indeno[1,2,3-cd]pyrene	2.50	1.17	1.46	1.39	1.46	1.41	1.68	1.52	1.44	58	0.15	0.48
67	Dibenz[a,h]anthracene	2.50	1.39	1.75	1.65	1.77	1.70	1.94	1.75	1.71	68	0.17	0.52
68	Benzo[g,h,i]perylene	2.50	1.31	1.54	1.57	1.59	1.51	1.93	1.50	1.56	63	0.19	0.58

Purpose	BNA Soil Method Detection Limit Study
Location	IEA-New Jersey
Matrix	Soil
Method	Method 8270A
Date	May 20, 1995
Analyst	Hassam Fahmy
Instrument ID	MSG
Spreadsheet	BNSO19955.WB2

	Spike Conc. ug/KG	Laboratory Sample ID Number g1414	g1415	g1416	g1417	g1418	g1419	g1420	Mean Conc.	Mean % Rec	Sample S.D.	Calculated MDL
1 N-Nitrosodimethylamine	166.50	134.87	106.89	83.58	112.22	94.91	82.25	125.54	105.8	64	20.18	63.4
2 bis(2-Chloroethyl)ether	166.50	115.55	123.21	114.89	126.87	118.22	111.22	87.91	114.0	68	12.65	39.8
3 2-Chlorophenol	333.00	237.43	247.09	231.77	240.09	253.75	238.76	189.81	234.1	70	20.78	65.3
4 1,3-Dichlorobenzene	166.50	115.55	124.21	110.89	117.88	115.88	105.89	85.58	110.8	67	12.51	39.3
5 1,4-Dichlorobenzene	166.50	111.56	123.88	112.55	115.22	117.55	109.22	86.91	111.0	67	11.64	36.6
6 Benzyl alcohol	166.50	116.55	119.21	110.22	124.54	130.20	112.55	88.91	114.6	69	13.23	41.6
7 1,2-Dichlorobenzene	166.50	117.88	124.54	119.21	125.54	127.54	111.56	90.24	116.6	70	12.85	40.4
8 2-Methylphenol	333.00	127.54	126.21	118.55	123.88	123.54	122.54	98.90	120.2	36	9.80	30.8
9 bis(2-chloroisopropyl)ether	166.50	125.21	133.20	122.88	129.20	130.54	121.55	94.91	122.5	74	12.87	40.5
10 4-Methylphenol	333.00	112.22	125.87	107.89	119.21	119.21	120.88	88.25	113.4	34	12.54	39.4
11 n-Nitroso-di-n-propylamine	166.50	119.88	117.55	114.89	117.88	118.55	110.56	92.24	113.1	68	9.69	30.4
12 Hexachloroethane	166.50	104.23	111.56	104.23	109.89	116.55	106.89	87.91	105.9	64	9.05	28.4
13 Nitrobenzene	166.50	121.21	127.54	120.21	115.22	127.21	119.88	95.57	118.1	71	10.84	34.1
14 Isophorone	166.50	109.89	121.55	109.22	111.56	120.55	113.55	90.91	111.0	67	10.14	31.9
15 2-Nitrophenol	333.00	244.42	259.41	240.43	237.10	255.08	245.09	185.15	238.1	71	24.64	77.4
16 2,4-Dimethylphenol	333.00	179.15	220.11	209.12	209.79	205.46	213.45	171.50	201.2	60	18.40	57.8
17 bis(2-Chloroethoxy)methan	166.50	110.89	121.88	110.56	118.22	120.88	119.21	90.24	113.1	68	11.07	34.8
18 2,4-Dichlorophenol	333.00	226.77	242.76	230.77	227.44	246.75	229.44	173.16	225.3	68	24.28	76.3
19 1,2,4-Trichlorobenzene	166.50	120.55	123.54	116.22	119.55	123.21	121.21	91.91	116.6	70	11.16	35.1
20 Naphthalene	166.50	117.88	125.87	119.55	120.55	125.87	125.21	97.24	118.9	71	10.09	31.7
21 4-Chloroaniline	166.50	58.27	63.27	50.95	46.29	58.94	56.28	46.95	54.4	33	6.47	20.3
22 Hexachlorobutadiene	166.50	114.22	115.55	108.56	124.54	112.89	108.89	0.00	97.8	59	43.46	136.6
23 4-Chloro-3-methylphenol	333.00	239.09	261.74	238.10	243.09	265.40	248.09	201.13	242.4	73	21.09	66.3
24 2-Methylnaphthalene	166.50	158.18	163.84	153.18	159.17	173.83	161.84	123.21	156.2	94	15.87	49.9
25 2,4,6-Trichlorophenol	333.00	183.48	201.80	193.14	199.13	216.12	193.47	163.84	193.0	58	16.28	51.2
26 2,4,5-Trichlorophenol	333.00	98.57	110.22	105.56	108.23	106.56	107.89	86.58	103.4	31	8.28	26.0
27 2-Chloronaphthalene	166.50	116.55	129.54	119.55	125.87	126.21	121.88	101.90	120.2	72	9.19	28.9
28 2-Nitroaniline	166.50	85.58	92.24	86.25	100.23	92.57	93.57	71.26	88.8	53	9.17	28.8
29 Dimethylphthalate	166.50	116.55	133.87	121.55	130.54	128.54	123.88	104.89	122.8	74	9.81	30.8
30 Acenaphthylene	166.50	109.89	123.54	112.55	120.88	127.87	118.22	95.57	115.5	69	10.73	33.7
31 2,6-Dinitrotoluene	166.50	83.25	89.58	78.92	90.24	92.91	89.24	71.93	85.2	51	7.52	23.6
32 3-Nitroaniline	166.50	71.26	81.59	75.26	64.27	79.25	61.61	59.61	70.4	42	8.75	27.5
33 Acenaphthene	166.50	127.54	140.19	132.53	138.86	145.52	137.86	110.89	133.3	80	11.44	35.9
34 4-Nitrophenol	333.00	105.56	99.90	111.22	99.90	131.87	127.21	66.93	106.1	32	21.40	67.2
35 Dibenzofuran	166.50	118.22	131.20	122.88	127.54	134.87	123.21	99.23	122.4	74	11.65	36.6
36 2,4-Dinitrotoluene	166.50	69.93	80.25	73.59	87.25	82.58	80.92	58.94	76.2	46	9.53	30.0
37 Diethylphthalate	166.50	117.55	133.87	124.87	129.54	134.87	129.54	104.56	125.0	75	10.73	33.7
38 Fluorene	166.50	122.88	138.86	131.54	132.20	136.53	132.53	111.89	129.5	78	9.24	29.0
39 1,2-Diphenyl hydrazine	166.50	108.89	123.21	110.56	116.55	122.88	114.55	94.24	113.0	68	9.93	31.2
40 4-Chlorophenyl-phenylether	166.50	118.88	131.20	125.21	129.87	139.53	128.87	100.23	124.8	75	12.51	39.3
41 4-Nitroaniline	166.50	88.58	94.24	88.25	96.24	90.24	89.91	67.60	87.9	53	9.42	29.6
42 4,6-Dinitro-2,methylphenol	333.00	110.89	106.89	102.90	106.89	114.22	99.23	80.59	103.1	31	11.07	34.8
43 n-Nitrosodiphenylamine	166.50	109.56	117.88	105.23	116.22	117.22	112.89	91.58	110.1	66	9.34	29.4
44 4-Bromophenyl-phenylether	166.50	116.22	127.87	119.55	121.55	126.21	121.21	95.24	118.3	71	10.88	34.2
45 Hexachlorobenzene	166.50	119.21	121.88	111.22	124.87	123.54	119.88	94.57	116.5	70	10.62	33.4
46 Pentachlorophenol	333.00	53.61	83.92	65.93	78.92	66.27	83.92	0.00	61.8	19	29.42	92.5

47	Phenanthrene	166.50	122.54	136.86	114.89	133.20	134.87	129.87	94.24	123.8	74	15.13	47.5
48	Anthracene	166.50	115.55	125.54	116.22	125.87	128.54	119.88	95.57	118.2	71	11.15	35.0
49	Di-n-butylphthalate	166.50	141.19	195.47	123.21	131.20	154.18	141.53	119.88	143.8	86	25.64	80.6
50	Fluoranthrene	166.50	115.22	128.21	117.55	129.54	128.21	126.87	98.57	120.6	72	11.24	35.3
51	Benzidine	1665.00	904.76	1661.00	1150.85	1566.43	1101.23	869.80	839.83	1156.3	69	334.54	1051.5
52	Pyrene	166.50	119.21	136.20	125.21	128.87	131.54	130.20	108.56	125.7	75	9.23	29.0
53	Butylbenzylphthalate	166.50	108.23	123.54	110.56	116.55	120.88	115.88	99.90	113.6	68	8.08	25.4
54	Benzo[a]anthracene	166.50	118.22	138.20	128.87	126.21	131.87	121.88	103.90	124.2	75	11.06	34.8
55	3,3'-Dichlorobenzidine	1665.00	681.32	655.01	553.45	554.11	720.61	678.65	515.82	622.7	37	79.71	250.5
56	Chrysene	166.50	80.92	95.57	87.58	91.58	91.24	91.58	75.92	87.8	53	6.94	21.8
57	bis(2-Ethylhexyl)phthalate	166.50	134.53	150.18	138.53	132.87	152.51	141.53	113.55	137.7	83	12.96	40.7
58	Di-n-octylphthalate	166.50	103.90	114.22	107.23	115.88	117.22	114.22	89.24	108.8	65	9.91	31.1
59	Benzo[b]fluoranthene	166.50	102.56	111.56	92.57	102.56	110.89	107.89	80.59	101.2	61	11.17	35.1
60	Benzo[k]fluoranthene	166.50	92.24	109.22	92.57	102.23	113.89	111.22	66.93	98.3	59	16.32	51.3
61	Benzo[a]pyrene	166.50	79.92	96.90	81.92	88.91	93.57	87.58	71.93	85.8	52	8.55	26.9
62	Indeno[1,2,3-cd]pyrene	166.50	94.57	110.22	95.24	106.56	113.22	106.23	82.25	101.2	61	10.94	34.4
63	Dibenz[a,h]anthracene	166.50	104.56	118.22	95.24	106.56	111.89	110.22	81.92	104.1	63	12.07	37.9
64	Benzo[g,h,i]perylene	166.50	99.23	109.56	92.24	100.90	107.23	106.89	85.91	100.3	60	8.67	27.2

Purpose	Pesticide Method Detection Limit Study
Location	IEA-New Jersey
Matrix	Soil
Method	SW846 Method 8080
Date	March 22, 1995
Analyst	Louise Schultz
Instrument ID	HP58901B
Spreadsheet ID.	P846SO95.WB2
Column	RTX-35

		Spike Conc. ug/l	Laboratory Sample Identification Number MDL #1	MDL #2	MDL #3	MDL #4	MDL #5	MDL #6	MDL #7	Mean Conc.	Mean % Rec.	Sample S.D.	Calculated MDL
1	a-BHC	1.67	1.49	1.20	1.22	1.22	1.20	1.18	1.26	1.25	75	0.108	0.338
2	g-BHC	1.67	1.49	1.29	1.26	1.34	1.33	1.19	1.31	1.32	79	0.092	0.289
3	Heptachlor	1.67	1.75	1.44	1.48	1.52	1.57	1.45	1.54	1.54	92	0.106	0.332
4	Endosulfan I	1.67	1.68	1.38	1.33	1.25	1.36	1.32	1.43	1.39	84	0.138	0.435
5	Dieldrin	3.33	3.16	2.53	2.65	2.60	2.83	2.49	3.00	2.75	83	0.253	0.797
6	Endrin	3.33	3.6	2.84	2.76	3.00	3.33	2.81	2.96	3.04	91	0.310	0.975
7	4,4'-DDD	3.33	3.27	2.67	2.73	2.82	3.21	2.62	2.82	2.88	86	0.259	0.814
8	4,4'-DDT	3.33	3.02	2.41	2.42	2.50	2.61	2.34	2.60	2.56	77	0.227	0.714
9	Methoxychlor	16.65	15.58	12.72	12.55	12.95	12.99	12.19	13.25	13.18	79	1.114	3.500
10	b-BHC	1.67	1.17	1.43	1.37	1.17	1.18	1.35	1.29	1.28	77	0.108	0.339
11	d-BHC	1.67	1.4	1.54	1.54	1.39	1.48	1.47	1.46	1.47	88	0.060	0.187
12	Aldrin	1.67	2.33	1.71	2.20	6.23	3.56	1.83	1.89	2.82	169	1.627	5.113
13	Heptachlor Epoxide	1.67	1.54	1.53	1.56	1.49	1.61	1.56	1.51	1.54	93	0.039	0.123
14	g-Chlordane	1.67	1.47	1.53	2.54	1.43	1.54	1.47	1.50	1.64	98	0.399	1.253
15	a-Chlordane	1.67	1.37	1.50	1.51	1.41	1.48	1.46	1.47	1.46	88	0.050	0.158
16	4,4'-DDE	3.33	2.78	2.99	3.01	2.83	3.07	2.82	2.82	2.90	87	0.116	0.366
17	Endosulfan II	3.33	2.88	2.99	3.04	2.89	2.93	2.92	2.93	2.94	88	0.057	0.178
18	Endrin Aldehyde	3.33	3.86	3.50	3.43	3.24	3.16	3.56	3.19	3.42	103	0.249	0.783
19	Endosulfan Sulfate	3.33	3.09	3.43	3.66	3.18	2.85	3.40	2.86	3.21	96	0.304	0.955
20	Endrin Ketone	3.33	2.68	2.68	2.70	2.75	2.68	2.61	2.67	2.68	81	0.041	0.130

Calculated MDL is based on 10 ml final volume

Purpose	Pesticide Method Detection Limit Study
Location	IEA-New Jersey
Matrix	Water
Method	SW846 Method 8080
Date	March 17, 1995
Analyst	Louise Schultz
Instrument ID	HP58901B
Spreadsheet ID.	P846AQ95.WQ1
Column	RTX-35

		Spike Conc. ug/l	Laboratory Sample Identification Number MDL #1	MDL #2	MDL #3	MDL #4	MDL #5	MDL #6	MDL #7	Mean Conc.	Mean % Rec.	Sample S.D.	Calculated MDL	GWQC Calculated MDL
1	a-BHC	0.05	0.0418	0.0411	0.0403	0.0373	0.0428	0.0411	0.0419	0.0409	82	0.0018	0.006	0.0011
2	g-BHC	0.05	0.0431	0.0448	0.0420	0.0387	0.0444	0.0426	0.0419	0.0425	85	0.0020	0.006	0.0013
3	Heptachlor	0.05	0.0477	0.0470	0.0463	0.0424	0.0490	0.0461	0.0536	0.0474	95	0.0034	0.011	0.0021
4	Endosulfan I	0.05	0.0542	0.0542	0.0546	0.0474	0.0490	0.0523	0.0550	0.0524	105	0.0030	0.009	0.0019
5	Dieldrin	0.10	0.1010	0.1040	0.0992	0.0916	0.1020	0.0965	0.1060	0.1000	100	0.0048	0.015	0.0030
6	Endrin	0.10	0.1140	0.1160	0.1140	0.1000	0.1220	0.1140	0.1180	0.1140	114	0.0068	0.021	0.0043
7	4,4'-DDD	0.10	0.0846	0.0885	0.0815	0.0795	0.0913	0.0866	0.0889	0.0858	86	0.0042	0.013	0.0027
8	4,4'-DDT	0.10	0.0886	0.0902	0.0849	0.0792	0.0911	0.0856	0.0933	0.0876	88	0.0047	0.015	0.0030
9	Methoxychlor	0.50	0.4880	0.4940	0.4650	0.4290	0.4910	0.4580	0.4730	0.4711	94	0.0231	0.072	0.0145
10	b-BHC	0.05	0.0510	0.0504	0.0506	0.0495	0.0518	0.0493	0.0506	0.0505	101	0.0009	0.003	0.0005
11	d-BHC	0.05	0.0452	0.0434	0.0538	0.0515	0.0443	0.0489	0.0485	0.0479	96	0.0039	0.012	0.0024
12	Aldrin	0.05	0.0466	0.0392	0.0418	0.0426	0.0473	0.0468	0.1040	0.0526	105	0.0229	0.072	0.0144
13	Heptachlor Epoxide	0.05	0.0471	0.0456	0.0467	0.0464	0.0463	0.0461	0.0470	0.0465	93	0.0005	0.002	0.0003
14	g-Chlordane	0.05	0.0440	0.0426	0.0444	0.0450	0.0457	0.0460	0.0458	0.0448	90	0.0012	0.004	0.0008
15	a-Chlordane	0.05	0.0449	0.0428	0.0446	0.0446	0.0498	0.0449	0.0461	0.0454	91	0.0022	0.007	0.0014
16	4,4'-DDE	0.10	0.0886	0.0847	0.0896	0.0884	0.0894	0.0873	0.0927	0.0887	89	0.0024	0.008	0.0015
17	Endosulfan II	0.10	0.0900	0.0870	0.0918	0.0896	0.0904	0.0895	0.0928	0.0902	90	0.0018	0.006	0.0012
18	Endrin Aldehyde	0.10	0.1090	0.1090	0.1160	0.1080	0.1090	0.1020	0.1210	0.1106	111	0.0061	0.019	0.0039
19	Endosulfan Sulfate	0.10	0.0884	0.0943	0.1010	0.0885	0.0951	0.0876	0.0946	0.0928	93	0.0049	0.015	0.0031
20	Endrin Ketone	0.10	0.0826	0.0817	0.0823	0.0829	0.0829	0.0848	0.0846	0.0831	83	0.0012	0.004	0.0007

Calculated MDL is based on 10 ml final volume
GWQC calculated MDL is based on 2 ml final volume

Purpose	Pesticide Method Detection Limit Study
Location	IEA-New Jersey
Matrix	Water
Method	USEPA Method 608
Date	March 17, 1995
Analyst	Louise Schultz
Instrument ID	HP58901B
Spreadsheet ID.	P608AQ95.WQ1
Column	RTX-35

		Spike Conc. ug/l	MDL #1	MDL #2	MDL #3	MDL #4	MDL #5	MDL #6	MDL #7	Mean Conc.	Mean % Rec.	Sample S.D.	Calculated MDL	GWQC Calculated MDL
			Laboratory Sample Identification Number											
1	a-BHC	0.05	0.0418	0.0411	0.0403	0.0373	0.0428	0.0411	0.0419	0.0409	82	0.0018	0.006	0.0011
2	g-BHC	0.05	0.0431	0.0448	0.0420	0.0387	0.0444	0.0426	0.0419	0.0425	85	0.0020	0.006	0.0013
3	Heptachlor	0.05	0.0477	0.0470	0.0463	0.0424	0.0490	0.0461	0.0536	0.0474	95	0.0034	0.011	0.0021
4	Endosulfan I	0.05	0.0542	0.0542	0.0546	0.0474	0.0490	0.0523	0.0550	0.0524	105	0.0030	0.009	0.0019
5	Dieldrin	0.10	0.1010	0.1040	0.0992	0.0916	0.1020	0.0965	0.1060	0.1000	100	0.0048	0.015	0.0030
6	Endrin	0.10	0.1140	0.1160	0.1140	0.1000	0.1220	0.1140	0.1180	0.1140	114	0.0068	0.021	0.0043
7	4,4'-DDD	0.10	0.0846	0.0885	0.0815	0.0795	0.0913	0.0866	0.0889	0.0858	86	0.0042	0.013	0.0027
8	4,4'-DDT	0.10	0.0886	0.0902	0.0849	0.0792	0.0911	0.0856	0.0933	0.0876	88	0.0047	0.015	0.0030
9	Methoxychlor	0.50	0.4880	0.4940	0.4650	0.4290	0.4910	0.4580	0.4730	0.4711	94	0.0231	0.072	0.0145
10	b-BHC	0.05	0.0510	0.0504	0.0506	0.0495	0.0518	0.0493	0.0506	0.0505	101	0.0009	0.003	0.0005
11	d-BHC	0.05	0.0452	0.0434	0.0538	0.0515	0.0443	0.0489	0.0485	0.0479	96	0.0039	0.012	0.0024
12	Aldrin	0.05	0.0466	0.0392	0.0418	0.0426	0.0473	0.0468	0.1040	0.0526	105	0.0229	0.072	0.0144
13	Heptachlor Epoxide	0.05	0.0471	0.0456	0.0467	0.0464	0.0463	0.0461	0.0470	0.0465	93	0.0005	0.002	0.0003
14	g-Chlordane	0.05	0.0440	0.0426	0.0444	0.0450	0.0457	0.0460	0.0458	0.0448	90	0.0012	0.004	0.0008
15	a-Chlordane	0.05	0.0449	0.0428	0.0446	0.0446	0.0498	0.0449	0.0461	0.0454	91	0.0022	0.007	0.0014
16	4,4'-DDE	0.10	0.0886	0.0847	0.0896	0.0884	0.0894	0.0873	0.0927	0.0887	89	0.0024	0.008	0.0015
17	Endosulfan II	0.10	0.0900	0.0870	0.0918	0.0896	0.0904	0.0895	0.0928	0.0902	90	0.0018	0.006	0.0012
18	Endrin Aldehyde	0.10	0.1090	0.1090	0.1160	0.1080	0.1090	0.1020	0.1210	0.1106	111	0.0061	0.019	0.0039
19	Endosulfan Sulfate	0.10	0.0884	0.0943	0.1010	0.0885	0.0951	0.0876	0.0946	0.0928	93	0.0049	0.015	0.0031
20	Endrin Ketone	0.10	0.0826	0.0817	0.0823	0.0829	0.0829	0.0848	0.0846	0.0831	83	0.0012	0.004	0.0007

Calculated MDL is based on 10 ml final volume
GWQC calculated MDL is based on 2 ml final volume

Purpose	Water Method Detection Limit Study for Volatile Aromatics
Location	IEA-New Jersey
Matrix	Water
Method	EPA Method 602
Date	August 1995
Analyst	Claus Herrmann
Instrument ID	GC Purge and Trap
Spreadsheet ID.	MDL602GC.WQ2
Column	DBWAX

	Spike Conc. ug/l	Laboratory Sample Identification Number #1	#2	#3	#4	#5	#6	#7	Mean Conc.	Mean % Rec.	Sample S.D.	Calculated MDL
1 Benzene	0.500	0.571	0.583	0.548	0.558	0.492	0.554	0.538	0.549	109.8	0.029	0.092
2 Toluene	0.500	0.725	0.793	0.742	0.690	0.716	0.752	0.784	0.743	148.6	0.037	0.116
3 Ethylbenzene	0.500	0.479	0.502	0.463	0.475	0.463	0.485	0.517	0.483	96.7	0.020	0.063
4 1,3-Dichlorobenzene	1.000	1.410	1.500	1.440	1.410	1.350	1.370	1.420	1.414	141.4	0.049	0.153
5 1,4-Dichlorobenzene	1.000	1.580	1.670	1.610	1.530	1.510	1.530	1.590	1.574	157.4	0.056	0.176
6 1,3-Dichlorobenzene	1.000	2.020	1.980	1.950	1.860	1.880	1.920	1.900	1.930	193.0	0.057	0.179

All concentrations shown as ug/L

Appendix B

Health and Safety Plan
Evor Phillips Site
Site Excavation Activities
Old Bridge, New Jersey

September, 1996

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

8 South River Road
Cranbury, New Jersey 08512-9502
(609) 860-0590

Approvals and Acknowledgments

Approvals

I have read and approved this HASP with respect to project hazards, regulatory requirements, and BBL procedures.

Project Name: Evor Phillips Site Excavation Activities

_____ _____

Project Manager/Date Corporate HS Associate/Date

_____

Project/Site HS Staff/Date

Acknowledgments

The final approved version of this HASP has been provided to the Site Supervisor. I acknowledge my responsibility to provide the Site Supervisor with the equipment, materials and qualified personnel to implement fully all safety requirements in this HASP. I will formally review this plan with the HS Staff every six months until project completion.

_____ _____

Project Manager Date

I acknowledge receipt of this HASP from the Project Manager, and that it is my responsibility to explain its contents to all site personnel and cause these requirements to be fully implemented. Any change in conditions, scope of work, or other change that might affect worker safety requires me to notify the Project Manager and/or the Health and Safety Representative.

_____ _____

Site Supervisor Date

Health and Safety Plan Acknowledgment

I have read this Site-Specific Health and Safety Plan, or its contents have been presented to me, and I understand the contents, and I agree to abide by its requirements.

Name (Print)	Signature	Representing	Date

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1. Introduction

1.1 Objective

The objective of BBL site activities is to provide oversight of contractor activities during excavation of potential buried anomalies identified during the geophysical survey at the Evor Phillips Leasing Company (EPLC) site in Old Bridge, New Jersey. Test pits will be excavated in each of the areas to identify or characterize the anomalies and to remove any drums. BBL personnel will not participate in excavation activities, but will be working in proximity to these activities.

The objective of this plan is to provide a mechanism for establishing safe working conditions for BBL employees at the site.

1.2 Site and Facility Description

The EPLC site has been owned and occupied by numerous entities since the early 1970s, prior to which little or no site use information is available. Since the early 1970s, the site was used for industrial waste treatment operations. Two treatment ponds were reportedly used for the neutralization of acidic and caustic wastewaters until their closure in 1975. Silver recovery operations, including incineration of film materials, and oil recovery operations also were reportedly conducted at the site during the early 1970s.

Based on court testimony and information provided by confidential informants, extensive waste disposal activities are thought to have occurred on-site. The disposal of bulk acids and caustic solutions, silver- and cyanide-contaminated wastewaters associated with silver recovery operations, and drum and gas cylinders has been alleged. A review of historic aerial photographs confirmed the presence of drums and containers on the site during the 1970s. [*Taken from TRC Environmental Consultants, Inc. - Remedial Investigation Report (10/91]*

1.3 Policy Statement

The policy of Blasland, Bouck & Lee, Inc. (BBL) is to provide a safe and healthful work environment for all employees. No aspect of operations is of greater importance than injury and illness prevention. A fundamental principle of safety is the belief that all accidents and injuries are preventable. BBL will take every reasonable step to eliminate or control hazards in order to minimize the possibility of injury, illness, or accident involving a BBL employee.

This Health and Safety Plan (HASP) prescribes the procedures that must be followed by BBL employees during referenced site activities. Operational changes that could affect the health and safety (H&S) of personnel, the community, or the environment will not be made without the prior approval of the Project Manager, and the Regional Health and Safety Coordinator. This document will be periodically reviewed to ensure that it is current and technically correct. Any changes in site conditions and/or the scope of work will involve a review and modification to the HASP. Such changes will be completed in the form of an addendum.

The provisions of this plan are mandatory for all BBL personnel and subcontractors assigned to the project. The employees of other contracted companies will work in accordance with their own independent HASPs. All visitors to the work site must abide by the requirements of the construction contractor's HASP.

This HASP is not intended or represented to be suitable for use by other organizations,

This HASP is not intended or represented to be suitable for use by other organizations, or for reuse by Client or others on extensions of this or any other project. Any reuse without prior written approval or adaptation by BBL will be at the user's sole risk and without liability and legal exposure to BBL. Any requested modification or adaptation of this HASP will entitle BBL to further compensation at rates to be agreed upon by Client or others and BBL.

1.4 References

This HASP complies with applicable Occupational Safety and Health Administration (OSHA) regulations, United States Environmental Protection Agency (USEPA) regulations, and BBL Health and Safety policies and procedures. This plan follows the guidelines established in the following:

- *Standard Operating Safety Guides*, EPA (Publication 9285.1-03, June 1992).
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, NIOSH, OSHA, USCG, EPA (86-116, October 1985).
- Title 29 of the Code of Federal Regulations (CFR), Part 1910.120.
- Title 29 of the Code of Federal Regulations (CFR), Part 1926.
- *Pocket Guide to Chemical Hazards*, DHHS, PHS, CDC, NIOSH, (1994).
- *Threshold Limit Values*, ACGIH, (1995)
- *Quick Selection Guide to Chemical Protective Clothing*, Forsberg, K. and S.Z. Mansdorf, 2nd Ed., (1993).
- *Health and Safety Policies and Procedures Manual*, BBL.

1.5 Definitions

The following definitions are applicable to this HASP:

- *Site* - The area where the work is to be performed. The site may not include areas of the facility that have been fully characterized, are not subject to remedial action, and not potentially affected by activities conducted under this HASP. Figure 1 delineates the boundaries of the site.

- *Project* - All on-site work performed under the project scope of work.

- *Subcontractor* - Includes subcontractor personnel hired on-site by BBL.

- *On-Site Personnel* - All EPLC Site Advisory Group, BBL, and BBL subcontractor personnel involved with the project.

- *Visitor* - All other personnel, except the on-site personnel. All visitors must receive approval to enter the site.

- *Exclusion Zone* - Any portion of the site where hazardous substances are, or are reasonably suspected to be, present in the air, water or soil.

- *Contamination Reduction Zone* - Area between the Exclusion Zone and Clean Zone that provides a transition between contaminated and clean areas. Decontamination stations are located in this zone.

- *Clean/Support Zone* - The rest of the site. Support equipment is located in this zone.

2. Roles and Responsibilities

2.1 BBL Personnel

BBL personnel must adhere to these procedures during the performance of their work. Each person is responsible for completing tasks safely, and reporting any unsafe acts or conditions to his or her immediate supervisor or to the Site Supervisor. No person may work in a manner that conflicts with the safety and environmental precautions expressed in these procedures.

BBL on-site personnel will receive training in accordance with 29 CFR 1910.120 and be familiar with the requirements and procedures contained in this document prior to the beginning of project operations.

The roles of key BBL personnel are outlined in the following sections. Key personnel and contacts are summarized in Table 2-1.

2.2 Regional Health and Safety Coordinator

The Regional Health and Safety Coordinator (RHSC) or other BBL Division 61 representative is responsible for technical health and safety aspects of the project, including review and approval of this HASP. Inquiries regarding BBL procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. Any changes or addenda to this HASP must be approved by the RHSC or other member of Division 61.

2.3 Health and Safety Supervisor

The site/project Health and Safety Supervisor (HSS) is responsible for coordinating site H&S issues. The HSS will advise the Project Manager on H&S issues, and will establish and oversee the project air monitoring program. The HSS is the primary site contact on occupational H&S.

It is the responsibility of the HSS or designated alternate to:

- verify that all on-site personnel are made aware of the provisions of the HASP and have been informed of the nature of any physical and/or chemical hazards associated with the site activities;
- maintain a daily logbook for recording all significant H&S activities and incidents;
- verify that on-site personnel and visitors have received the required training, including instructions for safety equipment and personal protective equipment use;
- suspend work if health and/or safety-related concerns arise;
- provide on-site technical assistance;
- conduct site and personal air monitoring, including equipment maintenance and calibration. Where necessary, submit samples to an American Industrial Hygiene Association (AIHA) accredited laboratory;
- issue/obtain required work permits;
- conduct site safety orientation training and daily safety meetings;

- verify that on-site personnel have received the required physical examinations and medical certifications;
- review site activities with respect to the adequacy of the HASP; and
- maintain required H&S documents and records on-site.

2.4 Project Manager

The Project Manager (PM) is ultimately responsible for ensuring that all project activities are completed in accordance with the requirements and procedures in this plan. The PM is responsible to provide the Site Supervisor with the equipment, materials and qualified personnel to implement fully all safety requirements in this HASP.

It is the responsibility of the PM to:

- Report all accidents and incidents to the RHSC, and thoroughly investigate all such occurrences on the project;
- Approve, in writing, any addenda or modifications of this HASP;
- Suspend work if health and/or safety-related concerns arise; and
- Formally review this plan with the RHSC or HSM every three months until the project is completed.

2.5 Site Supervisor

The Site Supervisor (SS) is responsible for implementation of the HASP, including communication of site requirements to all on-site project personnel (including subcontractors) and consultation with the HSS. The SS will be responsible for informing the RHSC and the PM of any changes in the work plan or procedures so that those changes may be addressed in the HASP. Other responsibilities include:

- Stopping work, as required, to ensure personal safety and protection of property, or in cases of life or property-threatening safety noncompliance;
- Obtaining a site map and determining and posting routes to medical facilities and emergency telephone numbers, and arranging emergency transportation to medical facilities;
- Notifying local public emergency officers of the nature of the site operations, and posting of their telephone numbers in an appropriate location;
- Observing on-site project personnel for signs of chemical or physical trauma; and
- Verifying that all site personnel have the proper medical clearance, have met applicable training requirements, and have training documentation available in the office.

2.6 On-Site Personnel and Visitors

All personnel must read and acknowledge their understanding of this HASP, abide by the requirements of the plan, and cooperate with site supervision in ensuring a safe work site. Site personnel will immediately report any of the following to the SS or HSS:

- Accidents and injuries, no matter how minor;
- Unexpected or uncontrolled release of chemical substances;
- Symptoms of chemical exposure;
- Unsafe or malfunctioning equipment;
- Changes in site conditions that may affect the H&S of project personnel;
- Damage to equipment or property;
- Conditions or activities for which they are not properly trained;

TABLE 2-1
KEY PERSONNEL

Technical Committee Key Personnel		
Title/Role	**Name**	**Address/Telephone No.**
Chairman of the EPLCAd Hoc Generator Group	Ms. Lisa Kaul	Environmental Project Control 701 Devonshire Dr. C-17 Champaign, Ill 61820
Blasland, Bouck & Lee Key Personnel		
Role	**Name**	**Address/Telephone No.**
Corporate Health and Safety Associate	Jay D. Keough, CIH	8 South River Road Cranbury, NJ 08512 (609) 860-0590
Regional Health and Safety Coordinator	Herrick Teeter, IHIT	6723 Towpath Rd., Syracuse, N.Y. 13214 (315) 446-9120
Divisional Health and Safety Coordinator	Michael J. McNally	8 South River Road Cranbury, NJ 08512 (609) 860-0590
Site Supervisor/Health and Safety Supervisor	David Montanari or Michael Fleischner	8 South River Road Cranbury, NJ 08512 (609) 860-0590
Project Manager/Project Officer	Joseph J. Hochreiter	8 South River Road Cranbury, NJ 08512 (609) 860-0590

3. Project Hazards and Control Measures

3.1 Scope of Work

The scope of work includes oversight of contractor activities during excavation of potential buried anomalies identified during the geophysical survey. Test pits will be excavated in each of the areas to identify or characterize the anomalies and to remove any drums. BBL personnel will not participate in excavation activities, but will be working in proximity to these activities.

3.1.1 Job Hazard Assessment

A job hazard assessment is necessary to identify potential safety, health, and environmental hazards associated with each type of field activity. Because of the complex and changing nature of field projects, supervisors must continually inspect the work site to identify hazards that may harm site personnel, the community, or the environment. The SS must be aware of these changing conditions and discuss them with the HSS, RHSC, and the PM whenever these changes impact employee health, safety, the environment, or performance of the project. The SS will keep BBL personnel and subcontractors informed of the changing conditions and the RHSC will write or approve addenda to this HASP as necessary.

3.2 Field Activities, Hazards, Control Procedures

3.2.1 Mobilization

Site mobilization will include establishing exclusion, contamination reduction, and support zones. A break area will be set up outside the regulated work area. Mobilization may involve clearing areas for the support and contamination reduction zones. During this initial phase, project personnel will walk the site to confirm the existence of anticipated hazards and identify safety and health issues that may have arisen since the writing of this plan.

The hazards of this phase of activity are associated with heavy equipment movement, manual materials handling, installation of temporary on-site facilities, and manual site preparation.

Manual materials handling and manual site preparation may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Freezing-weather hazards include frozen, slick, and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces and unstable soil.

Environmental hazards include plants, such as poison ivy, poison oak; aggressive fauna, such as ticks, fleas, mosquitos, wasps, spiders, and snakes; weather, such as sunburn, lightning, rain, and heat and cold-related illnesses; and pathogens, such as rabies, Lyme disease, and blood-borne pathogens. Control procedures for these hazards are discussed in Section 4.0.

3.2.1.1 Excavation Oversight

This task involves oversight of a contractor during excavation of identified anomalies. BBL personnel will not participate in the excavation activities, but will be observing.

Physical Hazards: The physical hazards involved in excavation oversight are related

Physical Hazards: The physical hazards involved in excavation oversight are related to working in proximity to heavy equipment, and work in proximity to excavations. The presence of overhead utilities such as power lines requires careful positioning of all heavy equipment in order to maintain a safe distance between the lines and the closest part of the equipment. The presence of underground utilities such as gas lines, power lines, water lines, and sewer pipes must be determined prior to beginning any excavation.

Excavations pose significant hazards to employees if they are not carefully controlled. There exists a chance for the excavation to collapse in on itself if it is not dug properly, sloped, benched or shored as required. The excavation is also a fall hazard, and employees must pay careful attention to what they are doing or they risk a fall into the excavation.

All observation activities will be conducted from outside the excavation.

Noise may also present a hazard. Heavy equipment operation frequently results in noise levels exceeding 85 dBA, requiring the use of hearing protection for exposed personnel.

Chemical Hazards: Airborne concentrations of dust from excavation activities pose the potential for exposure.

Control: All excavation should be performed by locating the equipment in the most stable ground position possible. If necessary, the area will be compacted or otherwise prepared in order to safely support the equipment.

Daily inspections of all excavations shall be made by a competent person, one who has received training in excavation safety. The inspector shall determine the likelihood of a cave-in, and remedial action such as sloping or shoring shall be taken if the walls appear to be unstable.

All spoil shall be located at least 2 feet from the edge of an active excavation to prevent it from falling back into the excavation. The excavation shall be guarded on all sides by barricades or caution tape at least 2 feet from the edge to warn vehicle and equipment operators of its presence.

All project personnel shall participate in the Daily Safety Meetings and be instructed on the following requirements:

- Before excavating, the existence and location of overhead power lines will be confirmed with the equipment operators. Careful observance of the required clearances is essential.

- When excavating equipment is located in the vicinity of overhead power lines, a minimum distance must be maintained between the lines and any point on the equipment. The following table presents minimum distances for various power lines.

Nominal System Voltage	Minimum Required Clearance
0-50 kV	10 feet
51-100 kV	12 feet
101-200 kV	15 feet
201-300 kV	20 feet
301-500 kV	25 feet
501-750 kV	35 feet
751-1000 kV	45 feet

When the equipment is in transit, with the boom lowered and no load, the equipment clearance must be at least 4 feet for voltages less than 50kV, 10 feet for voltages of 50 kV to 345 kV, and 16 feet for voltages above 345 kV.

Dust Control - If necessary, airborne particulate generation will be controlled during site excavation activities. Dry, dusty soil will be wetted with a fine water spray to control the generation of dust. The material will not be wetted to a degree which will cause runoff or erosion.

3.2.2 Decontamination Activities

All BBL vehicles and equipment will be decontaminated before leaving the site. Personnel involved in decontamination activities may be exposed to skin contact with contaminated soil, volatile emissions from contaminated vehicles and equipment, water spray, noise, and cold stress from the water spray. Personnel involved in decontamination activities wear personal protective equipment, typically one level below the level worn by personnel working in the exclusion zone.

3.2.3 Demobilization

Demobilization will involve the removal of all equipment, supplies, and vehicles brought to the site. The physical hazards of this phase of activity are associated with manual materials handling. Manual materials handling may cause blisters, sore muscles, and joint and skeletal injuries. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Freezing weather hazards include frozen, slick, and irregular walking surfaces. Wet weather may cause wet, muddy, slick walking surfaces.

Exposure to contaminated soil is possible. Airborne contaminants will be monitored for volatile organic compounds and total dust according to Section 8, Air Monitoring. Decisions on personal protective equipment (PPE) for the chemical hazards will be based on measurements made before and during work activities in accordance with Section 5 of this HASP.

Environmental hazards include plants, such as poison ivy, and poison oak; aggressive fauna, such as ticks, fleas, mosquitos, wasps, spiders, and snakes; weather, such as sunburn, lightning, rain, and heat and cold-related illnesses; and pathogens, such as rabies, Lyme disease, and blood borne pathogens.

3.3 Chemical Hazards

The chemical hazards associated with site operations are related to inhalation, ingestion, and skin exposure to site constituents of concern.

Airborne concentrations of constituents of concern during certain site tasks may be significant, and will require air monitoring of potentially toxic and flammable atmospheres during such operations. Air monitoring will be conducted by the site construction contractor.

The potential for inhalation of contaminants during site operations is low for sampling operations, and moderate for drilling and excavation operations. The potential for dermal contact with contaminated soils during drilling, excavation, and sampling operations is high.

Table 3-2 lists the chemical hazardous properties of the site constituents of concern (COCs).

Table 3-3 lists the exposure limits and anticipated levels of COCs at the site.

The Material Safety Data Sheets (MSDSs) for constituents of concern and materials used on site are included in Appendix A.

TABLE 3-3
EXPOSURE LIMITS AND ANTICIPATED LEVELS OF CONSTITUENTS OF CONCERN

Constituent of Concern[1]	OSHA PEL	ACGIH TLV	Media Contaminated	Range of Constituent Concentrations On Site[2]
Arsenic	0.01 mg/m3	0.01 mg/m3	Soil	0-53 ppm
Beryllium	0.002 mg/m3	0.002 mg/m3	Soil	0-110 ppm
Cadmium	0.005 mg/m3	0.01 mg/m3	Soil	0-69 ppm
Copper	1 mg/m3	1 mg/m3	Soil	0-13,900 ppm
Mercury	0.025 mg/m3	0.05 mg/m3	Soil	0-25 ppm
Lead	0.05 mg/m3	0.05 mg/m3	Soil	420-877 ppm
Nickel	0.01 mg/m3	0.01 mg/m3	Soil	0-440 ppm
PCBs	0.5 mg/m3	0.5 mg/m3	Soil	0-6 ppm
Selenium	0.2 mg/m3	0.2 mg/m3	Soil	0-345 ppm
Zinc (oxide)	5 mg/m3	5 mg/m3	Soil	0-2000 ppm
Benzo (k) fluoranthene	-	-	Soil	0-19 ppm
Benzo (a) pyrene	-	-	Soil	1-7 ppm
Indeno (1,2,3,cd) pyrene	-	-	Soil	0-5 ppm
Dibenzo (a,h) anthracene	-	-	Soil	0-3 ppm
Benzo (a) anthracene	-	-	Soil	0-7 ppm
Chrysene	-	-	Soil	0-13 ppm

[2] Provides high and low constituent levels from previous site sampling. If no previous sampling has been completed values represent anticipated contaminant levels.

ppm = parts contaminant per million parts soil mg/m^3 = milligrams per cubic meter of air

4. General Safety Practices

4.1 General Practices

- At least one copy of this plan must be at the project site, in a location readily available to BBL personnel, and reviewed by BBL project personnel prior to their starting work.

- BBL site personnel must work within sight or call of another site worker.

- Contaminated protective equipment, such as respirators, hoses, boots, etc., must not be removed from the regulated area before being cleaned or properly packaged and labeled.

- Contaminated waste, debris, and clothing must be properly contained, and legible and understandable precautionary labels must be affixed to the containers.

- Removing contaminated soil from protective clothing or equipment with compressed air, shaking, or any other means that disperses contaminants into the air is prohibited.

- Food, beverages, or tobacco products must not be present or consumed in the exclusion and contamination reduction zones. Cosmetics must not be applied within these zones.

- Containers must be moved only with the proper equipment, and must be secured to prevent dropping or loss of control during transport.

- Emergency equipment such as eyewash, fire extinguishers, portable shower, etc. must be removed from storage areas and staged in readily accessible locations.

- Employees must inform site co workers of nonvisible effects of exposure to toxic materials. The symptoms of such exposure may include:

  - Headaches;
  - Dizziness;
  - Nausea;
  - Blurred vision;
  - Cramps; and
  - Irritation of eyes, skin, or respiratory tract.

- Visitors to the site must abide by the following:

  - All visitors must be instructed to stay outside the exclusion and contamination reduction zones, and remain within the support zone during the extent of their stay. Visitors must be cautioned to avoid skin contact with surfaces which are contaminated or suspected to be contaminated.

  - Visitors requesting to observe work in the exclusion zone must don all appropriate PPE prior to entry into that zone, and must be cleared for hazardous waste work as evidenced by a complete physical examination; have 40-hours of hazardous waste operations training; and have 8-hours of refresher training within

the past 12 months. If respiratory protective devices are necessary, visitors who wish to enter the contaminated zone must have been respirator-trained and fit tested for a respirator within the past 12 months;

- Visitor inspection of the contaminated area is at the discretion of the SS.

4.1.1 Buddy System

BBL on-site personnel must use the buddy system. Visual contact must be maintained with another site worker at all times, and site personnel must observe each other for signs of chemical exposure, or heat or cold stress. Indication of adverse effects include, but are not limited to:

- Changes in complexion and skin coloration;
- Changes in coordination;
- Changes in demeanor;
- Excessive salivation and pupillary response; and
- Changes in speech pattern.

Site workers must also be aware of potential exposure to possible safety hazards, unsafe acts, or noncompliance with safety procedures.

If protective equipment or noise levels impair communications, prearranged hand signals must be used for communication. Personnel must stay within line of sight of another site worker.

4.2 Heat/Cold Stress

Heat and cold are two physical agents which can adversely affect workers if not dealt with properly. Stress caused by heat or cold can result in lower productivity, lower morale, and greater risk of employee injury. Also, severe heat or cold stress can directly endanger workers' health. Through proper training, recognition of symptoms, work breaks, monitoring, and proper use of protective equipment, many heat and cold-related stresses on workers can be prevented and controlled. A discussion of heat stress and safety precautions for working in hot environments are included as Appendix C. A discussion of cold stress and safety precautions for working in cold environments are included as Appendix D.

4.3 Biological Hazards

Biological hazards may include poison ivy, snakes, thorny bushes and trees, ticks, mosquitoes, and other pests.

4.3.1 Tick-Borne Diseases

Lyme Disease, Erlichiosis, and Rocky Mountain Spotted Fever (RMSF) are diseases transmitted by ticks; they occur throughout the United States during spring, summer, and fall.

Lyme Disease. The disease commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, New Jersey, Pennsylvania, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin. Few cases have been identified in other states (less than 1 in 100,000).

Erlichiosis. The disease also commonly occurs in summer and is transmitted by the

bite of infected ticks. "Hot spots" in the United States include New York, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin. Few cases have been identified in other states.

These diseases are transmitted primarily by the Deer Tick, which is smaller and redder than the common Wood Tick. The diseases may be transmitted by immature ticks, which are small and hard to see. The tick may be as small as a period on this page.

Symptoms of Lyme disease include a rash or a peculiar red spot, like a bull's eye, which expands outward in a circular manner. The victim may have headache, weakness, fever, a stiff neck, swelling and pain in the joints, and eventually, arthritis. Symptoms of Erlichiosis include muscle and joint aches, and flu-like symptoms, but there is typically no skin rash.

Rocky Mountain Spotted Fever. This disease is transmitted via the bite of an infected tick. The tick must be attached 4 to 6 hours before the disease-causing organism (*Rickettsia rickettsii*) becomes reactivated and can infect humans. The primary symptom of RMSF is the sudden appearance of a moderate-to-high fever. The fever may persist for two to three weeks. The victim may also have a headache, deep muscle pain, and chills. A rash appears on the hands and feet on about the third day and eventually spreads to all parts of the body. For this reason, RMSF may be confused with measles or meningitis. The disease may cause death if untreated, but if identified and treated promptly, death is uncommon.

Control. Tick repellant containing diethyltoluamide (DEET) should be used in tick infested areas, and pants legs should be tucked into boots. In addition, workers should search the entire body every three or four hours for attached ticks. Ticks should be removed promptly and carefully without crushing, since crushing can squeeze the rickettsia into the skin. A gentle and steady pulling action should be used to avoid leaving the head or mouth parts in the skin. Hands should be protected with surgical gloves when removing ticks.

4.3.2 Poisonous Plants

Poison ivy may be present in the work area. Personnel should be alerted to its presence, and instructed on methods to prevent exposure.

Control. The main control is to avoid contact with the plant, cover arms and hands, and frequently wash potentially exposed skin. Particular attention must be given to avoiding skin contact with objects or protective clothing that have touched the plants. Treat every surface that may have touched the plant as contaminated, and practice contamination avoidance. If skin contact is made, the area should be washed immediately with soap and water, and observed for signs of reddening.

4.3.3 Snakes

The possibility of encountering snakes exists, specifically for personnel working in heavily wooded/ vegetated areas. Rocky hillsides are favorite habitats of poisonous snakes. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties; cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs; defects in coagulation, and

effects from local release of substances by enzymatic actions. Other noticeable effects of venomous snake bites include swelling, edema and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

Control. To minimize the threat of snake bites, all personnel walking through vegetated areas must be made aware (during training) of the potential for encountering snakes and will avoid actions potentiating encounters, such as turning over logs, etc. Additional caution will be exercised around preferred snake habitat. If a snake bite occurs, an attempt should be made to kill the snake for identification. The victim must be transported to the nearest hospital within 30 minutes; first aid consists of applying a constriction band, and washing the area around the wound to remove any unabsorbed venom.

4.4 Noise

Exposure to noise over the OSHA action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging hearing, noise can impair voice communication, thereby increasing the risk of accidents on site.

Control. BBL personnel must wear hearing protection - with a Noise Reduction Rating (NRR) of at least 20 - when noise levels exceed 85 dBA. When it is difficult to hear a co-worker at normal conversation distance, the noise level is approaching or exceeding 85 dBA, and hearing protection is necessary. All site personnel who may be exposed to noise must also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss.

4.5 Spill Control Plan

BBL personnel must take every necessary precaution to minimize the potential for spills during site operations. BBL on-site personnel are obligated to report immediately any discharge, no matter how small, to the SS.

4.6 Sanitation

Site sanitation will be maintained according to OSHA and Department of Health requirements.

4.6.1 Break Area

Breaks will be taken in the support zone, away from the active work area after site personnel go through decontamination procedures. There will be no smoking, eating, drinking, or chewing gum or tobacco in the work area.

4.6.2 Potable Water

The following rules apply for all project field operations:

- An adequate supply of potable water will be provided at each work site. Potable water must be kept away from hazardous materials, contaminated clothing, and contaminated equipment.
- Portable containers used to dispense drinking water must be capable of being tightly closed, and must be equipped with a tap dispenser. Water must not be drunk directly from the container, nor dipped from the container.
- Containers used for drinking water must be clearly marked and not used for any other purpose.
- Disposable cups will be supplied; both a sanitary container for unused cups and a receptacle for disposing of used cups must be provided.

4.6.3 Sanitary Facilities

Access to facilities for washing before eating, drinking, or smoking will be provided.

4.6.4 Lavatory

If permanent toilet facilities are not available, an appropriate number of portable chemical toilets will be provided.

4.6.5 Trash Collection

Trash collected from the contamination reduction zone (CRZ) will be separated as routine hazardous waste. Trash collected in the support and break areas will be disposed of as nonhazardous waste. Labeled trash receptacles will be set up in the CRZ and in the support zone.

4.7 Electrical Hazards

Electricity may pose a particular hazard to site workers due to the use of portable electrical equipment. If wiring or other electrical work is needed, it must be performed by a qualified electrician.

General electrical safety requirements include:

- All electrical wiring and equipment must be a type listed by UL, Factory Mutual Engineering Corporation (FM), or other recognized testing or listing agency.
- All installations must comply with the National Electrical Safety Code (NESC), the National Electrical Code (NEC), or United States Coast Guard regulations.
- Portable and semi-portable tools and equipment must be grounded by a multi-conductor cord having an identified grounding conductor and a multicontact polarized plug-in receptacle.
- Tools protected by an approved system of double insulation, or its equivalent, need not be grounded. Double insulated tools must be distinctly marked and listed by UL or FM.
- Live parts of wiring or equipment must be guarded to prevent persons or objects from touching them.

- Electric wire or flexible cord passing through work areas must be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching.
- All circuits must be protected from overload.
- Temporary power lines, switch boxes, receptacle boxes, metal cabinets, and enclosures around equipment must be marked to indicate the maximum operating voltage.
- Plugs and receptacles must be kept out of water unless of an approved submersible construction.
- All extension outlets must be equipped with ground fault circuit interrupters (GFCI).
- Attachment plugs or other connectors must be equipped with a cord grip and be constructed to endure rough treatment.
- Extension cords or cables must be inspected prior to each use, and replaced if worn or damaged. Cords and cables must not be fastened with staples, hung from nails, or suspended by bare wire.
- Flexible cords must be used only in continuous lengths without splice, with the exception of molded or vulcanized splices made by a qualified electrician.

4.8 Lifting Hazards

Back strain or injury may be prevented by using proper lifting techniques. The fundamentals of proper lifting include:

- Consider the size, shape, and weight of the object to be lifted. A mechanical lifting device or additional persons must be used to lift an object if it cannot be lifted safely alone.
- The hands and the object should be free of dirt or grease that could prevent a firm grip.
- Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, rough or slippery surfaces.
- Fingers must be kept away from points which could crush or pinch them, especially when putting an object down.
- Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear.
- The load should be kept as low as possible, close to the body with the knees bent.
- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible.
- A worker should not carry a load that he or she cannot see around or over.

- When putting an object down, the stance and position are identical to that for lifting; the legs are bent at the knees, and the back is straight as the object is lowered.

5. Personal Protective Equipment

Personal protective equipment (PPE) is required to safeguard site personnel from various hazards. Varying levels of protection may be required depending on the level of contaminants and the degree of physical hazard. This section presents the various levels of protection and defines the conditions of use for each level.

5.1 Respiratory Protection

Respiratory protection is an integral part of employee protection at sites with potential airborne contamination.

5.1.1 Site Respiratory Protection Program

The site respiratory protection program will consist of the following:

- All site personnel who may use respiratory protection will have an assigned respirator.
- All site personnel who may use respiratory protection will have been fit tested and trained in the use of a full-face air purifying respirator within the past 12 months.
- All site personnel who may use respiratory protection must within the past year have been medically certified as being capable of wearing a respirator. Documentation of the medical certification must be provided to the HSS, prior to commencement of site work.
- Only cleaned, maintained, NIOSH/MSHA-approved respirators are to be used on this site.
- If respirators are used, the respirator cartridge is to be properly disposed of at the end of each work shift, or when load-up or breakthrough occurs.
- Contact lenses are not to be worn when a respirator is worn.
- All site personnel who may use respiratory protection must be clean-shaven. Mustaches and sideburns are permitted, but they must not touch the sealing surface of the respirator.
- Respirators will be inspected, and a positive/negative pressure test performed prior to each use.
- After each use, the respirator will be wiped with a disinfectant, cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag, away from direct sunlight in a clean, dry location, in a manner that will not distort the facepiece.

5.2 Levels of Protection

Protection levels are determined based upon contaminants present in the work area. A summary of the levels is presented in this section.

5.2.1 Level D Protection

The minimum level of protection that will be required of BBL personnel at the site will be Level D, which will be worn as the initial protection level for site operations. The following equipment will be used:

- Work clothing as prescribed by weather;

- Steel toe work boots, meeting ANSI Z41;
- Safety glasses or goggles, meeting ANSI Z87;
- Hard hat, meeting ANSI Z89; and
- Hearing protection (If noise levels exceed 85 dBA, then hearing protection with a U.S. EPA NRR of at least 20 dBA must be used).

5.2.2 Modified Level D Protection

Modified Level D will be used when airborne contaminants are not present at levels of concern, but site activities are causing an increased potential for skin contact with subsurface liquids and solids. Modified Level D consists of:

- Tyvek® coveralls;
- Safety toe work boots;
- Vinyl or latex booties, or PVC overboots;
- Safety glasses or goggles;
- Hard hat;
- Face shield in addition to safety glasses or goggles when projectiles pose a hazard;
- Nitrile gloves; and
- Hearing protection (if necessary).

5.2.3 Level C Protection

Level C protection will be required when the airborne concentration of suspected contaminants is known to be one half the ACGIH TLV or the OSHA PEL. Level C protection will be used for operations when air monitoring instruments indicate an upgrade is necessary. See Table 8-1.

The following equipment will be used for Level C protection:

- Full face, air purifying respirator with organic vapor /acid gas cartridges in combination with high efficiency particulate filters (HEPA) which are NIOSH/MSHA approved;
- Polyethylene-coated Tyvek® suit, ankles and cuffs taped to boots and gloves;
- Nitrile gloves over nitrile sample gloves;
- Safety toe work boots, ANSI approved;
- Chemical resistant Neoprene boots with steel toes; or latex booties or PVC boots over safety toe shoes;
- Hard hat, ANSI approved; and
- Hearing protection (if necessary).

5.2.4 Level B Protection

Level B protection will be required when the airborne concentration of suspected contaminants is known or suspected to exceed the protection factor for Level C respiratory equipment. Level B protection is also worn when contaminant concentrations may change, or during initial work activities before airborne contaminant concentrations have been determined.

The following equipment will be used for Level B protection:

- Full face, air-supplied respirator (SCBA or airline with escape bottle) which is NIOSH/MSHA approved;
- Polyethylene-coated Tyvek® suit, ankles and cuffs taped to boots and gloves, hood taped to respirator facepiece;
- Nitrile gloves over nitrile sample gloves;
- Safety toe work boots, ANSI approved;
- Chemical resistant Neoprene boots with steel toes; or latex booties or PVC boots over safety toe shoes;
- Hard hat, ANSI approved; and
- Hearing protection (if necessary).

5.2.5 Selection of PPE

Equipment for personal protection will be selected based on the potential for contact, site conditions, ambient air quality, and the judgment of supervising site personnel and H&S professionals. The PPE used will be chosen to be effective against the COCs present on the site.

5.3 Using PPE

Depending upon the level of protection selected for this project, specific donning and doffing procedures may be required. The procedures presented in this section are mandatory if Level C or B PPE is used.

All people entering the exclusion zone (EZ) must put on the required PPE in accordance with the requirements of this plan. When leaving the EZ, PPE will be removed in accordance with the procedures listed, to minimize the spread of contamination.

5.3.1 Donning Procedures

These procedures are mandatory only if Level C or B PPE is used on the project:

- Remove bulky outer wear. Remove street clothes and store in clean location;
- Put on work clothes or coveralls;
- Put on the required chemical protective coveralls or rain gear;
- Put on the required chemical protective boots or boot covers;
- Tape the legs of the coveralls to the boots with duct tape;
- Put on the required chemical protective gloves;
- Tape the wrists of the protective coveralls to the gloves;
- Don the required respirator and perform appropriate fit check;
- Put hood or head covering over head and respirator straps and tape hood to facepiece; and

- Don remaining PPE, such as safety glasses or goggles and hard hat.

When these procedures are instituted, one person must remain outside the work area to ensure that each person entering has the proper protective equipment.

5.3.2 Doffing Procedures

The following procedures are only mandatory if Level C or B PPE is required for this project. Whenever a person leaves a Level C or higher work site, the following decontamination sequence will be followed:

- Upon entering the contamination reduction zone (CRZ), rinse contaminated materials from the boots or remove contaminated boot covers;
- Clean reusable protective equipment;
- Remove protective garments, equipment, and respirator. All disposable clothing should be placed in plastic bags which are labeled with contaminated waste labels;
- Wash hands, face and neck or shower (if necessary);
- Proceed to clean area and dress in clean clothing; and
- Clean and disinfect respirator for next use.

All disposable equipment, garments, and PPE must be bagged in plastic bags, and labeled for disposal. See Section 7.0 for detailed information on decontamination stations.

5.4 Selection Matrix

The level of personal protection selected will be based upon real-time air monitoring of the work environment and an assessment by the SS of the potential for skin contact with contaminated materials. The PPE selection matrix is given in Table 5-1. This matrix is based upon information available at the time this plan was written. The Airborne Contaminant Action Levels in Table 8-1 should be used to verify that the PPE prescribed in this matrix is appropriate.

Table 5-1
PPE Selection Matrix

Task	Level of Protection
Construction Oversight	D/Modified D/C
Site support zone activities	D

6. Site Control

6.1 Authorization to Enter

Only BBL personnel who have completed hazardous waste operations initial training as defined under OSHA Regulation 29 CFR 1910.120; have completed their training or refresher training within the past 12 months; and have been certified by a physician as fit for hazardous waste operations will be allowed within a site area designated as an EZ or CRZ. Personnel without such training or medical certification may enter the designated support zone (SZ) only.

6.2 Site Orientation and Hazard Briefing

No BBL employee will be allowed in the general work area during site operations without first being given a site orientation and hazard briefing. This orientation will consist of a review of this HASP. In addition to this meeting, Daily Safety Meetings will be held each day before work begins.

All people on the site, including visitors, must document their attendance to this briefing as well as the Daily Safety Meetings on the forms included with this plan.

6.3 Certification Documents

A training and medical file may be established for the project and kept on site during all site operations. The 24 or 40-hour training, update, and specialty training (first-aid/cardiopulmonary resuscitation [CPR]) certificates, as well as the current annual medical clearance for all project field personnel, will be maintained within that file. BBL personnel must provide their training and medical documentation prior to the start of field work.

6.4 Entry Requirements

In addition to the authorization, hazard briefing, and certification requirements listed above, no BBL employee will be allowed on any field site unless he or she is wearing the minimum support zone PPE as described in Section 5. Personnel entering the EZ or CRZ must wear the required PPE for those locations.

6.5 Emergency Entry and Exit

People who must enter the site on an emergency basis will be briefed of the hazards by the SS. All hazardous activities will cease in the event of an emergency and any sources of emissions will be controlled, if possible.

People exiting the site because of an emergency will gather in a safe area for a head count. The SS is responsible for ensuring that all people who entered the work area have exited in the event of an emergency.

7. Decontamination

7.1 Contamination Control Zones

Contamination control zones are maintained to prevent the spread of contamination and to prevent unauthorized people from entering hazardous areas.

7.1.1 Exclusion Zone

The EZ consists of the specific work area, or can be the entire area of suspected contamination. This zone will be set up by the construction contractor. BBL employees entering the EZ must use the required personal protective equipment and will have the appropriate training and medical clearance for hazardous waste work. The EZ is the defined area where there is a possible respiratory and/or contact health hazard. The location of each exclusion zone will be identified by cones, caution tape, or other appropriate means.

7.1.2 Contamination Reduction Zone

The CRZ or transition area will be established by the construction contractor to perform decontamination of personnel and equipment. BBL personnel entering or leaving the exclusion zone will pass through this area to prevent any cross-contamination and for reasons of accountability. Tools, equipment, and machinery will be decontaminated in a specific location. The decontamination of all personnel will be performed on site adjacent to the exclusion zone. Personal protective outer garments and respiratory protection will be removed in the CRZ and prepared for cleaning or disposal. This zone is the only appropriate corridor between the EZ and the SZ.

7.1.3 Support Zone

The SZ is a clean area outside the CRZ located to prevent employee exposure to hazardous substances. Eating and drinking will be permitted in the support area only after proper decontamination. Smoking may be permitted in the support zone, subject to site requirements.

7.2 Posting

The EZ, CRZ and SZ will be prominently marked and delineated by the construction contractor.

7.3 Personnel Decontamination

BBL personnel working in the contaminated zone must undergo personal decontamination prior to entering the support zone. Personnel leaving the contaminated zone will remove the gross contamination from their outer clothing and boots. Personnel will remove their outer garment and gloves and deposit them in the lined waste receptacles. Personnel will then decontaminate their hard hats, and boots with an aqueous solution of Alconox or other appropriate cleaning solution. These items are then hand carried to the next station. Personnel will thoroughly wash their hands and face before leaving the decontamination zone. Respirators will be sanitized and then placed in a clean plastic ziplock bag.

7.4 Equipment Decontamination

If the BBL vehicle enters the contaminated zone, it will be decontaminated prior to leaving the zone. If the level of vehicle contamination is low, decontamination may be limited to rinsing of tires and wheel wells with water. If the vehicle is significantly contaminated, steam cleaning or pressure washing of vehicles and equipment may be required.

7.5 Personal Protective Equipment Decontamination

Where and whenever possible, single use, external protective clothing must be used for work within the EZ or CRZ. This protective clothing must be disposed of improperly labeled containers.

Reusable protective clothing will be rinsed at the site with detergent and water. The rinsate will be collected for disposal.

When removed from the CRZ, the respirator will be thoroughly cleaned with soap and water. The respirator face piece, straps, valves and covers must be thoroughly cleaned at the end of each work shift, and ready for use prior to the next shift. Respirator parts may be disinfected with a solution of bleach and water, or by using a spray disinfectant.

8. Site Monitoring

8.1 Air Monitoring

Air monitoring will be conducted by the construction contractor to determine employee exposure to airborne contaminants. The monitoring results will dictate work procedures and the selection of PPE. The BBL employee on site will follow the instructions of the construction contractor regarding monitoring results and PPE recommendations.

9. Employee Training

9.1 General

BBL on-site project personnel must have completed hazardous waste operations-related training, as required by OSHA Regulation 29 CFR 1910.120. All field employees receive a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. Personnel who completed their training more than 12 months prior to the start of the project must have completed an 8-hour refresher course within the past 12 months. The BBL SS must have completed an additional 8 hours of training for supervisors and must have a current first-aid/CPR certificate.

9.2 Basic 40-Hour Course

The following is a list of the topics typically covered in a 40-hour training course:

- General safety procedures;
- Physical hazards (fall protection, noise, heat stress, cold stress);
- Names and job descriptions of key personnel responsible for site H&S;
- Safety, health, and other hazards typically present at hazardous waste sites;
- Use, application and limitations of PPE;
- Work practices by which employees can minimize risks from hazards;
- Safe use of engineering controls and equipment on site;
- Medical surveillance requirements;
- Recognition of symptoms and signs which might indicate overexposure to hazards;
- Worker right-to-know (Hazard Communication OSHA 1910.1200);
- Routes of exposure to contaminants;
- Engineering controls and safe work practices;
- Components of a site H&S program and HASP;
- Decontamination practices for personnel and equipment;
- Confined-space entry procedures; and
- General emergency response procedures.

9.3 Supervisor Course

Management and supervisors receive an additional eight hours of training which typically includes:

- General site safety and health procedures;
- PPE programs; and
- Air monitoring techniques.

9.4 Site-Specific Training

Site-specific training will be accomplished through a site briefing and review of this HASP before work begins. In addition, Daily Safety Meetings (DSMs) will cover the work to be accomplished, the hazards anticipated, the protective clothing and procedures required to minimize site hazards, and emergency procedures. No work will be performed before the DSM has been held. The DSM must also be held prior to new tasks and repeated if new hazards are encountered.

9.5 First Aid and CPR

At least two employees current in first aid/CPR will be assigned to the work crew and will be on the site during operations. Refresher training in first aid (triennially) and CPR (annually) is required to keep the certificate current. These individuals must also receive training regarding the precautions and protective equipment necessary to protect against exposure to blood-borne pathogens.

10. Medical Surveillance

10.1 Medical Examination

BBL personnel on site must have successfully completed a pre-placement or annual physical examination, which is provided free-of-charge to the employee. This medical surveillance program must comply with OSHA 29 CFR 1910.120 (F).

10.1.1 Preplacement Medical Examination

BBL on-site project personnel must have completed a comprehensive medical examination within the past 12 months that meets the requirements of applicable OSHA regulations. The annual medical examination typically includes the following elements:

- Medical and occupational history questionnaire;
- Physical examination;
- Complete blood count, with differential;
- Liver enzyme profile;
- Chest X-ray, once every three years, for nonasbestos workers;
- Pulmonary function test;
- Audiogram;
- Electrocardiogram for persons older than 45 years of age, or if indicated during the physical examination;
- Drug and alcohol screening, as required by job assignment;
- Visual acuity; and
- Follow-up examinations, at the discretion of the examining physician or the corporate medical director.

The examining physician provides the employee with a letter summarizing his findings and recommendations, confirming the worker's fitness for work and ability to wear a respirator. Documentation of medical clearance will be available for each employee during all project site work. Each employee also has the right to inspect and copy his medical records.

10.1.2 Other Medical Examination

In addition to pre-employment, annual, and exit physicals, personnel may be examined:

- At employee request after known or suspected exposure to toxic or hazardous materials;
- At the discretion of the client, HS professional, or occupational physician in anticipation of, or after known or suspected exposure to toxic or hazardous materials; and
- At the discretion of the occupational physician.

10.1.3 Periodic Exam

Following the placement examination, BBL employees must undergo a periodic examination, similar in scope to the placement examination. For employees potentially exposed over 30 days per year, the frequency of periodic examinations will be annual. For employees potentially exposed less than 30 days per year, the frequency for periodic examinations will be 18 months.

10.2 First Aid and Medical Treatment

BBL employees on site must report any near-miss incident, accident, injury, or illness to their immediate supervisor and the SS. First aid will be provided by the designated site first aider. Injuries and illnesses requiring medical treatment must be documented. The SS must conduct an accident investigation as soon as emergency conditions no longer exist and first-aid and/or medical treatment has been ensured. These two

reports must be completed and submitted to the RHSC within 24 hours after the incident.

If first-aid treatment is required, first aid kits are kept at the CRZ. If treatment beyond first aid is required, the injured should be transported to the medical facility. If the injured is not ambulatory, or shows any sign of not being in a comfortable and stable condition for transport, then an ambulance/paramedics should be summoned. If there is any doubt as to the injured worker's condition, it is best to let the local paramedic or ambulance service examine and transport the worker.

10.3 Medical Restriction

When the examining physician identifies a need to restrict work activity, the employee's supervisor must communicate the restriction to the employee, the RHSC, and the HSS. The terms of the restriction will be discussed with the employee and this supervisor. Every attempt should be made to keep the employee working, while not violating the terms of the medical restriction.

11. Emergency Procedures

11.1 General

The construction contractor will establish evacuation routes and assembly areas for each site. BBL personnel entering the site will be informed of these routes and assembly areas. If necessary, a site plan will be made marking the evacuation routes and will be posted at conspicuous locations.

Each site will be evaluated for the potential for fire, explosion, chemical release, or other catastrophic events. For active facilities, site emergency procedures must be communicated to all project personnel. Unusual events, activities, chemicals, and conditions will be reported to the SS immediately.

11.2 Emergency Response

If an incident occurs, the following steps will be taken:

- The SS will evaluate the incident and assess the need for assistance and/or evacuation;
- The SS will call for outside assistance as needed;
- The SS will act as liaison between outside agencies and on-site personnel;
- The BBL on site employee will inform the PM and Regional HS Coordinator are notified promptly of any incident involving the BBL employee; and
- The SS will take appropriate measures to stabilize the incident scene.

11.2.1 Fire

In the case of a fire on the site, the SS will assess the situation and direct fire-fighting activities. The SS will ensure that the client site representative (as appropriate) is immediately notified of any fires. Site personnel will attempt to extinguish the fire with available extinguishers, if safe to do so. In the event of a fire that site personnel are unable to safely extinguish, the local fire department will be summoned via 911 or other number.

11.2.2 Spill

If a spill occurs, the following steps will be taken:

- Notify SS immediately.
- Evacuate immediate area of spill.
- Conduct air monitoring to determine needed level of PPE.
- Don required level of PPE and prepare to make entry to apply spill containment and control procedures.
- No entry will made until atmosphere is less than 10% LEL.
- Absorb or otherwise clean up the spill and containerize the material, sorbent, and affected soils.

The SS has the authority to commit resources as needed to contain and control released material and to prevent its spread to off-site areas.

11.3 Medical Emergency

All employee injuries must be promptly reported to the SS. The SS will ensure that:

- The injured employee receives prompt first aid and medical attention;

- In emergency situations, the worker is to be transported by appropriate means to the nearest urgent care facility (normally a hospital emergency room); and

- EMR is to be notified by site personnel as soon as possible after the worker has left the site. The caller should dial 1-800-229-3674 and follow the instructions for

reaching the Injury Management office. When the Case Manager answers, the caller should provide the information requested by the Case Manager.

11.3.1 First Aid - General

- Survey the scene. Determine if it is safe to proceed. Try to determine if the conditions which caused the incident are still a threat. Protect yourself from exposure before attempting to rescue the victim.
- Do a primary survey of the victim. Check for **airway** obstruction, **breathing**, and **pulse**. Assess likely routes of chemical exposure by examining the eyes, mouth, nose, and skin of the victim for symptoms.
- Phone Emergency Medical Services (EMS). Give the location, telephone number used, caller's name, what happened, number of victims, victims' condition, and help being given.
- Maintain airway and perform rescue breathing as necessary.
- Perform cardiopulmonary resuscitation (CPR) as necessary.
- Do a secondary survey of the victim. Check **vital signs** and do a **head-to-toe exam**.
- Treat other conditions as necessary. If the victim can be moved, take him to a location away from the work area where EMS can gain access.

11.3.2 First Aid - Inhalation

Any employee complaining of symptoms of chemical overexposure as described in Section 3 will be removed from the work area and transported to the designated medical facility for examination and treatment.

11.3.3 First Aid - Ingestion

Call EMS and consult a poison control center for advice. If available, refer to the MSDS for treatment information, if recommended. If unconscious, keep the victim on his side and clear the airway if vomiting occurs.

11.3.4 First Aid - Skin Contact

Project personnel who have had skin contact with contaminants will, unless the contact is severe, proceed through the decontamination zone, to the wash-up area. Personnel will remove any contaminated clothing, and then flush the affected area with water for at least 15 minutes. The worker should be transported to the medical facility if they show any sign of skin reddening, irritation, or if they request a medical examination.

11.3.5 First Aid - Eye Contact

Project personnel who have had contaminants splashed in their eyes or who have experienced eye irritation while in the contaminated zone, must immediately proceed to the eyewash station, set up in the decontamination zone. Do not decontaminate prior to using the eyewash. Remove whatever protective clothing is necessary to use the eyewash. Flush the eye with clean running water for at least 15 minutes. Arrange prompt transport to the designated medical facility.

11.4 Reporting Injuries and Illnesses

All injuries and illnesses, however minor, will be reported to the SS immediately. The SS will complete an injury report and submit it to the PM and RHSC within 24 hours.

11.5 Emergency Information

The means to summon local public response agencies such as police, fire, and ambulance will be reviewed in the Daily Safety Meeting. Agencies include:

- Old Bridge Police Department: 721-4000
- Old Bridge Fire Department: 721-4000
- Poison Control Center: 1-800-962-1253
- BBL Site Supervisor: David Montanari/Michael Fleischner (609) 860-0590
- BBL H&S Supervisor: David Montanari/Michael Fleischner (609) 860-0590
- BBL Corporate H&S - Jay D. Keough, CIH - (609) 860-0590

- **Primary Hospital: Raritan Bay Medical Center**, Ferry Road & Route 18 N, Old Bridge N.J. **360-1000**

  Take Route 18 North to Ferry Road

- Secondary Hospital: Raritan Bay Medical Center, 530 New Brunswick Ave., Perth Amboy 442-3700

  Take Route 9 North to Bordentown Road, right on Bordentown Road, past Route 35, hospital is on the left.

Table 3-2 Chemical Hazard Information

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Arsenic and soluble inorganic compounds (as As) [7740-38-2]	NA	NA	Inh Abs Ing Con	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances; hyperpigmentation of the skin (carcinogenic); peripheral neuropathy, respiratory irritation.	Eye: Irrigate immediately (15 min) Skin: Soap wash immediately Swallow: Immediate medical attention	0.01 mg/m^3 0.2 mg/m^3 (Ca–29 CFR 1910.1018 Inorganic compounds)	C0.002 mg/m^3	PEL TLV REL	Ca [100 mg/m^3]
Beryllium and compounds (as Be) [7440-41-7]	NA	NA	Inh	Respiratory systems; weakness, fatigue, weight loss. Carcinogenic.	Eye: Irrigate immediately	0.002 mg/m^3 [c] 0.002 mg/m^3 0.0005 mg/m^3	C0.005 mg/m^3	PEL TLV REL	Ca [10 mg/m^3]
Cadmium dust (as Cd) [7440-43-9]	NA	NA	Inh Ing	Pulmonary edema, dyspnea, cough, chest tightness, substernal pain; headache; chills, muscular aches; nausea, vomiting, diarrhea; anosmia, emphysema, proteinuria, mild anemia. Carcinogenic.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiration support Swallow: Immediate medical attention	0.005 mg/m^3 0.01 mg/m^3 Ca, lowest feasible concentration		PEL TLV REL	Ca [50 mg/m^3]
Coal-tar-pitch volatiles (benzene-soluble fraction) (polynuclear aromatic hydrocarbons [PAH]) [65996-93-2]	?	?	Inh Con	Eye sensitivity to light, eye and skin irritation; dermatitis, bronchitis. Carcinogenic.	Eye: Irrigate immediately (15 mins) Skin: Soap wash Breath: Respiratory support Swallow: Immediate medical attention	0.2 mg/m^3 0.2 mg/m^3 0.2 mg/m^3 (cyclohexane extractable) Ca		PEL TLV REL	Ca [700 mg/m^3]
Copper dusts and mists (metal) (copper sulfate) [7440-50-8]	NA	NA	Inh Ing Con	Irritated pharynx and nasal mucous membrane; nasal perforation; eye irritation; metallic taste; dermatitis; in animals: lung, kidney, and liver damage; anemia.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 1 mg/m^3 1 mg/m^3		PEL TLV REL	NE

Refer to footnotes at end of table.

Table 3-2 (Cont'd)

Chemical Hazard Information

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Lead inorganic dusts and fumes (as Pb) [7439-92-1]	NA	NA	Inh Ing Con	Weakness, lassitude, insomnia; facial pallor; eye pallor, anorexia, low body weight, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremors; wrist and ankle paralysis; brain damage; kidney damage; irritated eyes; hypotension.	Eye: Irrigate immediately Skin: Soap flush promptly Breath: Respiratory support Swallow: Immediate medical attention	0.05 mg/m^3 0.15 mg/m^3 $<$0.1 mg/m^3 See 29 CFR 1910.1025 Blood lead $<$0.060 mg/ 100 g whole blood		PEL TLV REL	700 mg/m^3
Mercury vapor [7439-97-6]	?	?	Inh Abs Con	Coughing, chest pain, dyspnea, bronchial pneumonitis; tremors, insomnia; irritability, indecision; headache, fatigue, weakness stomatitis, salivation; gastrointestinal disturbance, anorexia, low weight; proteinuria, irritated eyes, and skin.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	0.05 mg/m^3 (skin) 0.05 mg/m^3 (skin) 0.05 mg/m^3 (skin)		PEL TLV REL	28 mg/m^3
Nickel, metal, and other compounds (as Ni) [7440-02-0]	NA	NA	Inh Ing Con	Headache, vertigo; nausea, vomiting, epigastric pain; substernal pain; coughing, hyperpnea; cyanosis; weakness; leukocytosis, pneumonitis; delirium, convulsions. Carcinogenic.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 (1 mg/m^3) * 0.015 mg/m^3 Ca * NIC—0.05 A1		PEL TLV REL	Ca NE

Refer to footnotes at end of table.

Table 3-2 (Cont'd)

Chemical Hazard Information

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Polychlorinated biphenyls (PCBs) (Aroclor-1242) [53469-21-9] and (Aroclor-1254) [11097-69-1]	?	?	Inh Ing Abs Con	Aroclor-1242: irritated eyes; chloracne; acne-form dermatitis; mildly toxic by ingestion. Poison by subcutaneous route. Carcinogenic. Aroclor- 1254: irritated eyes and skin; acne-form dermatitis; poison by intravenous route. Moderately toxic by ingestion and intraperitoneal routes. Carcinogenic.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	Aroclor-1242: 1 mg/m^3 (skin) 1 mg/m^3 (skin) 0.001 mg/m^3 Aroclor-1254: 0.5 mg/m^3 (skin) 0.5 mg/m^3 (skin) 0.001 mg/m^3		PEL TLV REL PEL TLV REL	Ca [10 mg/m^3] Ca [5 mg/m^3]
Selenium compounds (as Se) [7782-49-2]	?	?	Inh Con Abs Ing	Irritated eyes, nose, and throat, distorted vision, chills, fever, dyspnea; bronchitis; metallic taste, garlic breath; gastrointestinal disturbance; dermitis; skin an eye burns.	Eye: Irrigate immediately Skin: Water flush Breath: Respiratory support Swallow: Immediate medical attention	0.2 ppm 0.2 ppm 0.2 ppm		PEL TLV REL	Unknown
Zinc (as oxide fume) [1314-13-2]	NA	NA	Inh	Sweet metallic taste; dry throat, cough, chills, fever; tight chest, dyspnea, rales, reduced pulmonary function; headache; blurred vision; muscular cramps, low back pain; nausea, vomiting; fatigue, lassitude, malaise.	Breath: Respiratory support	5 mg/m^3 5 mg/m^3 5 mg/m^3	10 mg/m^3 10 mg/m^3 10 mg/m^3	PEL TLV REL	NE

Refer to footnotes at end of table.

Table 3-2 (Cont'd)

Chemical Hazard Information

Refer to footnotes at end of table.

Table 3-2 (Cont'd)

Chemical Hazard Information

[a]IP = Ionization potential (electron volts).
[b]Route = Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; Con, Skin and/or eye contact.
[c]TWA = Time-weighted average. The TWA concentration for a normal work day (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[d]STEL = Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the TWA is not exceeded.
[e]PEL = Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
TLV = American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value—TWA.
REL = National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.
[f]IDLH (NIOSH)—Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE = No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 1990).
C = Ceiling limit value which should not be exceeded at any time.
Ca = Carcinogen.
NA = Not applicable.
? = Unknown.
LEL = Lower explosive limits.
LC_{50} = Lethal concentration for 50 percent of population tested.
LD_{50} = Lethal dose for 50 percent of population tested.
NIC = Notice of intended change (ACGIH).

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Refer to footnotes at end of table.

APPENDIX A
MATERIAL SAFETY DATA SHEETS

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Material Safety Data Sheets Collection:

Sheet No. 296
Arsenic and Compounds

Issued: 4/90

Section 1. Material Identification

Arsenic Description: Obtained from flue dust of copper and lead smelters as white arsenic (arsenic trioxide). Reduction with charcoal and sublimation in an N_2 current yields pure arsenic. Metallic arsenic is used for hardening copper, lead, and alloys; as a doping agent in germanium and silicon solid-state products, special solders, and medicine; and to make gallium arsenide for dipoles and other electronic devices. Arsenic compounds are used in manufacturing certain types of glass; in textile printing, tanning, taxidermy, pharmaceuticals, insecticides and fungicides, pigment production, and antifouling paints; and to control sludge formation in lubricating oils. Arsenic trioxide is the source for 97% of all arsenic products.
Other Designations: CAS No. 7440-38-2; arsen; arsenic black; As; gray arsenic; metallic arsenic.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R 1
I 4
S 2
K 0

Genium

HMIS
H 3
F 2
R 2
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Arsenic and soluble compounds, as As

OSHA PEL
8-hr TWA: 0.5 mg/m^3,* 0.01 mg/m^3†

NIOSH REL, 1987
Ceiling: 0.002 mg/m^3

ACGIH TLV, 1989-90
TLV-TWA: 0.2 mg/m^3

Toxicity Data‡
Man, oral, TD_{Lo}: 76 mg/kg administered intermittently over a 12-year period affects the liver (tumors) and blood (hemorrhage)
Man, oral: 7857 mg/kg administered over 55 years produces gastrointestinal (in the structure or function of the esophagus), blood (hemorrhage), and skin and appendage (dermatitis) changes
Rat, oral, TC_{Lo}: 605 µg/kg administered to a 35-week pregnant rat affects fertility (pre- and post-implantation mortality)

* Organic compounds.
† Inorganic compounds.
‡ See NIOSH, *RTECS* (CG0525000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: sublimes at 1134 F/612 C
Melting Point: 1497 F/814 C
Vapor Pressure: 1 mm at 702 F/372 C (sublimes)
Atomic Weight: 74.92
Density: 5.724 at 57 F/14 C
Water Solubility: Insoluble†

Appearance and Odor: A brittle, crystalline, silvery to black metalloid. Odorless.

* This data pertains to arsenic only.
† Arsenic is soluble in nitric acid (HNO_3).

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use dry chemical, CO_2, water spray, or foam to fight fires.
Unusual Fire or Explosion Hazards: Flammable and slightly explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Arsenic is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Arsenic can react vigorously on contact with powerful oxidizers such as bromates, peroxides, chlorates, iodates, lithium, silver nitrate, potassium nitrate, potassium permanganate, and chromium (VI) oxide. This material is also incompatible with halogens, bromine azide, palladium, dirubidium acetylide, zinc, and platinum.
Hazardous Products of Decomposition: Thermal oxidative decomposition of arsenic and its compounds produces irritating or poisonous gases.

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Section 6. Health Hazard Data

Carcinogenicity: The IARC, NTP, and OSHA list arsenic as a human carcinogen (Group 1). This evaluation applies to arsenic and arsenic compounds as a whole, and not necessarily to all individual chemicals within the group. Studies report that both the trivalent and pentavalent compounds are strongly implicated as causes of skin, lung, and lymphatic cancers. Experimental studies have shown that arsenic has tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Arsenic compounds are irritants of the skin, mucous membranes, and eyes. The moist mucous membranes are most sensitive to irritation. Prolonged contact results in local hyperemia (blood congestion) and later vesicular or pustular eruption. Epidermal carcinoma is a reported risk of exposure. Peripheral neuropathy (degenerative state of the nervous system) is common after acute or chronic arsenic poisoning. Symptoms include decreased sensation to touch, pinprick, and temperature; loss of vibration sense; and profound muscle weakness and wasting. Other complications of acute and chronic arsenic poisoning are encephalopathy (alterations of brain structure) and toxic delirium.
Medical Conditions Aggravated by Long-Term Exposure: Damage to the liver, nervous, and hematopoietic (responsible for the formation of blood or blood cells in the body) system may be permanent. Pulmonary and lymphatic cancer may also occur.
Target Organs: Liver, kidneys, skin, lungs, lymphatic system.
Primary Entry Routes: Inhalation, ingestion of dust and fumes, via skin absorption.
Acute Effects: Acute industrial intoxication is more likely to arise from inhalation of arsine. However, with corrosive arsenical vapors, conjunctivitis, eyelid edema, and even corneal erosion may result. Inhalation may result in nasal irritation with perforation of the septum, cough, chest pain, hoarseness, pharyngitis, and inflammation of the mouth. If ingested, metallic or garlic taste, intense thirst, nausea, vomiting, abdominal pain, diarrhea, and cardiovascular arrhythmias (heartbeat irregularities) may occur. Symptoms generally occur within 30 minutes, but may be delayed for several hours if ingested with food. Acute poisoning may result in acute hemolysis (breakdown of red blood cells).
Chronic Effects: Chronic symptoms include weight loss, hair loss, nausea, and diarrhea alternating with constipation, palmar and plantar hyperkeratoses (thickening of the corneous layer of skin on palms and soles of feet), and skin eruptions, and peripheral neuritis (inflammation of the nerves). Leukemia, bone marrow depression, or aplastic anemia (dysfunctioning of blood-forming organs) may occur after chronic exposure.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: If emesis is unsuccessful after two doses of Ipecac, consider gastric lavage. Monitor urine arsenic level. Alkalinization of urine may help prevent disposition of red cell breakdown products in renal tubular cells. If acute exposure is significant, maintain high urine output and monitor volume status, preferably with central venous pressure line. Abdominal X-rays should be done routinely for all ingestions. Chelation therapy with BAL, followed by n-penicillamine is recommended, but specific dosing guidelines are not clearly established.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and contact with skin and eyes. Use nonsparking tools. With a clean shovel, scoop material into a clean, dry container and cover. Absorb liquid material with sand or noncombustible inert material and place in disposal containers. Do not release to sewers, drains, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations*
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance† (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [† per Clean Water Act, Sec. 307(a); per Clean Air Act, Sec. 112]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations‡
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

* Designations for arsenic only.
‡ Listed as arsenic organic compounds (as As).

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELs, ACGIH TLVs, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed, properly labeled, containers in a cool, well-ventilated area away from all incompatible materials (Sec. 5) and heat and ignition sources. Protect containers from physical damage.
Engineering Controls: Avoid inhalation or ingestion of dust and fumes, and skin or eye contact. Practice good personal hygiene and housekeeping procedures. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program with training, maintenance, inspection, and evaluation. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Provide preplacement and annual physical examination with emphasis on the skin, respiratory system, and blood.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Arsenic, solid
DOT Hazard Class: Poison B
ID No.: UN1558
DOT Label: Poison
DOT Packaging Requirements: 173.366
DOT Packaging Exceptions: 173.364

IMO Shipping Name: Arsenic, metallic
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN1558

MSDS Collection **References:** 7, 26, 38, 53, 73, 85, 87, 88, 89, 100, 103, 109, 123, 124, 126, 127, 130, 136, 138
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD M4

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Section 1. Material Identification

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Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial source is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refining. Lead is used mostly in manufacturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a constuction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.
Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R	0
I	4
S	-
K	0

Genium

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F 1
R 0
PPG*
* Sec. 8

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affected organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure.

Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, inorganic compounds)
8-hr TWA: 50 μg/m^3
Action Level TWA*: 30 μg/m^3

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 μg/100 g

1989-90 ACGIH TLV (Lead, inorganic, fumes and dusts)
TLV-TWA: 150 μg/m^3

1988 NIOSH REL
10-hr TWA: <100 μg/m^3

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 μg/m^3 affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 F (1740 C)
Melting Point: 621.3 F (327.4 C)
Vapor Pressure: 1.77 mm Hg at 1832 F (1000 C)
Viscosity: 3.2 cp at 621.3 F (327.4 C)
Molecular Weight: 207.20
Specific Gravity (20 C/4 C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*

Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system. The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead can be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

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Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
Chronic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival (gum) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33, Appendix II—EP Toxicity Test Procedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially washing hands before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations which emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 µg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 µg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Lead compounds, soluble, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN2291
IMO Label: St. Andrews Cross (**X**, Stow away from foodstuffs)
IMDG Packaging Group: III

MSDS Collection **References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 162
Copper

Issued: 12/85 Revision: A, 8/90

Section 1. Material Identification

32

Copper (Cu) Description: Widely distributed in nature in elemental state, arsenites, sulfides, chlorides, and carbonates. Prepared by crushing, grinding, and concentrating copper ores by flotation and leaching or by smelting copper ore concentrates to yield a blister (96 to 98%) copper which is electrolytically refined to yield 99.9+% copper. Copper is the most widely used structural metal, next to iron and aluminum. Used in electric wiring; switches, heating, plumbing, roofing, and building construction; alloys (brass, bronze, Monel metal, beryllium-copper); coins; chemical and pharmaceutical machinery; electroplated protective coatings and undercoats for nickel, chromium, zinc, etc., cooking utensils; insecticides; antifouling paints; and as a catalyst. Copper whiskers are used in thermal and electrical composites. Copper flakes are used as insulation for liquid fuels.

Other Designations: CAS No. 7440-50-8, bronze powder, copper slag-airborne, copper slag-milled.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

Cautions: *Copper may be toxic through contact, inhalation, and ingestion.* It may cause skin and eye irritation and metal fume fever. Copper is not considered a fire hazard, but fine particles may burn in air.

R 0
I 4
S 1
K 0

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H 2
F 0
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Copper, ca 100%

1989 OSHA PELs	1989-90 ACGIH TLVs	1988 NIOSH REL	1985-86 Toxicity Data‡
8-hr TWA: 1 mg/m³*	TLV-TWA: 1 mg/m³*	None established	Human, oral, TD_{Lo}: 120 µg/kg affects the gastrointestinal tract (nausea or vomiting)
8-hr TWA: 0.1 mg/m³†	TLV-TWA: 0.2 mg/m³†		Rat, oral, TD_{Lo}: 1210 µg/kg (35 weeks prior to mating) affects fertility (pre- and post-implantation mortality)

* Copper dusts and mists, as Cu.
† Copper fume.
‡ See NIOSH, *RTECS* (GL5325000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 4703 F (2595 C)
Melting Point: 1981 F (1083 C)
Vapor Pressure: 1 mm Hg at 2962 F (1628 C)
Molecular Weight: 63.546
Density/Specific Gravity: 8.94
Water Solubility: Insoluble

Appearance and Odor: Solid, various shapes, odorless, red/brown-colored metal or powder. Copper is ductile, tough, and easily worked. It is very resistant to corrosion, but readily attacked by alkalies.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire since copper does not burn. Finely divided copper burns in air, and in extreme cases ignites spontaneously.

Unusual Fire or Explosion Hazards: Liquid copper explodes on contact with water. High concentrations of fine copper particles in the air may present an explosion hazard.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and a fully encapsulating suit.

Section 5. Reactivity Data

Stability/Polymerization: Copper is stable at room temperature in closed containers under normal storage and handling conditions. However, on long standing, a white, highly explosive peroxide deposit may form. Copper's vapors are uninhibited and may form polymers in vents and flame arresters.

Chemical Incompatibilities: Copper reacts violently with ammonium nitrate, bromates, iodates, chlorates, ethylene oxide, hydrazoic acid, potassium oxide, dimethyl sulfoxide + trichloroacetic acid, hydrogen peroxide, sodium peroxide, sodium azide, sulfuric acid, hydrogen sulfide + air, and lead azide. A potentially explosive reaction occurs with actylenic compounds. Copper ignites on contact with chlorine, fluorine [above 250 F (121 C)], chlorine trifluoride, and hydrazinium nitrate [above 158 F (70 C)]. It is also incompatible with 1-bromo-2-propyne; an incandescent reaction occurs with potassium dioxide.

Conditions to Avoid: Avoid prolonged exposure to air and moisture. On exposure to moist air, copper slowly converts to the carbonate.

Hazardous Products of Decomposition: Thermal oxidative decomposition of copper can produce metallic oxides (copper fumes).

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Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list copper as a carcinogen. Experimental studies show tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Copper is a necessary human nutrient, excessive intake levels of which the kidneys normally eliminate. In individuals with kidney disease or, rarely, Wilson's disease (abnormal retention and storage of copper in the body that damages the liver, kidneys, brain, blood, bones, and endocrine glands), copper levels may accumulate. Significant industrial exposure to copper occurs mainly through inhalation of fumes during welding, smelting, or refining operations; or through exposure to copper dusts and mists during mining, extracting, refining, or manufacturing processes. Copper particles may irritate, discolor, and damage eyes. Exposure to copper salts in many applications is potentially toxic. Copper dusts, fumes, and salts may irritate the upper respiratory tract. Long-term exposure may irritate the skin and discolor the skin or hair.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with impaired pulmonary or renal function should avoid exposure.
Target Organs: Respiratory system, skin, eyes, liver, kidneys.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Inhalation of copper fumes may give rise to metal fume fever (after an incubation period of about 5 hr), an allergic reaction with flu-like symptoms—high temperature, metallic taste, nausea, coughing, general weakness, muscle aches, and exhaustion. These symptoms usually disappear within 24 hr. Direct contact with copper causes skin and (less often) eye irritation, and itching of the linings of the nose, mouth, and respiratory tract. Exposure to copper dust may cause a greenish-black skin discoloration. Copper ingestion causes nausea, vomiting, abdominal pain, and diarrhea. Ingestion of large doses may cause stomach and intestine ulceration, jaundice, and kidney and liver damage.
Chronic Effects: Continued exposure to copper may cause mild dermatitis and degeneration of the mucous membranes. Repeated or prolonged exposure to copper dusts and mists can discolor skin and hair and irritate the skin. Repeated inhalation can cause chronic respiratory disease. Individuals with Wilson's disease (1 in 200,000 individuals) are more susceptible to chronic copper poisoning. If undetected and untreated, this progressive condition is eventually fatal.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing with artificial respiration.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: A blood count shows leucocytosis if an individual has metal fume fever. Consider chellation with penicillamine or BAL (British Anti-Lewisite or dimercaprol) for chronic intoxication.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, remove all heat and ignition sources, and provide adequate ventilation. Avoid creating dusty conditions. Cleanup personnel should protect against vapor inhalation and skin and eye contact. Cleanup methods such as vacuuming (with the appropriate filter) or wet mopping minimizes dust dispersion. Absorb liquid containing copper with vermiculite, dry sand, or other inert materials. Place in appropriate containers for disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per Clean Water Act, 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Some recommendations follow. For copper dust and mists greater than 50 mg/m^3, wear a high-efficiency particulate respirator, a supplied-air respirator, or an SCBA, all with a full facepiece. For copper dust and mists greater than 2000 mg/m^3, wear a supplied-air respirator equipped either with a full facepiece operated in pressure-demand or positive-pressure mode or with a hood in continuous-flow mode. For copper fumes over 100 mg/m^3, wear either a powered air-purifying respirator with a high-efficiency filter, or a supplied-air respirator equipped either with a full facepiece operated in pressure-demand or positive-pressure mode or with a hood in continuous-flow mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Eye and face protection is required when grinding, welding, cutting, or remelting. Protect skin from molten metal and radiant heat when melting scrap. Machine turnings may also present a laceration hazard. When handling oil-contaminated copper, wear rubber gloves to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below OSHA PELs and ACGIH TLVs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store copper in tightly closed containers in a cool, dry, well-ventilated area. Avoid exposure to air and moisture.
Engineering Controls: Avoid dust and fume inhalation and direct contact with skin and eyes. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Maintain exposures below the PEL/TLV. Monitor copper dust and mist levels in the air.
Other Precautions: Provide placement and periodic examinations that emphasize the skin, eyes, and respiratory system. Prevent exposing individuals with chronic respiratory disease or Wilson's disease.
Transportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection **References:** 26, 38, 73, 84, 88, 89, 100, 101, 103, 109, 124, 126, 127, 132, 133, 134, 136, 138, 139, 143, 144
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:
Sheet No. 23
Cadmium Metal/Powder
Issued: 9/77 Revision: D, 5/93

Section 1. Material Identification

Cadmium Metal/Powder (Cd) Description: Occurs naturally in the mineral greenockite (cadmium sulfide). This form is rare and most cadmium is obtained by extraction from other ores containing it as a mineral (lead, copper, and zinc). Zinc sulfide ores are the main source; by direct distillation or recovery from the electrolytic process. Used in electroplating other metals, fire protection systems, nickel-cadmium storage batteries, power transmission wire, TV phosphors, pigments for ceramic glazes, machinery enamels, baking enamels, photography and lithography, selenium rectifiers, electrodes for cadmium-vapor lamps, and photoelectric cells; as a fungicide and a Weston standard cell control of atomic fission in nuclear reactors.
Other Designations: CAS No. 7440-43-9, colloidal cadmium.
Manufacturer: Contact your supplier/distributor. Consult latest *Chemical Week Buyers' Guide*[73] for suppliers list.

Cautions: Cadmium is a highly toxic metal. Symptoms may be delayed several hours and include pulmonary edema (fluid in lungs) which can be fatal. Chronic effects include kidney damage. Cd is considered a carcinogen by several government agencies. The powder is pyrophoric and presents a significant fire/explosion hazard.

Powder

HMIS			
H	3*	R	3
F	1	I	4
R	3	S	2
		K	3

Genium

Solid

HMIS			
H	3*	R	1
F	0	I	4
R	0	S	2
		K	1

*Chronic effects PPE-Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Cadmium, ca 100%

1992 OSHA PEL
8-hr TWA: 5 μg/m^3

1992 OSHA SECAL*
TWA: 15 or 50 μg/m^3

1990 IDLH Level
50 mg/m^3

1993-94 ACGIH TLVs
TWA: 0.01 mg/m^3 (total dust), Class A2 carcinogen
TWA: 0.002 mg/m^3 (respirable fraction)

1991 DFG (Germany) MAK
None established

1992 NIOSH REL
Carcinogen, keep as low as possible

1992 Toxicity Data†
Human, inhalation, LC_{Lo}: 39 mg/m^3/20 min caused cardiac changes, thrombosis, and respiratory depression.
Rat, oral, LD_{50}: 225 mg/kg; details not reported.
Woman, inhalation, LC_{Lo}: 129 μg/m^3 for 20 continuous years produced lung tumors.
Man, TC_{Lo}: 88 μg/m^3/8.6 years caused kidney and ureter toxicity with protein in the urine.

* Separate engineering control limit: to be achieved in processes and work places where it is not possible to achieve the PEL through engineering and work practices alone. The SECAL for Cd is 15 or 50 μg/m^3 depending on the processes involved. See Federal Register 57 (178): 42222, Table VIII-B1, 9/14/92.
†See NIOSH, *RTECS* (EU9800000), for additional mutation, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 1409 F (765 C)
Melting Point: 610 F (321 C)
Vapor Pressure: 0.095 mm Hg at 609.6 F (320.9 C)
Refraction Index: 1.13
Mohs Hardness: 2.0
Molecular Weight: 112.4

Density: 8.642
Water Solubility: Insoluble
Other Solubilities: Soluble in nitric (rapidly), hydrochloric (slowly), and other acids. The solid is soluble in ammonium nitrate solution, but the powdered form undergoes an explosive reaction.

Appearance and Odor: Silver-white, blue-tinged, lustrous, odorless, soft metal that is easily cut with a knife. The powder is grayish-white.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: The solid metal is not flammable, but the finely divided powder is pyrophoric. As a rule, the more finely divided the powder is, the greater the potential for explosion. Use carbon dioxide, dry chemical, or sand. **Unusual Fire or Explosion Hazards:** Processes that create cadmium dust such as cutting, grinding, or welding present a serious explosion hazard in presence of ignition sources. Avoid creation of cadmium dust clouds. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Do not release runoff from fire control methods to sewers or waterways; dike for proper disposal.

Section 5. Reactivity Data

Stability/Polymerization: Cadmium easily tarnishes in moist air as it is oxidized to cadmium oxide. The solid is stable in dry air. The powder is pyrophoric. Cd becomes brittle at 176 F (80 C). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include ammonium nitrate (powdered Cd), hydrazoic acid, tellurium, zinc, ammonia, sulfur, selenium, nitryl fluoride, and oxidizing agents. **Conditions to Avoid:** Creation of Cd dust clouds, exposure to heat and ignition sources, and contact with incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of Cd can produce toxic cadmium oxide (CdO) fumes.

Section 6. Health Hazard Data

Carcinogenicity: The following agencies list Cd as a carcinogen: IARC Class 2A (probably carcinogenic in humans),[183] NTP Class 2 (reasonably anticipated to be a carcinogen),[169] and NIOSH Class X (carcinogen defined without further categorization),[183] ACGIH TLV-A2 (suspected human carcinogen),[183] EPA-B1 (Probable human carcinogen) and DFG MAK-A2 (unmistakably carcinogenic in animal experimentation only).[183]
Summary of Risks: Dust or fume inhalation generally results in acute symptoms delayed up to 24 hr. Effects include a flu-like syndrome similar to metal fume fever with chills, fever, and muscle pain in the back and limbs. Pulmonary edema (fluid in lungs) can develop after severe exposure and may result in death. If victim recovers, residual changes may include lung fibrosis (thickening) and vascular changes. Long-term exposure to Cd damages the liver and kidneys (accumulates, half-life = 7 to 30 yr). Proteinuria (protein in urine) of low molecular weight is the first sign of tubular dysfunction. Excess urinary glucose is also seen. Bone demineralization similar to osteoporosis (decreased bone density)...

Continue on next page

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Section 6. Health Hazard Data, *continued*

occurs *not* as a direct effect of Cd exposure, but indirectly by altering kidney regulation of calcium and phosphorus which are needed for strong, healthy bones. Some studies show a correlation between anemia (low hemoglobin in blood) and high Cd levels. Selenium (Se) and zinc (Zn) appear to suppress Cd toxicity; Se binds up Cd, preventing it from entering body tissue and Zn may compete for the same metabolic site. **Medical Conditions Aggravated by Long-Term Exposure:** Kidney, blood, or respiratory disorders. **Target Organs:** Blood, kidney, liver, respiratory system. **Primary Entry Routes:** Inhalation, ingestion. **Acute Effects:** Inhalation may cause irritation of the eyes, nose, and throat, nausea and vomiting, abdominal colic, diarrhea, chest tightness, cough, headache, and weakness. Pulmonary edema could develop up to 24 hr post exposure. Kidney damage may occur after acute exposures, but is more likely with chronic exposure. **Chronic Effects:** Symptoms may be delayed several years after last exposure and include perforation of the nasal septum (tissue between the nostrils), loss of smell, chronic bronchitis, severe progressive emphysema, anorexia, insomnia, fatigue, pallor, anemia, kidney damage, bone demineralization, lung fibrosis and possible cancer of the respiratory tract.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Wash exposed area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of cadmium's irritating nature.

Note to Physicians: ß-2 microglobulin excretion of > 200 µg/g creatinine indicates kidney dysfunction as does a renal cortex [Cd] of 180 to 220 µg/g of wet kidney cortex. Blood Cd levels are *not* indicative of exposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against inhalation. Carefully scoop up small spills and place in sealed impermeable containers. *Do not* disperse dust by sweeping. Remember that Cd powder can be pyrophoric and must be handled carefully. Prevent entry into sewers, drains, and waterways. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.24): D006, Characteristic of Toxicity; regulatory level = 1.0 mg/L

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 10 lb (4.54 kg)† [* per CWA, Sec. 307(a)]

SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1027)

* No reporting of releases of this substance is required if the diameter of the pieces of the solid metal is equal to or exceeds 100 µm (0.004 in.)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For any detectable concentration, use a SCBA or supplied air respirator (with auxiliary SCBA) with a full facepiece operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear gloves, boots, aprons, and gauntlets to prevent Cd dust from contacting skin. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL or SECAL (Sec. 2). Lunchroom facilities should not have concentrations above 2.5 $\mu g/m^3$ at any time. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes; launder before reuse. Remove Cd from shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using Cd, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage/Handling Requirements: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles. Do not allow cadmium dust to build up in storage area.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level.

Administrative Controls: Prohibit workers from removing Cd from protective clothing and equipment by blowing, shaking, or any other means that disperses Cd into the air. Employees must not enter eating facilities while wearing PPE unless it is vacuumed with a HEPA. Consider preplacement and periodic medical exams of exposed workers emphasizing the blood, kidneys, liver, and respiratory system. Educate workers on Cadmium's carcinogenicity.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Poisonous solids, n.o.s.*, Pyrophoric metals, n.o.s.†

DOT Hazard Class: 6.1*, 4.2†

ID No.: UN2811*, UN1383†

DOT Packing Group: III*, I†

DOT Label: Keep away from food*, Spontaneously Combustible†

Special Provisions (172.102): —*, B11†

* Solid metal, † Powder

Packaging Authorizations

a) **Exceptions:** 173.153*, None†

b) **Non-bulk Packaging:** 173.213*, .187†

c) **Bulk Packaging:** 173.240*, .242†

Quantity Limitations

a) **Passenger Aircraft or Railcar:** 100 kg*, Forbidden†

b) **Cargo Aircraft Only:** 200 kg*, Forbidden†

Vessel Stowage Requirements

a) **Vessel Stowage:** A*, D†

b) **Other:** –

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 148, 159, 167, 169, 183, 185, 186

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** TW Thoburn, MPH, MD

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Material Safety Data Sheets Collection:

Sheet No. 723
Nickel Metal

Issued: 8/90

Section 1. Material Identification

Nickel (Ni) Description: Found in ores in combination with sulphur, oxygen, antimony, arsenic, and/or silica. The Orford (sodium sulfide and electrolysis) and the Mond (nickel carbonyl) processes are used to refine nickel. Used in electroplating, casting operations for machine parts, manufacturing acid-resisting and magnetic alloys and tapes, synthesizing acrylic esters; in surgical and dental prostheses, coinage, catalytic gastrification of coal, paint pigments, Ni-Cd batteries, ceramics and glass; and as a catalyst in hydrogenation of fats and oils.
Other Designations: CAS No. 7440-02-0, Raney alloy, Raney nickel.*
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

Cautions: Nickel is an eye, skin, and respiratory tract irritant. *Chronic inhalation of nickel dust or fumes may cause cancer of the lungs and nasal passages. Nickel powder (Raney nickel) is a dangerous fire hazard.*

R	0
I	3
S	2
K	1

NFPA

catalyst
HMIS
H 2
F 4
R 0
PPG†

Genium

metal
HMIS
H 2
F 1
R 0
PPG†
† Sec. 8

* Raney nickel is prepared by leaching (with 25% caustic soda solution) aluminum from an alloy of 50% aluminum and 50% nickel. It is used as a catalyst for hydrogenation. Raney nickel, a silvery gray metal powder, is a dangerous fire risk and ignites spontaneously in air (Sec. 4). Nickel catalysts cause many industrial accidents.

Section 2. Ingredients and Occupational Exposure Limits

Nickel, ca 100%

1989 OSHA PEL	1989-90 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data*
8-hr TWA: 1 mg/m^3	TLV-TWA: 1 mg/m^3	0.015 mg/m^3	Dog, intravenous, LD_{Lo}: 10 mg/kg Guinea pig, oral, LD_{Lo}: 5 mg/kg Rat, implant, TD_{Lo}: 250 mg/kg

* See NIOSH, *RTECS* (QR5950000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 4946 F (2730 C)
Melting Point: 2651 F (1455 C)
Vapor Pressure: 1 mm at 3290 F (1810 C)
Atomic Weight: 58.71
Density: 8.90 at 25 C
Water Solubility: Insoluble

Appearance and Odor: A silvery-white, hard, malleable and ductile metal.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Smother with suitable dry powder or use large amounts of water.
Unusual Fire or Explosion Hazards: Nickel is combustible as dust or powder. Raney nickel ignites spontaneously in air. Nickel carbonyl (*MSDS Collection*, No. 226), a highly toxic substance, may form under fire conditions.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since nickel dust or powder is toxic if inhaled, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Nickel is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Nickel can react violently with fluorine, ammonium nitrate, hydrogen + dioxane, performic acid, selenium, sulfur, ammonia, hydrazine, phosphorus, and titanium + potassium chlorate. Nickel is also incompatible with oxidants. Raney nickel catalysts may initiate hazardous reactions with sulfur compounds, *p*-dioxane, hydrogen, hydrogen + oxygen, ethylene + aluminum chloride, magnesium silicate, methanol, and organic solvents + heat.
Conditions to Avoid: Avoid incompatibilities.
Hazardous Products of Decomposition: Thermal oxidative decomposition of nickel can produce highly toxic nickel carbonyl.

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Section 6. Health Hazard Data

Carcinogenicity: The IARC and NTP classify nickel as, respectively, a human carcinogen (Group 1) and an anticipated human carcinogen.
Summary of Risks: Nickel dust or fume is a respiratory irritant that with chronic exposure may cause nasal or lung cancer in humans. The average latency period for the induction of these cancers appears to be about 25 yr (within a 4- to 51-yr range). Experimental studies show nickel also has neoplastigenic, tumorigenic, and teratogenic effects in laboratory animals. Hypersensitivity to nickel is common and can cause conjunctivitis, allergic contact dermatitis, and asthma. The allergic contact dermatitis ("nickel-itch," a pink papular erythema with pustulation and ulceration) usually clears within one week, but sensitization is permanent.
Medical Conditions Aggravated by Long-Term Exposure: Chronic pulmonary, upper respiratory tract, and skin disorders. Carcinoma of the paranasal sinuses, larynx, and lung may also develop.
Target Organs: Nasal cavities, lungs, skin.
Primary Entry Routes: Inhalation, dermal contact, and ingestion.
Acute Effects: Exposure to nickel fumes can cause upper respiratory tract irritation (with nonproductive cough, rapid breathing, dyspnea, chest tightness), metal fume fever (chills, fever, flu-like symptoms), asthma, inflammation of the lungs (noninfectious pneumonia), eye (conjunctiva) irritation, nausea, vomiting, and abdominal pain. Dermal contact causes "nickel itch." Ingesting large doses causes nausea, vomiting, and diarrhea.
Chronic Effects: Prolonged or repeated contact can cause nickel sensitization. Symptoms of sensitization include nickel dermatitis with eczematous skin and lichenification (hardened and leathery skin). Chronic inhalation exposure can cause chronic pulmonary irritation, chronic thickening of the mucous membranes of the nose, nasal sinusitis, anosmia (loss or impairment of the sense of smell), and perforation of the nasal septum. Chronic exposure to dust and fumes may cause carcinoma of paranasal sinuses, larynx, and lung.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Since oral toxicity for elemental nickel is low, inducing vomiting is seldom necessary. In cases of severe vomiting or diarrhea, treat for fluid replacement.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Chronic exposure to nickel dust may cause *eosinophilic pneumonitis* (Loeffler's syndrome) which responds well to systemic cortico-steroids. There are cases of host rejection of nickel-containing prostheses after development of nickel sensitivity.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personal should protect against vapor inhalation and dermal contact. Avoid dust generation. Using nonsparking tools, carefully scoop spilled material into appropriate containers for reclamation or disposal. After completing material pickup, wash spill site. Do not release to sewers or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL, ACGIH TLV, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from incompatible materials (Sec. 2). Protect against physical damage. Store Raney nickel under inert gas or water in tightly closed containers away from heat or ignition sources, acids, caustics, and oxidizing materials.
Engineering Controls: Minimize all possible exposures to potential carcinogens. Avoid vapor inhalation and dermal contact. Use only with appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures.
Other Precautions: Provide preplacement and periodic medical examinations that emphasize the skin, nasal cavities, and lungs, including a 14" x 17" chest roentgenogram and urine nickel determinations.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Nickel catalyst, wetted with not less than 40% water or other suitable liquid, by weight, finely divided, activated, or spent
IMO Hazard Class: 4.2
ID No.: UN1378
IMO Label: Spontaneously combustible
IMDG Packaging Group: II

MSDS Collection **References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 140, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 683
Polychlorinated Biphenyls (PCBs)

Issued: 11/88 Revision: A, 9/92

Section 1. Material Identification

Polychlorinated Biphenyls [$C_{12}H_{10-n}Cl_n$ (n=3, 4, 5)] Description: A class of nonpolar chlorinated hydrocarbons with a biphenyl nucleus (two benzene nuclei connected by a single C-C bond) in which any or all of the hydrogen atoms have been replaced by chlorine. Commercial PCBs are mixtures of chlorinated biphenyl isomers with varying degrees of chlorination. Prepared industrially by the chlorination of biphenyl with anhydrous chlorine in the presence of a catalyst such as ferric chloride or iron filings. Except for limited research and development applications, PCBs have not been produced in the US since 1977. When large quantities of PCBs were manufactured in the US, they were marketed under the tradename Aroclor (Monsanto) and were characterized by four digit numbers. The first two digits indicating biphenyls (12), triphenyls (54), or both (25, 44); the last two digits indicating the weight percent of chlorine. PCBs' thermal stability, nonflammability, and high dielectric capability made them very useful in electrical equipment. Formerly used as additives in hydraulic fluids, heat transfer systems, lubricants, cutting oils, printer's ink, fire retardants, asphalt, brake linings, automobile body sealants, plasticizers, adhesives, synthetic rubber, floor tile, wax extenders, dedusting agents, pesticide extenders, and carbonless reproducing paper. PCBs are still used in certain existing electrical capacitors and transformers that require enhanced electrical protection to avoid heating from sustained electric faults.

R 1
I 4
S 3*
K 1
* Skin absorption

NFPA
1 / 2 / 0 / –

HMIS
H 2‡
F 1
R 0
PPE†
† Sec. 8
‡ Chronic Effects

Other Designations: CAS No. 1336-36-3, Aroclor, Clophen, Chlorextol, chlorinated biphenyls, chlorinated diphenyl, chlorinated diphenylene, chloro biphenyl, chloro-1,1-biphenyl, Dykanol, Fenclor, Inerteen, Kaneclor, Montar, Noflamol, Phenoclor, Pyralene, Pyranol, Santotherm, Sovol, Therminol FR-1

Cautions: PCBs are potent liver toxins that may be absorbed through skin. Potentially, chronic or delayed toxicity is significant because PCBs accumulate in fatty tissue and may reasonably be anticipated to be carcinogens. PCBs are a bioaccumulative environmental hazard. When burned, decomposition products may be more hazardous than the PCBs.

Section 2. Ingredients and Occupational Exposure Limits

PCBs, contain various levels of polychlorinated dibenzofurans and chlorinated naphthalenes as contaminants

1991 OSHA PELs, Skin
8-hr TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m^3)
Category III: Substances with systemic effects, onset of effect > 2 hr., half-life > shift length (strongly cumulative)
Short-term Level: 1 ppm, 30 min., average value, 1 per shift

TWA (Chlorodiphenyl, 54% chlorine): 0.05 ppm (0.5 mg/m^3)
Category III: (see above)
Short-term Level: 0.5 ppm, 30 min., average value, 1 per shift

1985-86 Toxicity Data*
Rat, oral, TD: 1250 mg/kg administered intermittently for 25 weeks produced liver tumors.
Mammal, oral, TD_{Lo}: 325 mg/kg administered to female for 30 days prior to mating and from the 1st to the 36th day of gestation produced effects on newborn (stillbirth; live birth index; viability index).

1990 NIOSH REL
TWA (Chlorodiphenyl, 42% chlorine): 0.001 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m^3

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloroacne won't occur.
† See NIOSH, *RTECS* (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 F (340-375 C)
Melting Point: 42%: -2.2 F (-19 C); 54%: 14 F (-10 C)
Vapor Pressure: 1 mm Hg at 100 F (38 C); 10^{-6} to 10^{-3} mm at 20 C
Molecular Weight: 188.7 to 398.5

Specific Gravity: 1.3 to 1.8 at 20 C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats; slightly soluble in glycerol and glycols.

Appearance and Odor: PCBs vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins, depending upon chlorine content.

* Physical and chemical properties vary widely according to degree and to the position of chlorination.

Section 4. Fire and Explosion Data

Flash Point: 286-385 F (141-196 C) OC*	Autoignition Temperature: 464 F (240 C)	LEL: None reported	UEL: None reported

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water spray may be ineffective. Use water spray to cool fire-exposed containers or transformers. Do not scatter PCBs with high-pressure water streams. **Unusual Fire or Explosion Hazards:** Combustion products (hydrogen chloride, phosgene, polychlorinated dibenzofurans, and furans) are more hazardous than the PCBs themselves. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Approach fire from upwind to avoid highly toxic decomposition products. Structural firefighter's protective clothing will provide *limited* protection. Do not release runoff from fire control methods to sewers or waterways. Dike for later disposal.

* Flash points shown are a range for various PCBs. Some forms do not have flash points.

Section 5. Reactivity Data

Stability/Polymerization: PCBs are very stable materials but are subject to photodechlorination when exposed to sunlight or UV (spectral region above 290 nanometers). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs are chemically inert and resistant to oxidation, acids, and bases. **Conditions to Avoid:** Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition [1112-1202 F (600-650 C)] of PCBs can produce highly toxic derivatives, including polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hydrogen chloride, phosgene and other irritants.

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Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] and NTP[169] list PCBs as an IARC probable carcinogen (overall evaluation is 2A; limited human data; sufficient animal data) and NTP anticipated carcinogen, respectively. **Summary of Risks**: PCBs are potent liver toxins that can be absorbed through unbroken skin in toxic amounts without immediate pain or irritation. PCBs have low acute toxicity, but can accumulate in fatty tissue and severe health effects may develop later. Generally, toxicity increases with a higher chlorine content; PCB-oxides are more toxic. The toxic action on the liver also increases with simultaneous exposure to other liver toxins, e.g. chlorinated solvents, alcohol, and certain drugs. Pathological pregnancies (abnormal pigmentations, abortions, stillbirths, and underweight births) have been associated with increased PCB serum levels in mothers; PCBs can be passed in breast milk. PCBs can affect the reproductive system of adults. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, liver, and respiratory disease. **Target Organs:** Skin, liver, eyes, mucous membranes, and respiratory tract. **Primary Entry Routes:** Inhalation, dermal contact, ingestion. **Acute Effects:** Exposure to PCB vapor or mist is severely irritating to the skin, eyes, nose, throat, and upper respiratory tract. Intense acute exposure to high concentrations may result in eye, lung, and liver injury. Systemic effects include nausea, vomiting, increased blood pressure, fatigue, weight loss, jaundice, edema and abdominal pain. Cognitive, neurobehavior and psychomotor impairment and memory loss have also been seen after acute exposure. **Chronic Effects:** Repeated exposure to PCBs can cause chloroacne; redness, swelling, dryness, thickening and darkening of the skin and nails; swelling and burning of the eyes, and excessive eye discharge; distinctive hair follicles; gastrointestinal disturbances; neurological symptoms including headache, dizziness, depression, nervousness, numbness of the extremities, and joint and muscle pain; liver enlargement; menstrual changes in women; and chronic bronchitis. Cancer, primarily liver, is also a possible result of exposure, but data is inconclusive.

FIRST AID Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Rinsing eyes with medical oil (olive, mineral) initially may remove PCB and halt irritation better than water rinsing alone. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Multiple soap and water washings are necessary.* Avoid the use of organic solvents to clean the skin. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** In most cases, accidental PCB ingestion will not be recognized until long after vomiting would be of any value. Never give anything by mouth to an unconscious or convulsing person. Vomiting of the pure substance may cause aspiration. Consult a physician. **Note to Physicians:** Monitor patients for increased hepatic enzymes, chloroacne, and eye, gastrointestinal, and neurologic symptoms listed above. Diagnostic tests include blood levels of PCBs and altered liver enzymes.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and isolate hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. For small spills, take up with sand or other noncombustible material and place into containers for later disposal. For larger spills, dike far ahead of spill to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** PCBs have been shown to bio-concentrate significantly in aquatic organisms. **Ecotoxicity:** Bluegill, TLm: 0.278 ppm/96 hr. Mallard Duck, LD_{50}: 2000 ppm. **Environmental Degradation:** In general, the persistence of PCBs increases with an increase degree of chlorination. **Soil Absorption/Mobility:** PCBs are tightly absorbed in soil and generally do not leach significantly in most aqueous soil systems. However, in the presence of organic solvents, PCBs may leach rapidly through the soil. Volatilization of PCBs from soil may be slow, but over time may be significant. **Disposal:** Approved PCB disposal methods include: incineration with scrubbing, high-efficiency boilers, landfills, and EPA-approved alternative disposal methods. Each disposal method has various criteria. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 311(b)(4) and 307(a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Minimum respiratory protection should include a combination dust-fume-mist and organic vapor cartridge or canister or air-supplied, depending upon the situation. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Butyl rubber, neoprene, Teflon, and fluorocarbon rubber have break through times greater than 8 hrs. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Segregate contaminated clothing in such a manner so that there is no direct contact by laundry personnel. Implement quality assurance to ascertain the completeness of the cleaning procedures. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a closed, labelled, container in a ventilated area with appropriate air pollution control equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Inform employees of the adverse health effects associated with PCBs. Limit access to PCB work areas to authorized personnel. Consider preplacement and periodic medical examinations with emphasis on the skin, liver, lung, and reproductive system. Monitor PCB blood levels. Consider possible effects on the fetus. Keep medical records for the entire length of employment and for the following 30 yrs.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Polychlorinated biphenyls
DOT Hazard Class: 9
ID No.: UN2315
DOT Packing Group: II
DOT Label: CLASS 9
Special Provisions (172.102): 9, N81

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 100 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 34

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 163, 164, 168, 169, 174, 175, 180
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy MPH, CIH; **Medical Review:** AC Darlington, MD

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Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 136

SELENIUM

Issued: April 1988

SECTION 1. MATERIAL IDENTIFICATION 25

Material Name: SELENIUM

Description (Origin/Uses): Used to manufacture other selenium compounds; also used in photography and xerography and as a catalyst and pigment.

Other Designations: Elemental Selenium; Selenium Base; Selenium Dust; Selenium Metal; Selenium Metal Powder; Se; NIOSH *RTECS* No. VS7700000; CAS No. 7782-49-2

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

Comments: See Genium Industrial MSDS 152 (Selenium Dioxide).

HMIS	Not Found
H 3	
F 0	R 1
R 1	I 4
PPG*	S 2
*See sect. 8	K 0

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Selenium, CAS No. 7782-49-2	ca 100	IDLH* Level: 100 mg/m³ **OSHA PEL**** 8-Hr TWA: 0.2 mg/m³ **ACGIH TLV,** 1987-88** TLV-TWA: 0.2 mg/m³ **Toxicity Data***** Rat, Oral, LD_{50}: 6700 mg/kg Rat, Inhalation, LD_{Lo}: 33 mg/kg (8 Hrs)

*Immediately dangerous to life and health
**This exposure limit is defined for selenium compounds as Se.
***See NIOSH, *RTECS*, for additional data with references to reproductive, mutagenic, and tumorigenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: ca 1263 F (684 C)
Water Solubility: Insoluble
Melting Point: ca 644 F (340 C)

Specific Gravity (H_2O = 1): Both amorphous and crystalline forms have specific gravities between 4 and 5.
Molecular Weight: 79 Grams/Mole

Appearance and Odor: A dark red to bluish black amorphous solid or dark red, grey, or black crystals appearing in two distinct forms, or allotropes, because of differences in crystalline structures; odorless.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
*	*		*	*

Extinguishing Media: *Selenium does not burn. Use agents such as dry chemical, "alcohol" foam, or carbon dioxide that will extinguish the surrounding fire.

Unusual Fire or Explosion Hazards: None.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Selenium is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Chemical Incompatibilities: This material reacts dangerously with carbides, fluorine, oxygen, potassium, and many more materials (see Genium ref. 84).

Conditions to Avoid: Avoid direct contact with incompatible chemicals to prevent dangerous and violent reactions. Avoid the unintended contact of water with selenium in storage areas or reactor vessels.

Hazardous Products of Decomposition: When heated to decomposition, selenium readily emits toxic oxides of selenium (SeO_x). Selenium itself is a highly toxic and dangerous material.

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SECTION 6. HEALTH HAZARD INFORMATION

Selenium is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Direct exposure to selenium or inhalation of its dust causes severe irritation of the skin, eyes, and the upper respiratory tract (URT). **Caution:** Some symptoms of exposure to selenium (e.g., chemical pneumonia) may be delayed for several hours. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** URT, skin, eyes. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** Skin and eye burns, contact dermatitis, intense irritation of the URT, and headache. Cases with flulike symptoms resembling metal-fume fever within 24 hours of exposure have been reported.
Chronic Effects: Odor of garlic on breath; fatigue; irritability; URT irritation; pallor; gastrointestinal distress; metallic taste; and an allergic eye reaction with red, sometimes puffy, eyelids.
FIRST AID: Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water. **Skin.** Immediately wash the affected area with plenty of running water. Any worker who develops a rash or contact dermatitis must get medical attention and prevent any further contact with selenium metal or its compounds (e.g., selenium dioxide; see Genium Industrial MSDS 152). **Inhalation.** Remove exposed person to fresh air; restore and/or support his or her breathing as needed. Prompt administration of oxygen gas (O_2) by trained medical personnel may aid recovery. **Ingestion.** Give exposed person several glasses of water to dilute material. Do not induce vomiting. Never give anything by mouth to someone who is unconscious or convulsing.

Treat each exposure to selenium as an emergency! GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. If chelation therapy to remove the metallic selenium is indicated, calcium disodium edetate ($CaNa_2$-EDTA) is the chelating agent of choice; do *not* use dimercaprol. Burns may require treatment with 10% sodium thiosulfate cream.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate all nonessential personnel, provide adequate ventilation, and do not add any water to the spill or leak area. Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8). Scoop up spilled selenium into suitable containers for disposal. Carefully sweep or vacuum up small spills or residues without creating dust.
Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations for disposal. Follow Federal, state, and local regulations.
OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste: Listed without a Number
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks) wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves; boots; aprons; and clean, impervious, body-covering clothing to prevent any possibility of skin contact.
Ventilation: Install and operate general and local maximum explosion-proof ventilation systems powerful enough to maintain airborne levels of selenium below the OSHA PEL standard cited in section 2. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. Make the 10% sodium thiosulfate solution or cream and the $CaNa_2$-EDTA chelating agent formula (sect. 6) readily available to a trained safety specialist. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage. Do *not* wear contact lenses in any work area.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store selenium in a cool, dry, well-ventilated area in tightly closed containers away from oxidizing agents, organic materials, water, metals, and incompatible chemicals (see sect. 5). **Special Handling/Storage:** Prevent moisture or water contamination in any storage facility. Consider installing an automatic monitoring system to detect selenium contamination; storage under an inert gas (e.g., a nitrogen blanket) may be warranted depending on the work environment. **Engineering Controls:** Use selenium in closed engineering systems because of its significant health and physical hazards (see sects. 4, 5, and 6). All engineering systems (production, transportation, etc.) should be of maximum explosion-proof design (i.e., they must be nonsparking, electrically grounded and bonded, etc.). **Comments:** Perform all work with selenium with a sustained, conscientious effort to prevent accidental contact with water. Do not create a dusty working environment. Develop a sustained, conscientious program of working guidelines prior to any accidental exposure.
Transportation Data (49 CFR 172.101-2)
DOT Shipping Name: Selenium Metal Powder **DOT Label:** Poison **IMO Label:** St. Andrew's Cross (X)*
DOT Class: Poison B **DOT ID No.** UN2658 **IMO Class:** 6.1
*Harmful-Stow away from Foodstuffs (IMO Label, Materials of Class 6.1 Packaging Group III)
References: 1, 2, 12, 73, 84-94, 100, 103. PJI

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Zinc Oxide **MSDS No. 45**
Date of Preparation: 12/78 Revision: B, 2/94
Errata: 6/94

Section 1 - Chemical Product and Company Identification 44

Product/Chemical Name: Zinc Oxide
Chemical Formula: ZnO
CAS No.: 1314-13-2
Synonyms: Amalox, Chinese White, flowers of zinc, philosopher's wool, zinc monoxide, zinc white
Derivation: Prepared by vaporization of metallic zinc and oxidation of the vapors with preheated air (French process) or roasting Franklinite with coal followed by oxidation (American process).
General Use: In cosmetics, sun-block ointments, driers, quick-setting cements, dental-closing waxes, electrostatic copying paper and electronics as a semiconductor; as a pigment in white paints (replacing lead carbonate), reagent in analytical chemistry, flame retardant, UV absorber in plastics, and in the manufacture of opaque and transparent glass, enamels, auto tires, white glue, matches, and porcelains.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Zinc oxide: 99.5+ % (medicinal grade), 90 - 99 % (technical grade)
Trace Impurities: Include cadmium, arsenic, lead, and mercury.

OSHA PELs
8 hr TWA: 15 mg/m^3 (total dust), 5 mg/m^3 (respirable fraction), 5 mg/m^3 (fume)

ACGIH TLVs
TWA: 10 mg/m^3 (total dust, no asbestos and <1 % crystalline silica)
TWA: 5 mg/m^3 (fume)
STEL: 10 mg/m^3 (fume)

NIOSH REL
10-hr TWA: 5 mg/m^3, ceiling: 15 mg/m^3 (dust)
10-hr TWA: 5 mg/m^3, STEL: 10 mg/m^3 (fume)

DFG (Germany) MAK
TWA: 5 mg/m^3 (respirable dust)
Category III: Substances with systemic effects
Onset of Effect: > 2 hr
Half-life: > shift length (strongly cumulative)

Peak Exposure Limit:
50 mg/m^3, 30 minute average value, 1/shift

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Zinc oxide exists as yellowish-white, odorless crystals with a bitter taste. It becomes more toxic when it is heated and produces fumes. The fine particles in the fume can be inhaled into the smallest regions of the lungs and produce flu-like symptoms. This syndrome is typically referred to as "metal fume fever," "zinc-chills," or "brass-founders' ague." It is noncombustible, but the finely divided powder can present an explosion hazard.

Wilson Risk Scale
R 1
I 3
S 2
K 1

HMIS
H 1
F 0
R 0

PPE*
*Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation.
Target Organs: Respiratory and central nervous systems, gastrointestinal tract.
Acute Effects
Ingestion: Zinc oxide is relatively non-toxic via ingestion because it is poorly absorbed through the digestive tract. However, ingestion of large amounts of zinc oxide dusts (either directly or swallowing with mucous if excess amounts are inhaled) can cause gastritis from formation of zinc chloride via reaction with the hydrochloric acid normally present in the stomach. Peptic ulcers occurring in workers are indicative of gastrointestinal damage.
Eye: None specified.
Skin: Prolonged skin contact can block the sweat glands and cause a papular (bumpy) rash to form.
Inhalation: "Metal fume fever" symptoms include throat dryness and irritation, a sweet or metallic taste, constricted chest, dry cough, chills, fatigue, headache, muscle cramps, low back pain, and occasionally blurred vision, nausea, and vomiting. Fever, sweating, difficulty breathing, leukocytosis (abnormally high number of circulating white blood cells) and rales (noise produced when breathing is difficult) are also possible. Most workers develop an immunity to these attacks. However, this is generally lost over the weekend and must be rebuilt on subsequent return to work. Only the freshly formed fume causes these symptoms, presumably because older fume adheres to other airborne particles and becomes too large to reach the deeper regions of the lungs.
Carcinogenicity: IARC, NTP, and OSHA do not list zinc oxide as a carcinogen. The EPA has given it a class D designation, indicating inadequate evidence or no data given.
Medical Conditions Aggravated by Long-Term Exposure: Respiratory disorders.

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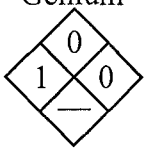
Chronic Effects: Gastrointestinal disturbances and latent liver dysfunction were reported in 15 of 25 workers exposed to 50 mg/m^3 (length of exposure not indicated).
Other: Zinc oxide causes hemolysis (cell breakage) in human red blood cells.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician if pain or irritation persists.
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Notes to Physicians: Treatment is symptomatic and supportive.

Section 5 - Fire-Fighting Measures

Genium



Flash Point: Noncombustible
Autoignition Temperature: Noncombustible
LEL: None reported.
UEL: None reported.
Extinguishing Media: Use agents suitable for surrounding fire.
Unusual Fire or Explosion Hazards: Finely divided powder presents an explosion hazard.
Hazardous Combustion Products: Zinc oxide *fume* may be released when heated.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel. Cleanup personnel should protect against contamination.
Small Spills: Carefully scoop up or vacuum (with appropriate filter). Damp mop any residue.
Large Spills
Containment: For large solution spills, dike far ahead for later reclamation or disposal. Do not release into sewers or waterways.
Cleanup: Flush dry spills to containment area for later reclamation or disposal. Damp mop any residue.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid excessive dust generation.
Storage Requirements: Store in air-tight containers in a cool, dry, well-ventilated area away from incompatibles (Sec. 10).

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose processes whenever possible to avoid dust dispersion into work area.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the respiratory and gastrointestinal tract.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For ≤ 50 mg/m^3, use any dust, mist, or fume respirator, any supplied-air respirator (SAR) or any SCBA. For ≤ 125 mg/m^3, use any powered, air-purifying respirator with a dust, mist, and fume filter or any SAR operated in continuous-flow mode. For ≤ 250 mg/m^3, use any air-purifying, full facepiece respirator with a high-efficiency particulate filter, any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter, any SAR with a tight-fitting facepiece and operated in continuous-flow mode, or any SAR or SCBA with a full facepiece. For ≤ 2500 mg/m^3, use any SAR operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

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Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Launder contaminated work clothes before reuse. Remove this material from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: White to yellowish-white, odorless powder or hexagonal crystals with a bitter taste.
Vapor Pressure: ~ 0 mm Hg at 68 F (20 C)
Formula Weight: 81.38
Density: 5.67 g/mL
Water Solubility: 1.6 mg/L at 84.2 F (29 C)
Other Solubilities: Soluble in dilute mineral acids, ammonia, ammonium chloride, ammonium carbonate, and fixed alkali solutions. Insoluble in ethyl alcohol.
Boiling Point: Sublimes at normal pressure.
Melting Point: 3587 F (1975 C)
pH: 6.95 (American Process), 7.37 (French process)
Refraction Index: 2.0041

Section 10 - Stability and Reactivity

Stability: Zinc oxide is stable at room temperature in air-tight containers under normal storage and handling conditions. It gradually absorbs carbon dioxide from air to form zinc carbonate.
Polymerization: Hazardous polymerization does not occur.
Chemical Incompatibilities: Include aluminum + hexachloroethane, chlorinated rubber (at 419 F/ 215 C), linseed oil, magnesium (reduced explosively upon heating), hydrogen fluoride, and zinc chloride or phosphoric acid (forms cement-like products due to formation of oxy-salts).
Conditions to Avoid: Exposure to incompatibles.
Hazardous Decomposition Products: Excessive heating of zinc oxide can produce toxic zinc oxide *fumes*.

Section 11- Toxicological Information

Toxicity Data:*

Eye Effects:
Rabbit, eye: 500 mg/24 hr caused mild irritation.

Skin Effects:
Rabbit, skin: 500 mg/24 hr caused mild irritation.

Mutagenicity:
Hamster embryo: 300 µg/L caused sister chromatid exchange.
E Coli: 3000 ppm caused DNA damage.

Acute Inhalation Effects:
Human, inhalation, TC_{Lo}: 600 mg/m^3 caused cough and difficulty breathing.

Acute Oral Effects:
Human, oral, LD_{Lo}: 500 mg/kg
Mouse, oral, LD_{50}: 7950 mg/kg

Reproductive Effects:
Rat, oral: 6846 mg/kg administered from 1 to 22 days of pregnancy caused homeostasis abnormalities in the newborns and stillbirths.

* See NIOSH, *RTECS* (ZH4810000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Data not found.
Environmental Degradation: Data not found.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
Container Cleaning and Disposal: Triple rinse containers and dispose of rinse water as you would other zinc oxide waste.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101): Not listed

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Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste Number: Not listed
Listed as a (zinc and compounds) CERCLA Hazardous Substance (40 CFR 302.4) per CWA, Sec. 307(a)
CERCLA Reportable Quantity (RQ): Not given for the broad class
SARA 311/312 Codes: 2
Listed as a (zinc fume or dust) SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed as a (zinc fume and dust) Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 73, 103, 124, 132, 133, 136, 139, 148, 149, 167, 187

Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... PA Roy, MPH, CIH
Medical Review ..... W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 162
Copper

Issued: 12/85 Revision: A, 8/90

Section 1. Material Identification 32

Copper (Cu) Description: Widely distributed in nature in elemental state, arsenites, sulfides, chlorides, and carbonates. Prepared by crushing, grinding, and concentrating copper ores by flotation and leaching or by smelting copper ore concentrates to yield a blister (96 to 98%) copper which is electrolytically refined to yield 99.9+% copper. Copper is the most widely used structural metal, next to iron and aluminum. Used in electric wiring; switches, heating, plumbing, roofing, and building construction; alloys (brass, bronze, Monel metal, beryllium-copper); coins; chemical and pharmaceutical machinery; electroplated protective coatings and undercoats for nickel, chromium, zinc, etc., cooking utensils; insecticides; antifouling paints; and as a catalyst. Copper whiskers are used in thermal and electrical composites. Copper flakes are used as insulation for liquid fuels.

Other Designations: CAS No. 7440-50-8, bronze powder, copper slag-airborne, copper slag-milled.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

Cautions: *Copper may be toxic through contact, inhalation, and ingestion.* It may cause skin and eye irritation and metal fume fever. Copper is not considered a fire hazard, but fine particles may burn in air.

R 0
I 4
S 1
K 0

Genium

HMIS
H 2
F 0
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Copper, ca 100%

1989 OSHA PELs	1989-90 ACGIH TLVs	1988 NIOSH REL	1985-86 Toxicity Data‡
8-hr TWA: 1 mg/m^3*	TLV-TWA: 1 mg/m^3*	None established	Human, oral, TD_{Lo}: 120 µg/kg affects the gastrointestinal tract (nausea or vomiting)
8-hr TWA: 0.1 mg/m^3†	TLV-TWA: 0.2 mg/m^3†		Rat, oral, TD_{Lo}: 1210 µg/kg (35 weeks prior to mating) affects fertility (pre- and post-implantation mortality)

* Copper dusts and mists, as Cu.
† Copper fume.
‡ See NIOSH, *RTECS* (GL5325000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 4703 F (2595 C)
Melting Point: 1981 F (1083 C)
Vapor Pressure: 1 mm Hg at 2962 F (1628 C)
Molecular Weight: 63.546
Density/Specific Gravity: 8.94
Water Solubility: Insoluble

Appearance and Odor: Solid, various shapes, odorless, red/brown-colored metal or powder. Copper is ductile, tough, and easily worked. It is very resistant to corrosion, but readily attacked by alkalies.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire since copper does not burn. Finely divided copper burns in air, and in extreme cases ignites spontaneously.

Unusual Fire or Explosion Hazards: Liquid copper explodes on contact with water. High concentrations of fine copper particles in the air may present an explosion hazard.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and a fully encapsulating suit.

Section 5. Reactivity Data

Stability/Polymerization: Copper is stable at room temperature in closed containers under normal storage and handling conditions. However, on long standing, a white, highly explosive peroxide deposit may form. Copper's vapors are uninhibited and may form polymers in vents and flame arresters.

Chemical Incompatibilities: Copper reacts violently with ammonium nitrate, bromates, iodates, chlorates, ethylene oxide, hydrazoic acid, potassium oxide, dimethyl sulfoxide + trichloroacetic acid, hydrogen peroxide, sodium peroxide, sodium azide, sulfuric acid, hydrogen sulfide + air, and lead azide. A potentially explosive reaction occurs with actylenic compounds. Copper ignites on contact with chlorine, fluorine [above 250 F (121 C)], chlorine trifluoride, and hydrazinium nitrate [above 158 F (70 C)]. It is also incompatible with 1-bromo-2-propyne; an incandescent reaction occurs with potassium dioxide.

Conditions to Avoid: Avoid prolonged exposure to air and moisture. On exposure to moist air, copper slowly converts to the carbonate.

Hazardous Products of Decomposition: Thermal oxidative decomposition of copper can produce metallic oxides (copper fumes).

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Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list copper as a carcinogen. Experimental studies show tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Copper is a necessary human nutrient, excessive intake levels of which the kidneys normally eliminate. In individuals with kidney disease or, rarely, Wilson's disease (abnormal retention and storage of copper in the body that damages the liver, kidneys, brain, blood, bones, and endocrine glands), copper levels may accumulate. Significant industrial exposure to copper occurs mainly through inhalation of fumes during welding, smelting, or refining operations; or through exposure to copper dusts and mists during mining, extracting, refining, or manufacturing processes. Copper particles may irritate, discolor, and damage eyes. Exposure to copper salts in many applications is potentially toxic. Copper dusts, fumes, and salts may irritate the upper respiratory tract. Long-term exposure may irritate the skin and discolor the skin or hair.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with impaired pulmonary or renal function should avoid exposure.
Target Organs: Respiratory system, skin, eyes, liver, kidneys.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Inhalation of copper fumes may give rise to metal fume fever (after an incubation period of about 5 hr), an allergic reaction with flu-like symptoms—high temperature, metallic taste, nausea, coughing, general weakness, muscle aches, and exhaustion. These symptoms usually disappear within 24 hr. Direct contact with copper causes skin and (less often) eye irritation, and itching of the linings of the nose, mouth, and respiratory tract. Exposure to copper dust may cause a greenish-black skin discoloration. Copper ingestion causes nausea, vomiting, abdominal pain, and diarrhea. Ingestion of large doses may cause stomach and intestine ulceration, jaundice, and kidney and liver damage.
Chronic Effects: Continued exposure to copper may cause mild dermatitis and degeneration of the mucous membranes. Repeated or prolonged exposure to copper dusts and mists can discolor skin and hair and irritate the skin. Repeated inhalation can cause chronic respiratory disease. Individuals with Wilson's disease (1 in 200,000 individuals) are more susceptible to chronic copper poisoning. If undetected and untreated, this progressive condition is eventually fatal.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing with artificial respiration.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: A blood count shows leucocytosis if an individual has metal fume fever. Consider chellation with penicillamine or BAL (British Anti-Lewisite or dimercaprol) for chronic intoxication.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, remove all heat and ignition sources, and provide adequate ventilation. Avoid creating dusty conditions. Cleanup personnel should protect against vapor inhalation and skin and eye contact. Cleanup methods such as vacuuming (with the appropriate filter) or wet mopping minimizes dust dispersion. Absorb liquid containing copper with vermiculite, dry sand, or other inert materials. Place in appropriate containers for disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per Clean Water Act, 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Some recommendations follow. For copper dust and mists greater than 50 mg/m^3, wear a high-efficiency particulate respirator, a supplied-air respirator, or an SCBA, all with a full facepiece. For copper dust and mists greater than 2000 mg/m^3, wear a supplied-air respirator equipped either with a full facepiece operated in pressure-demand or positive-pressure mode or with a hood in continuous-flow mode. For copper fumes over 100 mg/m^3, wear either a powered air-purifying respirator with a high-efficiency filter, or a supplied-air respirator equipped either with a full facepiece operated in pressure-demand or positive-pressure mode or with a hood in continuous-flow mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Eye and face protection is required when grinding, welding, cutting, or remelting. Protect skin from molten metal and radiant heat when melting scrap. Machine turnings may also present a laceration hazard. When handling oil-contaminated copper, wear rubber gloves to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below OSHA PELs and ACGIH TLVs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store copper in tightly closed containers in a cool, dry, well-ventilated area. Avoid exposure to air and moisture.
Engineering Controls: Avoid dust and fume inhalation and direct contact with skin and eyes. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Maintain exposures below the PEL/TLV. Monitor copper dust and mist levels in the air.
Other Precautions: Provide placement and periodic examinations that emphasize the skin, eyes, and respiratory system. Prevent exposing individuals with chronic respiratory disease or Wilson's disease.
Transportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection **References:** 26, 38, 73, 84, 88, 89, 100, 101, 103, 109, 124, 126, 127, 132, 133, 134, 136, 138, 139, 143, 144
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

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Section 1 - Chemical Product and Company Identification 44

Product/Chemical Name: Mercury
Chemical Formula: Hg
CAS No.: 7439-97-6
Synonyms: colloidal mercury, hydrargyrum, liquid silver, Quicksilver
Derivation: Obtained by roasting cinnabar (mercury sulfide) and purified by distillation, or as a by-product of gold mining.
General Use: Used in agricultural poisons, anti-fouling paint, dental amalgams, mining amalgamation (to remove gold and other metals from ore), thermometers, barometers, dry cell batteries, chlorine and caustic soda production, electrical apparatus, and as a neutron absorber in nuclear power plants.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Mercury, ca 100 %wt

OSHA PEL
Ceiling: 0.1mg/m^3 (vapor and inorganic Hg)
8-hr TWA: 0.05 mg/m^3 (vapor), skin; (Vacated 1989 Final Rule Limit)

ACGIH TLVs
TWA: 0.025 mg/m^3 (inorganic compounds), skin

NIOSH REL
10-hr TWA: 0.05 mg/m^3 (vapor), skin

DFG (Germany) MAK
TWA: 0.01 ppm (0.1 mg/m^3)
Category III: Substances with systemic effects
Onset of Effect: > 2 hr
Half-life: > shift length (strongly cumulative)

Peak Exposure Limit:
0.1 ppm (1 mg/m^3), 30 min. average value, 1/shift

IDLH Level
28 mg/m^3

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Mercury exists as a heavy, odorless, silver-white liquid metal. It is highly toxic by both acute and chronic exposure. Exposure can cause corrosion of the eyes, skin, and respiratory tract and may result in irreversible nervous system damage. It readily forms amalgamations with most metals except iron.

Wilson Risk Scale
R 1
I 4
S 2*
K 1
*Skin absorption

HMIS
H 4*
F 0
R 0
*Chronic effects
PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, eye and skin contact/absorption.
Target Organs: Central nervous system, eyes, skin, respiratory system, liver, kidneys.
Acute Effects
Inhalation: Exposure to high vapor concentrations can cause severe respiratory damage. Other symptoms include wakefulness, muscle weakness, anorexia, headache, ringing in the ear, headache, diarrhea, liver changes, fever, gingivitis, chest pain, difficulty breathing, cough, inflammation of the mouth (stomatitis), salivation, bronchitis, and pneumonitis. Acrodynia (pink or Swifts disease), characterized by redness and peeling of the skin on the toes and fingers, was commonly seen in children in the 1950s and is still *infrequently* seen in workers.
Eye: Irritation and corrosion.
Skin: Skin can become severely irritated if allowed to remain in contact with mercury. Skin absorption will occur at 2.2% of the rate of absorption through the lungs.
Ingestion: Mercury generally passes through the digestive tract uneventfully. However, large amounts may get caught up in the intestine and require surgical removal. If an abscess or other perforation is present along the digestive tract, absorption into the blood stream with subsequent mercury poisoning is possible.
Carcinogenicity: IARC, NTP, and OSHA do not list mercury as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Central nervous system disorders.
Chronic Effects: Chronic exposure appears more common than acute and is primarily associated with central nervous system damage which can be permanent (ex. paresthesia of the hands, lips, feet). Early signs of toxicity include weakness, fatigue, anorexia, weight loss, and gastrointestinal disturbances. If exposure levels are high, characteristic tremors of the fingers, eyelids, and lips occur with progression to generalized tremors of the entire body. Psychic disorders are noticeable and characterized by behavior and personality changes, increased excitability, memory loss, insomnia, and depression. In severe cases, delirium and hallucinations may occur. Kidney damage is observed with oliguria (decreased urine output) progressing to anuria (urine cessation) and may require dialysis. The cornea and lens of the eyes may take on a brownish discoloration and the extraocular muscles may be damaged. This syndrome has been termed *Asthenic-Vegetative Syndrome* or *Micromercurialism.* Chronic symptoms occur increasingly with exposures to 0.1 mg/m^3 or higher. *Mutation:* Aneuploidy and other chromosomal aberrations

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have been observed in the lymphocytes from whole blood cultures in workers exposed to mercury. *Reproductive:* Mercury has been detected in stillborn babies of women treated with mercury for syphilis. In a study of six men acutely exposed (occupationally) to mercury levels as high as 44 mg/m^3, all suffered impaired sexual function. Repeated skin contact may cause allergic dermatitis in some individuals.

NOTE: Spilled mercury will release sufficient vapor over time to produce chronic poisoning.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

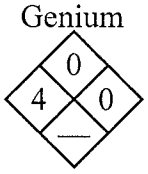
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water and then wash exposed area with soap. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. In general, mercury will pass through the digestive tract uneventfully.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI: *blood* (15 µg/L), *urine*: (35 µg/g creatinine). Extremely high urine levels of 0.5 to 0.85 mg Hg/L are indicative of polyneuropathy. 0.4 to 22 µg/L is reported to be the human lethal blood level. Obtain urinalysis including at a minimum: albumin, glucose, and a microscopic examination of centrifuged sediment. Use BAL or 2, 3-dimercaptosuccinic acid as chelators. *Do not* use calcium sodium EDTA because of nephrotoxicity. An electromyograph may determine extent of nerve dysfunction. It has been noted that exposure to mercury may predispose persons to development of carpal tunnel syndrome.

Section 5 - Fire-Fighting Measures



Flash Point: Nonflammable

Autoignition Temperature: Nonflammable

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use agents suitable for surrounding fire.

Unusual Fire or Explosion Hazards: None reported.

Hazardous Combustion Products: Toxic mercury vapor and mercuric oxide.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Keep a mercury spill kit readily available in areas where mercury is used. Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind.

Small and Large Spills: Follow instructions on mercury spill kit. Most kits come with an aspiration-driven vacuum trap with a mercury "sweeper" (copper or copper-plated brush). Wash spill area with a dilute calcium sulfide or nitric acid solution. If spill cannot be taken up readily, dust the top of the spill with flowers of sulfur or preferably, calcium polysulfide. This will produce a surface coating of mercury sulfide which will reduce mercury vapor dispersion into the air.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use appropriate PPE when working with mercury. *Do not* use on porous work surfaces (wood, unsealed concrete, etc.) to prevent spills from lodging in cracks.

Storage Requirements: Store in a cool, dry, well-ventilated area away from heat and incompatibles (Sec. 10). Store on non-porous floors and wash them regularly with a dilute calcium sulfide solution. Because mercury will form amalgamations with most metals except iron, metal shelves should be painted with a sufficiently thick coating to prevent this from happening.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Wherever possible, enclose processes to prevent mercury vapor dispersion into work area.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Administrative Controls: Consider pre-placement and periodic medical exams of exposed workers with emphasis on the skin, eyes, central nervous system, liver, and kidneys.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For ≤ 0.5 mg/m^3, use any chemical cartridge respirator with cartridges providing protection against mercury and equipped with an ESLI (end of service life indicator), any SCBA, or any SAR (supplied-air respirator). For ≤ 1.25 mg/m^3, use any SAR operated in continuous-flow mode, any PAPR (powered, air-purifying respirator) with an ESLI. For ≤ 2.5 mg/m^3, use any SCBA or SAR with a full facepiece, any SAR with a tight-fitting facepiece and operated in continuous-flow mode, or any chemical cartridge respirator with a full facepiece, chemical

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cartridges providing protection against mercury, and equipped with an ESLI. For ≤28 mg/m^3, use any SAR operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA with full facepiece and operated in pressure-demand or other positive pressure mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets made of butyl rubber, nitrile rubber, fluorocarbon rubber, neoprene rubber, polyvinyl chloride, chlorinated polyethylene, or polycarbonate to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid metal
Appearance and Odor: Silvery-white, odorless
Vapor Pressure: 0.0018 mm Hg at 77 F (25 C)
Formula Weight: 200.59
Density (H_2O=1): 13.534 g/cm^3 at 77 F (25 C)
Boiling Point: 674.09 F (356.72 C)
Freezing Point: -37.97 F (-38.87 C)
Viscosity: 15.5 mP at 77 F (25 C)
Electrical Resistivity: 95.76 µohm at 68 F (20 C)
Water Solubility: 0.28 µmol/L at 77 F (25 C)
Other Solubilities: Soluble in boiling sulfuric acid, nitric acid (reacts); slightly in lipids, and 2.7 mg/L in pentane. Insoluble in alcohol, ether, cold sulfuric acid, hydrogen bromide, and hydrogen iodide.
Surface Tension: 484 dyne/cm at 77 F (25 C)
Critical Temperature: 2664 F (1462 C)
Critical Pressure: 1587 atm

Section 10 - Stability and Reactivity

Stability: Mercury does not tarnish at ordinary temperatures but when heated to near its boiling point, it slowly oxidizes to mercuric oxide.

Polymerization: Hazardous polymerization does not occur.

Chemical Incompatibilities: Mercury forms alloys (amalgamates) with most metals except iron. It is incompatible with oxidizers such as bromine, 3-bromopropyne, methylsilane + oxygen, chlorine, chlorine dioxide, nitric acid, or peroxyformic acid; tetracarbonyl nickel + oxygen, alkynes + silver perchlorate, ethylene oxide, acetylenic compounds (explosive), ammonia (explosive), boron phosphodiiodide, methyl azide, nitromethane, and ground sodium carbide.

Conditions to Avoid: Exposure to high temperatures, metal surfaces or incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of mercury can produce mercuric oxide.

Section 11- Toxicological Information

Toxicity Data:*

Reproductive:
Rat, inhalation: 890 ng/m^3/24 hr for 16 weeks prior to mating had an effect on spermatogenesis.

Acute Dermal Toxicity:
Man, skin, TD_{Lo}: 129 mg/kg for 5 continuous hours caused ringing in the ears, headache, and allergic dermatitis.

Acute Oral Toxicity:
Man, oral, TD_{Lo}: 43 mg/kg caused tremor and jaundice or other liver changes.

Acute Inhalation Effects:
Woman, inhalation, TC_{Lo}: 150 µg/m^3/46 days caused anorexia, diarrhea, and wakefulness.
Man, inhalation, TC_{Lo}: 44300 µg/m^3/8 hr caused muscle weakness, liver changes, and increased body temperature.

Chronic Effects:
Rat, inhalation: 1 mg/m^3/ 24 hr for 5 continuous weeks caused proteinuria.

* See NIOSH, *RTECS* (OV4550000), for additional toxicity data.

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Section 12 - Ecological Information

Ecotoxicity: Catfish, LC_{50} = 0.35 mg/L/96 hr; mollusk (*Modiolus carvalhoi*), LC_{50} = 0.19 ppm/96 hr: tadpole (*Rana hexadactyla*), LC_{50} = 0.051 ppm/96 hr. Mercury is transformed to methyl mercury by bacteria in the environment and undergoes bioaccumulation readily. BCF for freshwater fish = 63,000; for saltwater fish = 10,000; and for marine and freshwater invertebrates = 100,000.

Environmental Degradation: Mercury is expected to volatilize rapidly when deposited on soil surfaces. Once in the air, it can be transported long distances before being redeposited on soil or in water. In water, mercury appears to bind to particulates where it eventually becomes deposited on the bed sediment. In general, mercury entering the environment can be deposited and revolatilized several times.

Section 13 - Disposal Considerations

Disposal: Incineration is *not* an appropriate disposal method. Wastewater may be treated by addition of chlorine to oxidize the mercury to its ionic state. The water can then be passed through an absorbent (an activated charcoal concentrate with a sulfur coating or peanut shell charcoal) to collect the ionic mercury, followed by distillation to recover the mercury. Sodium borohydride, a reducing agent, can be used to precipitate mercury from waste solutions. Bioremediation, using *Pseudomonas putida*, has also been suggested. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Mercury
Shipping Symbols: A, W
Hazard Class: 8
ID No.: UN2809
Packing Group: III
Label: Corrosive
Special Provisions (172.102): –

Packaging Authorizations
a) Exceptions: 173.164
b) Non-bulk Packaging: 173.164
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 35 kg
b) Cargo Aircraft Only: 35 kg

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: 40, 97

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste (40 CFR 261.33): U151
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA, Sec. 3001; CWA, Sec. 307(a), CAA, Sec. 112
CERCLA Reportable Quantity (RQ), 1 lb (0.454 kg)
SARA 311/312 Codes: 1, 2
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 73, 103, 124, 132, 136, 148, 149, 159, 167, 176, 187, 189

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Industrial Hygiene Review ..... RE Langford, PhD, CIH
Medical Review ..... T Thoburn, MD, MPH

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APPENDIX B
UNDERGROUND/OVERHEAD UTILITIES CHECKLIST

UNDERGROUND/OVERHEAD UTILITY CHECKLIST

Project Name/Number_____ **Date**_____

Location_____

Prepared By_____ **Project Manager**_____

This checklist must be completed for any intrusive subsurface work such as excavation or drilling. It documents that overhead and underground utilities in the work are identified and located. The Project Manager shall request utility markouts before the start of field operations to allow the client and utility companies sufficient time to provide them. If complete information is not available, a magnetometer or other survey shall be performed to locate obstacles prior to intrusive subsurface activities.

Procedure

A diagram of the work area depicting the proposed location of intrusive subsurface work sites (i.e., boring locations, excavation locations) must be attached to this form. The diagram must clearly indicate the areas checked for underground structures/utilities, and overhead power lines. This form and the diagram must be signed by the BBL Project Manager (if present), the BBL Site Supervisor, and the client representative.

Checklist

Type of Structure	Present	Not Present	Method of Markout
Electric Power Line			
Natural Gas Line			
Telephone Line			
Water Line			
Product Line			
Sewer Line			
Steam Line			
Drain Line			
Underground Tank			
Underground Cable			
Overhead Power Line			
Overhead Product Line			
Other (Specify)			

Client Representative_____ Date_____

BBL Project Manager_____ Date_____

BBL Site Supervisor_____ Date_____

APPENDIX C
BBL DAILY SAFETY MEETING LOG

BBL DAILY SAFETY MEETING LOG

PROJECT: _____ LOCATION: _____

DATE/TIME: _____ ACTIVITY: _____

1. Work Summary

2. Physical/Chemical Hazards

3. Protective Equipment/Procedures

4. Emergency Procedures

5. Signatures of Attendees	

APPENDIX D
ACCIDENT INVESTIGATION REPORT

APPENDIX E
DAILY AIR MONITORING LOG

DAILY AIR MONITORING LOG

Project: **Date:**

Monitoring Instruments:

Air Monitor: **Activity:**

Level of Protection:

Time	Location	Instrument Reading	Comments

APPENDIX F
DAILY PROJECT REPORT

DAILY PROJECT REPORT

SHT___ OF ___

	DAY: DATE:
	NAME:
	SIGNATURE:
ACTIVITIES PERFORMED:	
	TOTAL:_____HOURS
	CK'D BY:

Appendix C

INTEGRATED TECHNICAL SERVICES, INC.
PO BOX 156, PINEY HOLLOW RD.
WINSLOW, NEW JERSEY 08095

HEALTH AND SAFETY PLAN

Submitted to:

EVOR PHILLIPS LEASING COOPERATIVE PRP COMMITTEE (EPLCPC)
Evor Phillips Site
Old Bridge, New Jersey

February 1996

HEALTH AND SAFETY PLAN

1. INTRODUCTION

GENERAL

This work plan has been developed by **Integrated Technical Services, Inc.** (ITS) of Winslow, New Jersey to perform various remedial activities at the Evor Phillips Site located in Old Bridge, New Jersey on behalf of the Evor Phillips Leasing Cooperative PRP Committee (EPLCPC).

The Development of this work plan is based upon May 1995 site visit, various conversations with the EPLCPC members and TRC site drawings.

The focus of this remedial operation will be removal of all surface debris, structures and the removal of underground storage tanks and buried drums. ITS anticipates the duration of the project will be approximately eight weeks, barring no severe weather conditions to hamper field operations.

ITS has listed the following activities to be performed during this remedial event:

- Demolition of two structures.
- Removal of 24 aboveground tanks.
- Removal of 4 underground storage tanks.
- Collect and remove all steel scrap.
- Transportation and disposal of stockpiled soil.
- Removal of approximately 25 buried drums.
- Sample and dispose of 61 overpack drums.

ITS has developed a work schedule to condense activities , minimize overall duration of field activities.

<u>Phase I:</u>
- Sample stockpiled soils.
- Acquire waste stream approval.
- Removal of AST burners.

<u>Phase II:</u>
- Demolition of structures.
- Sample 100 drums - overpacks.
- Collect and dispose of scrap steel.

Phase III:
- Remove of buried drums.
- Removal of USTs.
- Consolidate 100 overpack drums.
- Loadout stockpiled soil.

Phase IV:
- Final loadout of buried drums, residual tank bottoms and overpack drums.

SITE SCOPE OF WORK

HASP DOCUMENTS:

This section of the Site Health and Safety Plan (HSP) document defines general applicability and general responsibilities with respect to compliance with health and safety programs.

1.1 Scope and Applicability of the Health and Safety Plans

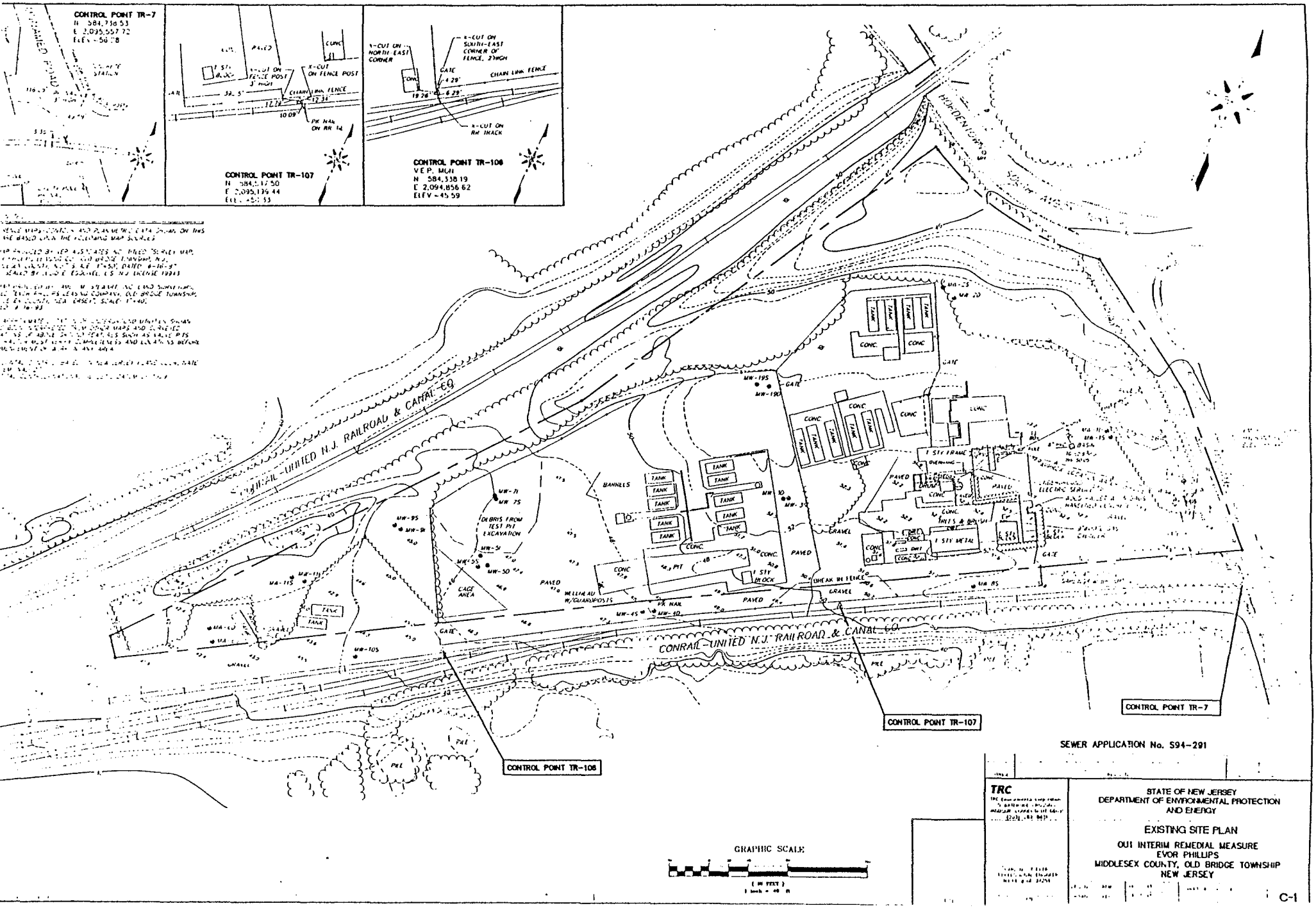
1.1.1 The purpose of the Site Health and Safety Plan is to define the requirements and designate protocols to be followed at the Evor Phillips Site during tank remediation activities in Old Bridge, New Jersey. Applicability extends to all Evor Phillips employees, contractors, and subcontractors.

1.1.2 All personnel must review the appropriate Site Specific Health and Safety Plan and sign an agreement to comply with the requirements prior to entering an exclusion zone or contamination reduction zone.

1.1.3 Current safety standards as defined by OSHA/NIOSH, health effects and standards for known contaminants, and procedures designed to account for the potential for exposure to unknown substances were considered during development of this plan. Specifically, the following reference sources have been consulted:

1.1.3.1 OSHA 29 CFR 1910.120 and 40 CFR

1.1.3.2 OSHA/NIOSH/EPA Coast Guard, "Occupational Health and Safety Guidelines for activities at Hazardous Waste Sites"



SEWER APPLICATION No. S94-291

TRC

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

EXISTING SITE PLAN

OU1 INTERIM REMEDIAL MEASURE
EVOR PHILLIPS
MIDDLESEX COUNTY, OLD BRIDGE TOWNSHIP
NEW JERSEY

C-1

2. PERSONNEL/IDENTIFICATION OF KEY HEALTH AND SAFETY PERSONNEL

2.1 Site-Specific Health and Safety Personnel

The following personnel are designated to carry out the stated job functions on-site. (One person may occupy more than one position.)

2.1.1 Contract Manager (CM) - David Wilder

The Contract Administrator for the Evor Phillips clean-up activities has overall responsibility for the safety of operations and the Health and Safety of all personnel. He will have the final decision regarding questions on Health and Safety policy.

2.1.2 Project Supervisor - Robert Foley

Overall coordinator of all construction activities. The Project Supervisor is senior on-site person and has the responsibility for safety of operations during remedial activities. Mr. Foley has executive experience (approximately 8 years) in the remediation of contaminated sites. He is knowledgeable in site delineation to reduce the possibility of cross contamination and the necessary controls to reduce potential exposure to the general population due to fugitive emissions.

2.1.3 Health and Safety Coordinator (HSC)- Mark LaMonte

Responsibilities include overall coordination of all safety matters with stop-work authority. The Health and Safety Coordinator will review the Health and Safety of all operations. His efforts will be coordinated through the appropriate management personnel and the on-site safety officer. In addition, the HSC will supervise the safety during Level B operations and the initiations of each new phase of the project.

2.1.4 Site Safety Officer (SSO) - Robert Foley or his designate

During mobilization and building demolition phases, Mr. Foley will be the designated Site Safety Officer. During these phases, no activities will be performed related to the handling of hazardous materials.

Once the mobilization and demolition activities are completed, Mark La Morte will be designated Site Safety Officer for the balance of the project. The SSO will meet required qualifications to perform his/her task in compliance with NJDEP and OSHA requirements.

Responsibilities include the daily implementation of this Health and Safety Plan. The Site Health and Safety Officer is responsible for the implementation and enforcement of the Safety Plan, overseeing the safety of daily operations and coordinating safety with subcontractors. In particular, he will:

2.1.4.1 Monitor the environment and the compliance of workers relative to pre-established personnel protection levels;

2.1.4.2 Notify the HSC and CM of discrepancies or violations of the Safety Plan;

2.1.4.3 Evaluate weather and chemical hazard information and recommend to the HSC and CM any necessary modifications to work plans or personnel protection levels;

2.1.4.4 The Site Safety Officer (SSO) has total responsibility for ensuring that the provisions of the HSP are adequate in the field. Changing field conditions may require decisions to be made concerning adequate protection programs. Therefore, it is vital that personnel assigned as HSO be experienced and meet the additional training requirements specified by OSHA in 29 CFR 1910.120 (see Section 3.0).

2.1.4.5 Daily Safety Meetings

Prior to the start of each work day, the Site Safety Officer will conduct a brief safety meeting. Items to be discussed include but are not limited to:

2.1.4.5.1 Proposed activities for the day;

2.1.4.5.2 Potential safety hazards for the day;

2.1.4.5.3 Field Change Orders;

2.1.4.5.4 Field team evaluation (compliance/non-compliance, approved field changes).

2.1.5 Field Team Leader

Responsibilities include the daily implementation of the various steps in the Evor Phillips projects.

2.1.6 Record Keeper

Responsibilities include maintaining a permanent log of personnel in and out times with notations of their activities and levels of protection throughout the day. In addition, a daily summary of work progression and OSHA 200 logs.

2.1.7 Field Team Members

Responsibilities include execution of daily activities and compliance with this Health and Safety Plan and the directives of the Site Officer.

3. PERSONNEL TRAINING REQUIREMENTS

Consistent with OSHA's 29 CFR 1910.120 regulation covering Hazardous Waste operations and Emergency Response, all site personnel will be trained in accordance with the requirements. At a minimum, all personnel will be trained to recognize the hazards on-site, the provisions of this HSP, and the responsible personnel.

3.1 Pre-Assignment and Annual Refresher Training

3.1.1 ITS shall perform a 4 hour training seminar specific to tasks performed at the Old Bridge site. The seminar shall include hazard awareness, emergency response, hazard communications protocol and review of onsite safety equipment in the event of an emergency.

All field personnel shall meet the minimum OSHA 1910.12 40 hour and 8 hour refresher courses. All personnel associated with confine space areas shall be certified in confine space entry procedures. All supervisors and management personnel shall have an additional 8 hours of supervisor training.

At a minimum, three field workers shall be certified in First Aid and CPR training.

3.2 Site Supervisor Training

3.2.1 Consistent with OSHA 29 CFR 1910.120 paragraph (e) (4), individuals designated as site supervisors require an additional 8 hours of training.

3.3 Training and Briefing Topics

3.3.1 The following items will be discussed by a qualified individual at the site specific training meeting, daily or periodically.

Site Specific Training Meeting	Daily	Periodically	Items
			Site characterization and analysis; (29 CFR 1910.120 (c), (1))
X	X		Physical Hazards-sec.(6.4) in HASP
X	X		Chemical Hazards-sec.(6.5) in HASP
X		X	Symptoms of overexposure to hazards; sec.(6.5) in HASP;(29 CFR 1910.120 (e), (VI))
X		X	Site Control, Sec. 12.0 in HASP; [29 CFR 1910.120 (d)]
X			Training requirements, Sec. 3.0 in HASP; [29 CFR 1910.120 (e)]
X		X	Protective controls and work practices Sec. 7.62 in HASP; [29 CFR 1910.120 (g)]
X		X	Heavy machinery; forklift backhoe [29 CFR 1926]; ladder [29 CFR 1910.26]; power tools 29 CFR 1910.242
X			Overhead and underground utilities
X			Structural integrity
X			Pressurized air cylinders; [29 CFR 1910.101 (b)] Sec.5.8 in HASP
X	X		Personal protective equipment, Sec. 7.7.1 in HASP; [29 CFR 1910.120 (g), 29 CFR 1910.134]

Site Specific Training Meeting	Daily	Periodically	Items
X		X	Respiratory protection, Sec. 7.7.4 in HASP; [29 CFR 1910.134, 29 CFR 1910.120 (g), ANSI Sec. 88.2, 1980]
X			Air monitoring Sec. 7.6.3-8.2 in HASP; [29 CFR 1910.120 (h)]
X		X	Decontamination, Sec. 13.0 in HASP; [29 CFR 1910.120 (k)]
X		X	Emergency response plan, Sec. 14.0 in HASP; [29 CFR 1910.120 (l)]
			Sanitation sec. 11 in HASP; [29 CFR 1910.120 (n)]

4. SUBSTANCE ABUSE

4.1 Employers (contractors) shall advise their employees and the employees of their subcontractors and agents that:

4.1.1 It is the policy of ITS to prohibit use, possession, and sale and distribution of alcohol, drugs, or any other controlled substances on its premises and to prohibit the presence in the work place of an individual with such substances in the body for non-medical reasons.

4.1.2 Entry onto Evor Phillips property constitutes consent of an inspection by ITS management of the employee's person, vehicle, and personal effects when entering, while on, or upon leaving Evor Phillips property.

4.1.3 Any employee who is found in violation of the policy or who refuses to permit inspection may be removed and barred from Evor Phillips property at the discretion of ITS.

4.1.4 Employers shall not assign (or reassign) any employee or agent (including employee or agent of their subcontractors) to Evor Phillips operations unless such employee has taken a drug screen and the screen results have proved negative.

5. SAFETY

5.1 Safety Instructions

5.1.1 All contractors will work in accordance with the rules and requirements of this approved Health and Safety Plan.

5.1.2 All incoming contractor personnel shall participate in a safety orientation at the site before starting work. An acknowledgement sheet must be signed by each contract employee to show they received proper site orientation.

5.2 Safety Program

5.2.1 This will be ITS's written safety program. All contract employees shall be required to follow this program while on the site.

5.2.2 Safe Work Practices (Mandatory)

5.2.2.1 Eating, drinking, and smoking are prohibited on-site, unless otherwise stipulated. Wash hands and face, at a minimum, before lunch and completion of work day.

5.2.2.2 Contact lenses shall not be worn.

5.2.2.3 Work in pairs at all times (Buddy System).

5.2.2.4 Avoid contact with contaminated objects and materials.

5.2.2.5 Do not climb over obstacles. Avoid walking in marshy areas, low lying areas where run-off water accumulates.

5.2.2.6 Wear proper head, foot, eye, and body protection which has been assigned.

5.2.2.7 OSHA guidelines and regulations shall be followed at a minimum for all site activities.

5.2.2.8 If new hazards are encountered, work activities shall be evaluated.

5.2.2.9 Site Safety Officer shall discuss safety matters with all site personnel at least once a day.

5.2.2.10 Precautions shall be taken to minimize heat stress.

5.2.2.11 Beards of other facial hair that interfere with respirator fit shall preclude admission to the hot zone when respiratory protection is required.

5.3 Protective Clothing

5.3.1 ITS (hereafter ITS) personnel will be required to wear hard hats, industrial quality side-shield safety glasses, and steel toe safety shoes as minimum requirements while on the site. These items shall be furnished by ITS See Section 7.6 and 7.7 for site specific personal protective clothing requirements.

5.3.2 Proper work clothes are required to be worn by all ITS employees. Long sleeved shirts shall be worn. (No sleeveless shirts, tank tops, shorts, sneakers or sandals allowed on-site.)

5.4 Site Facilities

5.4.1 ITS personnel will be permitted to use site facilities as directed by the Evor Phillips Project Manager.

5.5 Construction Equipment

5.5.1 Cranes, forklifts, trackhoes and similar construction equipment shall not be left unattended unless the equipment is shut down and secured so as to prevent unintentional movement (i.e., wheel chocks).

5.6 Access

5.6.1 Access to exit doors, fire extinguishers, safety showers, eye wash and any other emergency equipment shall not be blocked at any time. Roadways shall not be blocked without first gaining specific approval from the Contract Administrator.

5.7 Assured Grounding

5.7.1 ITS shall ensure ground fault circuit interrupter protection is in-place to cover the use of all electrical tools. OSHA's lock and tag out policy will be utilized on the Evor Phillips sites.

5.8 Gas Cylinders

5.8.1 Compressed gas cylinders shall be properly secured in an upright position. Unless the individual cylinders are equipped with regulating devices, they shall have the safety cap secured in-place.

5.9 OSHA Compliance

5.9.1 The special safety requirements listed do not in any way relieve ITS of its responsibility in regard to compliance with OSHA and/or any other contractual agreement and are only noted to highlight potential problem areas.

5.10 Safety Violations

5.10.1 In the event of safety violations or unsafe acts the Site Safety Officer shall notify the Contract Administrator and take immediate actions to correct the problem.

5.11 Emergency and Disaster Alarms

5.11.1 Emergency signals and area public address systems will be used to alert people of an emergency. In such an emergency, contract employees must place their equipment in a safe condition and report to the designated site specific rally point for head count.

5.12 Decontamination of Equipment

5.12.1 If ITS's equipment becomes contaminated it must be cleaned before it leaves the site. The contamination solution generated as a result of this activity must be handled appropriately in accordance with pertinent regulations.

6. HAZARD EVALUATION

The hazard evaluation is based upon a review of work tasks to be accomplished.

The following table represents each task with anticipated associated health hazards from documentation provided by the EPLCPC. In adition, ITS has provided a separate table outlining each chemical hazard in relation to work task.

TASK	CHEMICAL HEALTH HAZARDS
Demolition	None (airborne dust particles)
USTs #4 and #3	Fuel oil (No. 2)
Stockpiled soil	Petroleum hydrocarbons
Burner residue	Silver, lead, cadmium
Burner cinder block	Cadmium, silver, lead
UST #2	Fuel oil, di bromo phenol
UST #1	Lead, benzene, toluene, ethyl benzene
Overpack drums and buried drums	Benzene, petroleum hydrocarbon, dichloroethane, volatile organics (see attached chart)

6.1 Ambient Air Analysis

Prior to the start-up of remedial activities, the Health and Safety Officer will monitor the work area to ensure that the level of protection selected is adequate and to establish background levels. Air monitoring will be accomplished at the excavation area and in personnel breathing zone.

6.2 Non-Chemical Related Potential Hazards

The following standard potential construction hazards could occur on-site:

6.2.1 Slip-Trip-Fall;

6.2.2 Electrocution;

6.2.3 Machine-related accidents;

6.2.4 Toxic/pharmacological Effects

6.3 Chemical Related Hazards - Cadmium:

6.3.1 Exposure Limit - Cadmium: NIOSH; reduce exposure to lowest feasible concentration. OSHA 0.2 mg/m^3 and C 0.6 mg/m^3; IDLH - 50 ppm.

6.3.2 Incompatibles - Cadmium: Strong oxidizers; elemental sulfur, selenium and tellurium.

6.3.3 Symptoms - Cadmium:

Inhalation: Pulmonary edema.

Ingestion: Cough, chest tightening, chills, muscle aches, vomiting, diarrhea, mild anemia.

6.3.4 Target Organs - Cadmium: Respiratory system, kidneys, prostate, blood.

6.4 Chemical Related Hazards - Lead:

6.4.1 Exposure Limit - Lead: NIOSH; 0.100 mg/m³ (air concentration to be maintained so that worker blood level remains at less than 0.060 mg/100 g of whole blood). OSHA [1910.1025] 0.050 mg/m³; IDLH - 700 mg/m³.

6.4.2 Incompatibles - Lead: Strong oxidizers, hydrogen peroxide, acids.

6.4.3 Symptoms - Lead:

Inhalation: Weak, insomnia.

Ingestion: Pallor, anorexia.

Skin/eye contact: Abdominal pains, anemia, colic, hemorrhaging.

6.4.4 Target Organs - Lead: GI tract, central nervous system, kidneys, blood, gingival tissue.

6.5 Chemical Related Hazards - Silver:

6.5.1 Exposure Limits - Silver: NIOSH/OSHA 0.01 mg/m³; IDLH - N.E.

6.5.2 Incompatibles - Silver: Acetylene, ammonia, hydrogen peroxide, bromazide, chlorine, trifluoride, ethyleneimine, oxalic acid, tartaric acid.

6.5.3 Symptoms - Silver:

Inhalation: Blue-gray eyes, nasal.

Ingestion: Septum, throat, skin.

Skin/eye contact: Skin, ulceration.

6.5.4 Target Organs - Silver: Nasal septum, skin, eyes.

6.6 Chemical Related Hazards - Dichlorethane:

6.6.1 Exposure Limits - Dichlorethane: NIOSH; 100 ppm. OSHA 100 ppm; IDLH - 4000 ppm.

6.6.2 Incompatibles - Dichlorethane: Strong oxidizers; strong caustics.

6.6.3 Symptoms - Dichlorethane:

Inhalation: Depression, skin irritation.
Ingestion: Liver, kidney damage.

6.6.4 Target Organs - Dichlorethane: Skin, kidneys, liver.

6.6.5 IDLH: 4000 ppm.

6.7 Chemical Related Hazards - Benzene:

6.7.1 Exposure Limits - Benzene: NIOSH; .1 ppm. OSHA 1 ppm; IDLH - 3000 ppm.

6.7.2 Incompatibles - Benzene: Strong oxidizers; fluorides, nitric acid.

6.7.3 Symptoms - Benzene:

Inhalation: Irritate eyes, nose.

Ingestion: Staggered gait, fatigue.

Skin/eye contact: Lassitude, dermatitis, bone marrow, depression.

6.7.4 Target Organs - Benzene: Skin, bone marrow, eyes, blood, CNS, respiratory system.

6.7.5 IDLH: 3000 ppm.

6.8 Chemical Related Hazards - Copper:

6.8.1 Exposure Limits - Copper: NIOSH; 1.0 mg/m^3. OSHA 1.0 mg/m^3; IDLH - N.E.

6.8.2 Incompatibles - Copper: Oxidizers; sodium azide, acetylene.

6.8.3 Symptoms - Copper:

Inhalation: Irritation nasal, muscle membrane.

Ingestion: Pharynx, nasal perforation.

Skin/eye contact: Eye irritation, metallic taste.

6.8.4 Target Organs - Copper: Respiratory system, skin, liver, kidneys.

6.8.5 IDLH: None.

6.9 Chemical Related Hazards - Beryllium:

6.9.1 Exposure Limits - Beryllium: NIOSH; .005. OSHA .002; IDLH-10 mg/m^3.

6.9.2 Incompatibles - Beryllium: Acids, caustic, chlorinated hydrocarbons, oxidizers, lithium.

6.9.3 Symptoms - Beryllium:

Inhalation: Respiratory symptoms, weakness, fatigue, weight loss, carcinogen.

6.9.4 Target Organs - Beryllium: Lungs, skin, eyes.

6.9.5 IDLH: 10 mg/m^3.

6.10 Chemical Related Hazards - Arsenic

6.10.1 Exposure Limits - Arsenic: NIOSH; .002 mg/m^3. OSHA .01 mg/m^3; 100 ppm.

6.10.2 Incompatibles - Arsenic: Strong oxidizers; bromine azide.

6.10.3 Symptoms - :

Inhalation:	Nasal system.
Ingestion:	Skin irritation.
Absorption:	Dermatitis.

6.10.4 Target Organs - Arsenic: Skin, kidneys, liver, lungs, lymphatic system.

6.10.5 IDLH: 100 ppm.

6.11 Chemical Related Hazards - Chloroform:

6.11.1 Exposure Limits - Chloroform: NIOSH; 2 ppm. OSHA 2 ppm; IDLH - 1000 ppm.

6.11.2 Incompatibles - Chloroform: Strong oxidizers; strong caustics.

6.11.3 Symptoms - Chloroform:

Inhalation:	Dizziness, mental dullness, nausea.
Ingestion:	Disorientation, fatigue.
Skin/eye contact:	Hepatomegaly, eye irritation.

6.11.4 Target Organs - Chloroform: Liver, kidneys, heart, eyes, skin.

6.11.5 IDLH: 1000 ppm.

6.12 Chemical Related Hazards - PCB (Poly Chlorinated Biphenyl)

6.12.1 Exposure Limits - PCB: NIOSH; .001 mg/m^3. OSHA .5 mg/m^3; IDLH - 5 mg/m^3.

6.12.2 Incompatibles - PCB: Strong oxidizers.

6.12.3 Symptoms - PCB:

Inhalation: Irritated eyes, skin.
Absorption: Dermatitis.

6.12.4 Target Organs - PCB: Skin, eyes, liver.

6.12.5 IDLH: 5 mg/m^3.

6.13 Chemical Related Hazards - Methylene Chloride:

6.13.1 Exposure Limits - Methylene Chloride: NIOSH; .1 ppm. OSHA 500 ppm; IDLH - 5000 ppm.

6.13.2 Incompatibles - Methylene Chloride: Strong oxidizers; caustics.

6.13.3 Symptoms - Methylene Chloride:

Inhalation: Fatigue, weakness, sleepiness.

Ingestion: Light headed, limb numbness.

Skin/eye contact: Tingle, nausea, irritated eyes.

6.13.4 Target Organs - Methylene Chloride: Skin, CNS, eyes.

6.13.5 IDLH: 5000 ppm.

6.14 Chemical Related Hazards - Tetrachloroethane

6.14.1 Exposure Limits - Tetrachloroethane: NIOSH; 1 ppm. OSHA 1 ppm; IDLH - 150 ppm.

6.14.2 Incompatibles - Tetrachloroethane: Strong oxidizers; strong caustics.

6.14.3 Symptoms - Tetrachloroethane:

Inhalation:	Nausea, vomiting, abdominal pains.
Ingestion:	Enlarged liver, dermatitis.
Contact:	Kidney damage.
Absorption:	Jaundice, tremors fingers.

6.14.4 Target Organs - Tetrachloroethane: CNS, kidneys, liver.

6.14.5 IDLH: 150 ppm.

6.15 Chemical Related Hazards - Toluene:

6.15.1 Exposure Limits - Toluene: NIOSH; 100 ppm. OSHA 100 ppm; IDLH - 2000 ppm.

6.15.2 Incompatibles - Toluene: Strong oxidizers.

6.15.3 Symptoms - Toluene:

Inhalation:	Fatigue, weakness, confusion, euphoria.
Ingestion:	Dizziness, muscle fatigue, insomnia.
Skin/eye contact:	Paresthesia, dermatitis.
Absorption:	Dizziness, headaches, dilated pupils.

6.15.4 Target Organs - Toluene: Skin, CNS, respiratory system, liver, kidneys.

6.15.5 IDLH: 2000 ppm.

6.16 Chemical Related Hazards - Vinyl Chloride

6.16.1 Exposure Limits - Vinyl Chloride: NIOSH; .1 ppm. OSHA 1 ppm.

6.16.2 Incompatibles - Vinyl Chloride: Oxidizers, copper, aluminum, peroxide, metals.

6.16.3 Symptoms - Vinyl Chloride:

Inhalation: Weakness, abdominal pain, bleeding, pallor.
Ingestion: Hepatomegaly.

6.16.4 Target Organs - Vinyl Chloride: CNS, blood, liver, respiratory system.

6.17 Chemical Related Hazards - Phenol:

6.17.1 Exposure Limits - Phenol: NIOSH; 5 ppm. OSHA 5 ppm; IDLH - 250 ppm.

6.17.2 Incompatibles - Phenol: Strong oxidizers; calcium hypochlorite, aluminum chlorides, acids.

6.17.3 Symptoms - Phenol:

Inhalation: Irritate eyes, nose, throat.

Ingestion: Muscle ache, pain.

Skin/eye contact: Urine, liver, kidney damage, skin burns, dermatitis, tremors, convulsions.

Absorption: Anorexia, weight loss, weakness.

6.17.4 Target Organs - Phenol: Liver, kidney, skin.

6.17.5 IDLH: 250 ppm.

6.18 Chemical Related Hazards - Methyl Ethyl Ketone (2-Butanone)

6.18.1 Exposure Limits - Methyl Ethyl Ketone (2-Butanone): NIOSH; 200 ppm. OSHA 200 ppm; 2000 ppm.

6.18.2 Incompatibles - Methyl Ethyl Ketone (2-Butanone): Strong oxidizers; amines, ammonia, inorganic acids, caustics, copper, isocyanates.

6.18.3 Symptoms - Methyl Ethyl Ketone (2-Butanone):

Inhalation: Eyes, skin irritation, headache.
Ingestion: Dizziness, vomiting.

6.18.4 Target Organs - Methyl Ethyl Ketone (2-Butanone): CNS, lungs.

6.18.5 IDLH: 3000 ppm.

6.19 Chemical Related Hazards - Cyanides:

6.19.1 Exposure Limits - Cyanides: NIOSH; 5 mg/m^3. OSHA 5 mg/m^3; IDLH - 50 mg/m^3.

6.19.2 Incompatibles - Cyanides: Strong oxidizers; acids, chlorates and nitrates.

6.19.3 Symptoms - Cyanides:

Inhalation: Asphyxia.

Ingestion: Vomiting, increased pulse rate.

Skin/eye contact: Irritated eyes, slow gasping respiration, irritated skin.

Absorption: Weakness, headaches, nausea.

6.19.4 Target Organs - Cyanides: CNS, liver, kidneys, skin.

6.19.5 IDLH: 50 mg/m^3.

6.20 Chemical Related Hazards - Nitroquanidine

6.20.1 Exposure Limits - Nitroquanidine: NIOSH; .4 mg/m^3. OSHA .4 mg/m^3; 300 ppm.

6.20.2 Incompatibles - Nitroquanidine: Strong oxidizers.

6.20.3 Symptoms - Nitroquanidine:

Inhalation: Eye irritation, conjunctivitis, keratitis.
Ingestion: Skin irritation.

6.20.4 Target Organs - Nitroquanidine: Skin, eyes.

6.20.5 IDLH: 300 ppm.

6.21 Chemical Related Hazards - Ethyl Benzene:

6.21.1 Exposure Limits - Ethyl Benzene: NIOSH; 100 ppm. OSHA 100 ppm; IDLH - 2000 ppm.

6.21.2 Incompatibles - Ethyl Benzene: Strong oxidizers.

6.21.3 Symptoms - Ethyl Benzene:

Inhalation: Irritate eyes, muscle membrane.

Ingestion: Headache, dermatitis, coma.

6.21.4 Target Organs - Ethyl Benzene: Skin, eyes, CNS, respiratory system.

6.21.5 IDLH: 3000 ppm.

6.22 Chemical Related Hazards - Fuel Oil

6.22.1 Exposure Limits - Fuel Oil: NIOSH; 100 ppm. OSHA 100 ppm; IDLH - 4000 ppm.

6.22.2 Incompatibles - Fuel Oil: Strong oxidizers; strong caustics.

6.22.3 Symptoms - Fuel Oil:

Inhalation: Depression, skin irritation.
Ingestion: Liver, kidney damage.

6.22.4 Target Organs - Fuel Oil: Skin, kidneys, liver.

6.22.5 IDLH: 4000 ppm.

6.23 Chemical Related Hazards - 2-Ethylhexyl Phthalate:

6.23.1 Exposure Limits - 2-Ethylhexyl Phthalate: NIOSH; 1 ppm. OSHA 25 ppm; IDLH - 2000 ppm.

6.23.2 Incompatibles - 2-Ethylhexyl Phthalate: Strong oxidizers; decaborane.

6.23.3 Symptoms - 2-Ethylhexyl Phthalate:

Inhalation: Drowsiness, headache, nausea, vomiting.

Ingestion: Liver damage, kidney.

Skin/eye contact: Skin irritation.

Absorbtion: Eye irritation, nose throat.

6.23.4 Target Organs - 2-Ethylhexyl Phthalate: Liver, kidney, skin, eyes, CNS, respiratory system.

6.23.5 IDLH: 2000 ppm.

6.24 Chemical Related Hazards - Tri and Di Bromo Phenol:

6.24.1 Exposure Limits - Tri and Di Bromo Phenol: NIOSH/OSHA - .05 mg/m^3; IDLH - 150 ppm.

6.24.2 Incompatibles - Tri and Di Bromo Phenol: Strong oxidizer.

6.24.3 Symptoms - Tri and Di Bromo Phenol:

Inhalation: Irritation eyes, nose, throat.

Ingestion: Sweating, loss of weight, anorexia.

Skin/eye contact: Dizziness, nausea, vomiting, chest pain, high fever.

6.24.4 Target Organs - Tri and Di Bromo Phenol: Respiratory system, eyes, liver, kidneys, skin.

6.24.5 Tri/Di Bromo Phenol (Bromol) Health Risks:

In September 1995, Geo-Con performed trench excavations for the installation of new water tank trunk line located along the southeast corridor of the property. During the excavation, Di and Tri Bromo Phenol was detected, with an equipment operator overcome by vapors.

Although ITS is not scheduled to perform excavation activities along this water line, UST No. 2 is located adjacent to the area of concern.

In order to minimize exposure to the suspected highly contaminated zone, ITS proposes to remove the tank in a fashion to prevent soil disturbance to the east side of the UST. ITS shall excavate soils along the west and south end of the tank and remove the tank away from the water line.

As a precautionary measure, ITS will perform all soil excavation activities in Level B respiratory protection. As the excavation operation progresses, air monitoring results will determine whether down grading to full face respiratory protection is adequate.

7. PERSONNEL PROTECTIVE EQUIPMENT (PPE)

This section describes the general requirements for Levels of Protection, and the specific levels of protection required for each task.

7.1.1 Levels of Protection

Personnel wear protective equipment when response activities involved known or suspected atmospheric contamination, when vapors, gases, or particulates may be generated by Site activities, or when direct contact with skin affecting substances may occur. Full face piece respirators protect lungs, gastrointestinal tract, and eyes against airborne toxicants. Chemical resistant clothing protects the skin from contact with skin-destructible chemicals.

7.1.2 The specific levels of respiratory protection and necessary components for each have been divided into four categories according to the degrees of protection afforded:

7.1.2.1 Level A: A combination of skin and respiratory protection shall be worn when the highest level of respiratory, skin, and eye protection is required.

7.1.2.2 Level B: Shall be worn when the highest level of respiratory protection, but a lesser level of skin protection, is required. Level B is the primary personal protective ensemble of choice when encountering unknown environments.

7.1.2.3 Level C: Shall be worn when the criteria for using air purifying respirators are met, but a lesser level of skin protection is needed.

7.1.2.4 Level D: Shall be utilized only on sites where there is no history of respiratory hazards and continuous air monitoring assures that potential changing conditions are detected.

7.1.2.5 See Section 7.6 for site and task specific levels of protection.

7.1.3 Level A Personal Protective Equipment

7.1.3.1 Supplied sir respirator approved by the Mine Safety and Health Administration (MSHA) and National Institute for Occupational Safety and Health (NIOSH). Respirators may be positive pressure-demand, self contained breathing apparatus (SCBA), or positive pressure-demand, air line respirator (with escape bottle for Immediately Dangerous or Life and health (IDLH) or potential for IDLH atmosphere).

7.1.3.2 Fully encapsulating chemical-resistant suits

- Coveralls
- Long cotton underwear
- Gloves (inner), chemical-resistant
- Boots, chemical-resistant (over), steel toes work boots, (depending on suit construction, worn over or inside suit boots)
- Hard hat (under suit)
- Disposable gloves and boot covers (worn over fully encapsulating suit)
- Cooling unit
- Two-way radio communications (intrinsically safe)

7.1.4 Level B Respiratory Protection

7.1.4.1 Supplied air-respirator (MSHA/NIOSH approved). Respirators may be positive pressure-demand, self-contained breathing apparatus (SCBA), or positive, pressure-demand, airline respirator (with escape bottle for IDLH or potential IDLH atmosphere).

- Chemical resistant suit (tyvex, poly tyvex)
- Gloves: inner (surgical)
- Gloves: outer (PVC)
- Boots: chemical resistant with steel toe and shank
- Hard helmet
- Safety glass or face shield
- Company uniform

7.1.5 Level C Respiratory Protection

7.1.5.1 Air-purifying respirator, full-face, cartridge equipped (HEPA) (MSHA/NIOSH approved)

- Chemical resistant suit (tyvex, poly tyvex)
- Gloves: inner (surgical)
- Gloves: outer (PVC)
- Boots: chemical resistant with steel toe and shank
- Hard helmet
- Safety glass or face shield
- Company uniform

(Acid/organic cartridge with HEPA filter)

7.1.6 Level C (Modified)

Supplied air-respirator (MSHA/NIOSH approved). Respirators may be positive pressure-demand, self-contained breathing apparatus (SCBA), or positive, pressure-demand, airline respirator (with escape bottle for IDLH or potential IDLH atmosphere).

- Chemical resistant suit (tyvex, poly tyvex)
- Gloves: inner (surgical)
- Gloves: outer (PVC)
- Boots: chemical resistant with steel toe and shank
- Hard helmet
- Safety glass or face shield
- Company uniform

7.1.7 Level D Respiratory Protection

7.1.7.1 No respiratory protective equipment required.

- Gloves: leather palm or PVC
- Boots: chemical resistant with steel toe and shank
- Hard helmet
- Safety glass or face shield
- Company uniform

7.1.8 Level D (Modified)

- Gloves: leather palm or PVC
- Boots: chemical resistant with steel toe and shank
- Hard helmet
- Safety glass or face shield
- Company uniform
- White or poly tyvex suit
- Slush boots/chemical resitant disposable slip-ons

7.2 Personnel protective clothing is used in conjunction with respiratory protection. Since conditions affecting respiratory and dermal protection differ, the following levels of dermal protection are to be used with the appropriate level of respiratory protection.

7.2.1 Level 1 Protective Clothing: This level of protection is used when there is a likelihood of being splashed with an unknown chemical or with a chemical know to be dermally active. It is used when sampling drums that have been open or when there is reason to believe that the vapors are not absorbed through the skin. Personal protective equipment for Level 1 includes:

- Full Encapsulated Butyl Rubber suit;
- Chemical-resistant coveralls;
- Neoprene boots over steel toe work boots;
- Butyl rubber booties;
- Butyl rubber or neoprene gloves;
- Hard hat with face shield*;
- Face and eye covering. (Usually when this level of protection is chosen, it will be in conjunction with Level B or C respiratory protection, which provides face and eye protection).

* Optional

7.2.2 Level 2 Protective Clothing: This level is used when there is a likelihood of being splashed with chemicals that are dermally active but have a low or moderate level of danger to the individual, and when there is only a small likelihood of being splashed with an unknown chemical. Personal protective equipment for Level 2 includes:

- One (1) or two (2) piece chemical-resistant splash suit. Saranex can be used here;
- Chemical resistance coveralls;
- Neoprene boots over steel toe work shoes;
- Butyl rubber gloves;
- Face and eye covering;
- Hard hat with face shield*.

* Mandatory

7.2.3 Level 3 Protective Clothing: This level is used when there is no foreseeable likelihood of being splashed with unknown chemicals or when the chemicals in the area are known not to be a threat via the dermal route. Personal protective equipment for Level 3 includes:

- Disposable, chemical-resistant coveralls;
- Chemical-resistant cotton coveralls;
- Neoprene boots over steel toe work shoes;
- Safety boots;
- Butyl rubber gloves;
- Protective safety glasses;
- Hard hat with face shield*.

* Optional

7.3 Additional Considerations - As previously stated, a designated hazardous waste area will contain a variety of situations involving many chemicals in several combinations and concentrations. Protecting requirements will vary. The following are some work practices which will help avoid some problems.

7.3.1 Some sort of foot protection is needed on a site. If the ground to be worked on is contaminated with liquid and it is necessary to walk in the chemicals, some sort of protective "booties" can be worn over the boots. This cuts down on decontamination requirements. They are designed with soles to help prevent them from slipping around in the boot. For example, PVC bootie with elastic tops are available from several manufacturers. If non-liquids are to be encountered, a Tyvek booties could be used. If the ground contains sharp objects, the use of booties is questionable. Boots should be worn with either cotton or wool socks to help absorb the perspiration.

7.3.2 *The site requires the use of hard hats. Respirator straps should not be placed over the hard hats. This could affect the fit of the respirator.

7.3.3 Some types of protective materials conduct heat and cold readily. In cold conditions, natural material clothing should be worn under the protective clothing. Protective clothing should be removed prior to allowing a person "to get warm". Applying heat, such as a space heater, to the outside of the protective clothing may drive the contaminants through. In hot weather, under clothing will absorb sweat. It is recommended that hazardous waste site workers use all cotton undergarments.

7.3.4 Body protection should be worn over the boots and taped. In the case of a splash, this will prevent anything from running into the top of the boot. Gloves should be worn outside the sleeves and taped. This will prevent substances from entering the top of the glove.

PVC tape is preferred, but duct tape can be used.

7.3.5 Atmospheric conditions such as stability, temperature, wind direction, wind velocity, and pressure determine the behavior of contaminants in air or the potential for volatile material getting in air. These parameters should be considered in determining the need for and level of protection required.

*7.3.6 A program must be established for periodic monitoring of the air during site operations. Without an air monitoring program, any changes could go undetected and jeopardize response personnel. Portable real time monitoring

instruments located strategically on-site; and periodic walk-through by personnel carrying survey instruments will be used to monitor site conditions. (See section 7.7.2)

7.3.7 For operations in the on-site exclusion zone (which are of potential contamination), different levels of protection may be selected, and various types of chemical-resistant clothing may be worn. This selection would be based not only on measured air concentrations, but also on the job function or reason for being in the area and the potential for skin contact or inhalation of the materials present.

7.4 Modifications to levels of protection are permitted, and routinely employed during work activities to maximize protection and efficiency.

- Change in ambient levels of contaminants.
- Change in work scope which affects the degree of contact with contaminants.

7.4.1 The level of protection will be based upon the following:

7.4.1.1 Type and measured concentration of the chemical substance in the ambient atmosphere and its toxicity.

7.4.1.2 Potential for exposure to substances in air, splashes of liquids, or other direct contact with material due to work being done.

7.4.1.3 Knowledge of chemicals on-site along with properties such as toxicity, route of exposure and contaminant matrix.

7.4.1.4 In situations where the type of chemical, concentration and possibilities of contact are not known, the appropriate level of protection must be selected based on professional experience and judgement until the hazards can be better identified.

7.5 Reassessment of Protection Program

7.5.1 The level of protection provided by PPE selection shall be upgraded or downgraded based upon a change in site conditions or findings during site

remediation. When a significant change occurs, the hazards should be reassessed. Some indicators of the need for reassessment are:

- Change in job tasks during a work phase.
- Change of season/weather.
- When specific temperature extremes or individual medical consideration limit the effectiveness of PPE.
- Change in ambient levels of contaminants.
- Change in work scope which affects the degree of contact with contaminants.

7.6 Specific Levels of Protection Planned for Evor Phillips, hazardous substance handling activities:

7.6.1 Personnel Protective Equipment Table

TASK	LEVEL OF PROTECTION
Mobilization	Level D
Tank cleaning/AST-UST	Level C/B
Tank removal/AST-UST	Level D (modified)
Demolition of Buildings	Level D
Drum sampling/handling	Level C/B
Buried drums	Level C/B
Material handling/loadout	Level C (modified)

7.7 Standard Operating Procedures for Respiratory Protection

One of the primary means of eliminating worker exposure is through the use of personal protective equipment.

7.7.1 PERSONAL PROTECTIVE EQUIPMENT SELECTION

Selection of the personal protection equipment (PPE) is based on the toxicity or physical dangers associated with hazardous materials and route of exposure. Based on known or anticipated hazards, field personnel will be required to wear a minimum of Level D protection.

Level D - Criteria for Use:

HNU meter - 0 - 1 ppm Total Organic Vapors

Equipment:	Coveralls -	Tyvek disposable coveralls will be worn where there is a potential contact with the soil. In wet areas, PVC coated tyvek may be required.
	Gloves -	Surgical gloves inner/nitrile gloves outer
	Footwear -	Steel-toed work boots
	Goggles/Face shield	
	Hard hat	

Level C: - Criteria for use

HNU meter - 1.0-20 ppm Total Organic Vapors
PDM3: .002 - .005 mg/m^3

Equipment:	Respirator -	air purifying (MSHA/NIOSH approved) organic vapor cartridges with dust filter
	Coveralls -	Polyethylene coated Tyvek
	Gloves -	Surgical gloves inner/nitrile gloves outer
	Footwear -	Steel-toed work boots outer/chemical protected
	Goggles/Face shield	
	Hard hat	

Level B: - Criteria for use

HNU meter - greater than 20 ppm Total Organic Vapors
PDM3: .25 mg/m^3

Equipment:	Respirator -	open circuit, positive pressure (MSHA/NIOSH approved) or Type C hoseline positive pressure
	Coveralls -	Polyethylene coated Tyvek
	Gloves -	Surgical gloves inner/nitrile gloves outer
	Footwear -	Steel-toed work boots outer/chemical protected
	Goggles/Face shield	
	Hard hat	

All respiratory protection selection used shall meet the requirement of the established 29 CFR 1910.134, (ANSI, NIOSH).

ITS shall utilize the PDM-3, Mini-Rad to determine personnel protection upgrade utilizing PEL limits outlined for each anticipated health hazard.

7.7.2 Air Monitoring Frequency

ITS has implemented an air monitoring program consistent with each individual task to be performed during this remedial action. All monitoring devices and calibration frequency is outlined in section 7.7.3. The appropriate action levels for appropriate level of protection upgrades are outlined in section 7.7.1 and 7.7.4.

TASK	MONITORING EQUIP.	FREQUENCY
UST removal	LEL/O_2 meter	Confine space entry - continuous
Burner cleaning	LEL/O_2 meter PDM3	Confine space entry - continuous
Debris collection	PDM3	---
Demolition	PDM3	Continuous
Buried drums	HNU, Mini-Rad, PDM3	Continuous
Overpack sampling	HNU, Mini-Rad	Drum opening
Soil stockpile loadout	PDM3, HNU	Continuous
Perimeter monitoring	HNU, Mini-Rad, PDM3	4 time daily
Ambient air	PDM3	Continuous

All air monitoring results shall be documented on a daily air monitoring log (see attached). Each log will be in a three-ring binder stored on site for NJDEP inspection.

7.7.3 Monitoring Equipment

The following equipment or equivalent will be employed at the site.

MAKE/MODEL	CALIBRATION SCHEDULE	SETTING PROBE
Photoionization Detector HNU 101	Daily	11.7eV lamp 9.7 millivolts
PDM 3 - Aerosol dust monitor	(Factory) zeroed daily	---
Bio-Systems-100 L.E.L./O_2	Daily	---
Victoreen Model 190 Radiation Monitor	Daily	---

The PDM3 and photoionization detector (with an 11.7 eV lamp) will be used to monitor: (1) upwind concentrations, (2) work site concentrations, and (3) downwind exclusion zone limits. PDM3 will be in the prevailing wind direction. The mini RAD shall be positioned four (4) feet above surface grade within the exclusion zone.

The HNU PID101 will be zeroed with "zero air" in order to determine the actual background levels. The instruments (HNU and PDM3) will be checked at least once every hour during the work-shift. If "action" levels are exceeded, the Site Health and Safety Officer will evaluate the need to: (1) upgrade respiratory protection, or (2) stop work until the appropriate level of protection can be implemented.

7.7.4 Action Levels

Based on the HNU monitoring results, the following actions will be taken to safely perform necessary work:

7.7.4.1 If HNU readings in the Contamination Zone are below 1.0 ppm total VOC, Level D protection should be adequate.

7.7.4.2 If HNU readings in the Work Area exceed 5 ppm for more than one (1) minute, work will be stopped in that area to allow upgrading to Level C. If conditions seem to stabilize below 20 ppm, work may proceed under this conditions using full-face respirators with organic vapor/HEPA cartridges. Employees will be fit-tested to ensure an effective seal. Organic vapor cartridges should be changed when necessary.

7.7.4.3 Above 20 ppm, the Project Manager will continue air monitoring. If levels are detected greater than 20 ppm,

supplied air, Level B protection will be necessary. The Project Manager will monitor the perimeter of the Work Area and around the Clean Zone for possible migration outside the Contamination Zone. If any migration of the contaminates are observed, the Project Manger will take action immediately.

7.7.4.4 Oxygen deficient atmospheres (L.E.L./O_2 meter)

- Less than 19.5% (by volume) oxygen atmosphere requires upgrading to Level B respiratory protection.

7.7.4.5 Ionizing radiation (Victoreen Model 190)

- Normal background is 0.01 to 0.02 mR/hour.
- If less than 2 mR/hour is found, continue investigation with caution.
- If reading exceeds 2 mR/hour, cease operations until reading falls below 2 mR/hour.
- A conference between NJDEP and ITS management will discuss proceeding with the operation in the current work if readings continue to exceed 2 mR/hour.

7.7.5 Air Purifying Respirator (APR)

These units filter contaminants out of the surrounding air through a mechanical filter medium, a gas-absorbent cartridge, or a combination of the two. They cannot be used in oxygen-deficient atmospheres, or for air contaminants without breakthrough tests or warning properties of smell or taste. The purifying elements are specific in their protection; therefore, knowledge of the type of contaminant and approximate concentrations are essential to safe use of air-purifying respirators.

7.7.5.1 Inspection and checkout

Cartridge respirator facepieces must be cleaned, sanitized, and inspected before each use. This is the responsibility of the user or the individual authorized to service respirators. Cleaning and sanitizing chemicals must be approved by the SSO. Missing parts, including straps, are reason for removal from service.

A respirator facepiece in the same employee's custody need not be sanitized between uses. Cleaning and inspection are adequate. Sanitizing requires complete immersion in an approved sanitizing agent (e.g., MSA sanitizing agent). Towelettes (PDI, etc) do not sanitize effectively.

7.7.5.2 Storage

Respirators and cartridges should be stored in clean, dry locations when out of use and in a protective bag or pouch when carried around in the working environment.

Cartridges must always be stored in sealed plastic bags to prevent absorption of water vapor, gases or other vapors and to keep them clean. The facepiece should be stored in a plastic bag as long as it is considered ready to wear.

7.7.6 Self-Contained breathing apparatus

7.7.6.1 Introduction

Respiratory apparatus must frequently be used during response to hazardous materials incidents. If the contaminant in unknown or is known but the concentration is too high to use air-purifying respirators, then an atmosphere supplying respirator is required. The self-contained breathing apparatus (SCBA) is generally used because it allows the wearer to work without being confined by a hose or airline.

The wearer of the SCBA depends on it to supply clean breathing air. If the wearer is not properly trained to wear the SCBA or it is not properly cared for, then it may fail to provide the protection expected.

There are two types of apparatus: closed-circuit, which uses compressed oxygen, and open-circuit, which uses compressed air. SCBAs may operate in one of two modes, demand or pressure-demand. The length of time an SCBA operates is based on the sir supply. The units available operate from 5 minutes to over 4 hours.

The user should be completely familiar with the SCBA being worn. Check-out procedures have been developed for inspecting an SCBA prior to use, allowing the user to recognize potential problems. An

individual who checks out the unit is more comfortable and confident wearing it.

7.7.6.2 Modes of operation

7.7.6.2.1 Demand

In the demand mode, a negative pressure is created inside the face-piece-to-face and breathing tubes when the wearer inhales. This negative pressure draws down a diaphragm in the regulator of an SCBA. The diaphragm depresses and opens the admission valves, allowing air to be inhaled. As long as the negative pressure remains, air flows to the facepiece.

The problem with demand operation is that the wearer can inhale contaminated air through any gaps in the facepiece-to-face sealing surface. Hence, demand apparatus is assigned a Protection Factor of only 100, the same as for a full-face air-purifying respirator.

EXHIBIT 7.1
PRESSURE INSIDE FACEPIECE OF SCBA RELATIVE TO AMBIENT PRESSURE OUTSIDE

	DEMAND	PRESSURE DEMAND
Inhalation	-	+
Exhalation	+	+
Static (between breaths)	same	+

7.7.6.2.2 Pressure demand

An SCBA operating in the pressure demand mode maintains a positive pressure inside the facepiece at all times. The system is designed so that the admission valve remains open until enough pressure is built up to close it. The pressure builds up because air is prevented from leaving the system until the wearer exhales. Less pressure is required to close the admission valve than is required to open the spring-loaded exhalation valve.

At all times, the pressure in the facepiece is greater than the ambient pressure outside the facepiece. If any leakage occurs, it is outward from the facepiece. Because of this, the pressure-demand SCBA has been assigned a Protection Factor of 10,000.

7.7.7 Air Quality and Testing

7.7.7.1 Cylinder Air Must be Certified Grade D

Limiting Characteristics	**Grade D**
O_2	19.5-23.5%
Hydrocarbons	5 ppm
Carbon Monoxide	20 ppm
Odor	No Pronounced Odor
Carbon Dioxide	1,000 ppm

7.7.8 Supplied Air-Respirators

When these are used in atmosphere that are IDLH with respect to hazardous chemicals the supplied air-respirator must be certified as positive pressure. If an airline respirator is used, the maximum distance the airline can be is 300 feet.

7.7.9 Inspection of Pressure Demand Self-Contained Breathing Apparatus

The following checklist is to be used by students whenever they have to check out an SCBA. (Note: Any discrepancy found should be cause to set the unit aside until is can be repaired by a certified repair person).

7.7.9.1 Preliminary inspection. Check to ensure that:

7.7.9.1.1 High-pressure hose connector is tight on cylinder fitting;

7.7.9.1.2 Bypass valve is closed;

7.7.9.1.3 Mainline valve is closed;

7.7.9.1.4 There is no cover or obstruction on regulator outlet.

7.7.9.1.5 Pressure in the tank is at least 1,800 psi.

7.7.9.2 Backpack and harness assembly

7.7.9.2.1 Straps

7.7.9.2.1.1 Visually inspect for complete set.

7.7.9.2.1.2 Visually inspect for frayed or damaged straps that may break during use.

7.7.9.2.2 Buckles

7.7.9.2.2.1 Visually inspect for mating ends.

7.7.9.2.2.2 Check locking function.

7.7.9.2.3.	Backplate and cylinder lock
7.7.9.2.3.1	Visually inspect backplate for cracks and for missing rivets or screws.
7.7.9.3	Visually inspect cylinder hold-down strap and physically check strap tightener and lock to ensure that it is fully engaged.
7.7.9.4.	Cylinder and cylinder valve assembly
7.7.9.4.1	Cylinder
7.7.9.4.1.1	Physically check cylinder to ensure that is it tightly fastened to backplate.
7.7.9.4.1.2	Check hydrostatic test date to ensure that it is current.
7.7.9.4.1.3	Visually inspect cylinder for large dents or gouges in metal.
7.7.9.4.1.4	Visually inspect cylinder valve lock for presence.
7.7.9.4.1.5	Visually inspect cylinder gauge for condition of face, needle, and lens.
7.7.9.5	Open cylinder valve and listen or feel for leakage around packing. (If leakage is noted, do not use until repaired.)
7.7.9.6	Regulator and high-pressure hose
7.7.9.6.1	High-pressure hose and connector. Listen or feel for leakage in hose or at hose-to-cylinder connector. (Bubble in outer hose covering may be caused by seepage of air through hose when stored under pressure. This does not necessarily mean a faulty hose.)
7.7.9.6.2	Regulator and low-pressure alarm
7.7.9.6.2.1	Cover outlet of regulator with palm of hand. Open mainline valve and read regulator gauge (must read at least 1800 psi and not more than rated cylinder pressure).

7.7.9.6.2.2 Close cylinder valve and slowly move hand from regulator outlet to allow slow flow of air. Gauge should begin to show immediate loss of pressure as air flows. Low-pressure alarm should sound between 650 and 550 psi. Remove hand completely from outlet and close mainline valve.

7.7.9.6.2.3 Place mouth onto or over regulator outlet and blow. A positive pressure should be created and maintained for 5 to 10 seconds. Vacuum should remain constant. This tests the integrity of the diaphragm. Any loss of pressure or vacuum during this test indicates a leak in the apparatus.

7.7.9.6.2.4 Open cylinder valve.

7.7.9.6.2.5 Place hand over regulator outlet and open mainline valve. Remove hand from outlet and replace in rapid movement. Repeat twice. Air should escape when hand is removed each time, indicating a positive pressure in chamber.

7.7.9.6.2.6 Close mainline valve and remove hand from outlet.

7.7.9.6.2.7 Ascertain that no obstruction is in or over the regulator outlet. Open and close bypass valve momentarily to ensure flow of air through bypass system.

7.7.9.7 Facepiece and corrugated breathing tube

7.7.9.7.1 Facepiece

7.7.9.7.2 Visually inspect head harness for damaged serrations and deteriorated rubber. Visually inspect rubber facepiece body for signs of deterioration or extreme distortion.

7.7.9.7.3 Visually inspect lens for proper seal in rubber facepiece, retaining clamp properly in place, and cracks or large scratches.

7.7.9.7.4 Visually inspect exhalation valve for visible deterioration or foreign materials buildup.

7.7.9.8 Breathing tube and connector

7.7.9.8.1 Stretch breathing tube and visually inspect for deterioration and holes.

7.7.9.8.2 Visually inspect connector to ensure good condition of threads for presence and proper condition of "O" ring or gasket seal.

7.7.9.9 Negative pressure test for facepiece

7.7.9.9.1 Don backpack and facepiece.

7.7.9.9.2 With facepiece held tightly to face or facepiece properly donned, stretch breathing tube to open corrugations and place thumb or hand over end of connector.

7.7.9.9.3 Inhale. Negative pressure should be created inside mask, causing it to pull tightly to face. This negative pressure should be maintained for 5 to 10 seconds. If negative pressure leaks down, the facepiece assembly is not adequate and should not be worn.

7.7.10 Storage of units. Check to ensure that:

7.7.10.1 Cylinder is refilled as necessary and unit is cleaned and inspected (This is an operational requirement to avoid accidental usage of empty cylinders).

7.7.10.2 Cylinder valve is closed.

7.7.10.3 High-pressure hose connector is tight on cylinder.

7.7.10.4 Pressure is bled off high-pressure hose and regulator.

7.7.10.5 Bypass valve is closed.

7.7.10.6 Mainline valve is closed.

7.7.10.7 Facepiece is properly stored to protect against dust, sunlight, heat, extreme cold, excess moisture, and damaging chemicals.

7.7.11 SCBA Maintenance and Repair

SCBA's must be cleaned and maintained on a regular basis in order to be functioning properly when needed. Manufacturers' recommendations should be followed. General guidelines are presented below.

7.7.11.1 Routine Function Checkout - should be performed monthly even if the unit is not used. Same as SCBA checkout procedures.

7.7.11.2 Cleaning - after each usage. Sponge off and wipe down the tank, backpack/harness and regulator. Avoid getting water in the regulator (don't dunk, soak, hose off, etc.). Detach breathing hose from facemask. Dunk, wash each in a bucket of water/sanitizer solution. Then rinse under warm water. It is not usually necessary to disassemble the face mask. Alkanox or similar lab detergent can be used if sanitizer (available from manufacturer) is not available. At the very least, rinse the facepiece and hose under warm water. Set pieces out to dry (do not place near or use excessive heat, not in the bright sun) then reassemble.

7.7.11.3 Face Mask and Low Pressure Side - Regulator Maintenance. It will occasionally be necessary to repair and replace parts ('O' rings, springs, washers, etc.) on the face mask, backpack harness and low pressure side of the regulator. This work, although relatively simple, should be performed by a trained person. It is relatively easy to have one or two persons trained for this level of common repair.

7.7.11.4 High Pressure Side - Regulator Maintenance. Work on the high pressure side of the regulator, cylinder valve repair and alarm bell repair, should be performed only by a certified repair person, for that specific brand of SCBA.

EVOR PHILLIPS SITE
OLD BRIDGE, NEW JERSEY

AIR MONITORING FORM

DATE: _____ INSTRUMENT OPERATOR: _____

TIME	TASK	MONITOR READING		
		HNU	LEL/O_2	MINI-RAD

8.0 OTHER MONITORING PROGRAMS

Area and perimeter air monitoring will also be conducted during the set-up activities. The area sample results will be used to document zones of personal protection.

8.1 A scan of all work areas will be performed daily prior to initiation of site activities and throughout the duration of daily site operations in order to monitor:

8.1.1 the need for upgrading or downgrading personal protective equipment respiratory protection levels;

8.1.2 to detect elevations in air contaminant levels resulting in the need for additional air sampling. Site monitoring will be continuous and should be concentrated in areas of worker activity.

8.1.3 management and administrative personnel who will be present during on-site activities will be subject to ITS's real-time monitoring program. Results of routine monitoring with the real-time instruments will form the basis for any upgrades or downgrades of personal protection on the job site. Therefore, management personnel should be in place during construction activities and informed of the daily results and changes in the personal protection zones.

8.2 Quality Control

A disciplined system of equipment calibration, quality assurance and quality control, and documentation will be in effect during remediation activities. These activities will ensure that all methods, materials, equipment and results are consistent with OSHA/NIOSH and/or EPA approved programs. Management personnel on-site should also be familiar with the requirements of these procedures, a they determine the validity of all air sampling results.

8.3 Personal Protection Gear Maintenance

Each employee shall be responsible for the proper care taken for all assigned health and safety gear. This shall include safety glasses/shields, hard helmets, respirators (full/half), slush boots and ear protection. All employees maintain a response bag which includes all issued equipment.

The operations manager inspects employees response bags on a weekly basis to insure all equipment is maintained. This shall include evaluating whether equipment should be repaired and/or replaced.

All AO respirators are kept in self-lock bags while not in use. The employees are instructed to inspect and clean their respirators after each usage.

9. MEDICAL MONITORING PROGRAM

9.1 Rationale

The information will be used to determine if individuals are unusually susceptible to illness or injury from possible exposures in the work environment and to establish the present medical status of the individual. It may be used for future epidemiological studies, to adjudicate claims and determine benefits, report medical conditions required by law to Federal, state, and local agencies, and for other lawful purposes, including litigation.

9.2 Medical History

The medical history will be obtained by having each participant fill out a medical and occupational history form. The occupational exposure information should be reviewed by an industrial hygienist to assist the examining physician by providing specific information on those chemicals. The health questionnaire will aid the examining physician by indicating potential disease by problems.

9.3 Physical Examination

Each individual will receive a "hands on" physical examination by the attending physician. The physician will note any abnormalities observed during the examination. Temperature and blood pressure will be noted. The physician will include checking for perforated eardrums. A determination if the individual is capable of performing work while wearing a self contained breathing apparatus as well as protective suits shall be included. Any employees working onsite for thirty days or more will participate in exit physicals once the project is completed.

9.3.1 Medical Surveillance

9.3.1.1 General

ITS performs annual physicals for all field personnel and administrative staff whether visiting or working on hazardous waste sites. All employee records, including medical records for annual and

site specified physicals, will be retained for a 30 year period beyond their termination of the Company. In addition, the medical center, Life Care, Inc., will also retain records for up to 30 years.

9.3.1.2 Physical Evaluation

The physician responsible for reviewing and monitoring each employee's physical shall evaluate whether the employee is physically fit to perform designated site tasks. Both ITS and the employee will receive a copy of the physical examination results. If the physical demonstrates an employee with a health condition not conducive to field activities, the physician shall notify ITS management in writing. In addition, the employee will also be notified in writing. Depending upon the seriousness of the condition, the physician shall determine the extent of work the employee can perform. The employee may elect to consult with his or her family physician. During the evaluation process, Dr. Bojarksi will be available to discuss any results with the employee and his personal physician. Follow-up consultations with the employee will further determine return to work status.

A letter from the physician will reactivate the employee for full work status.

Medical Center: Life Care, Inc.
601 N. Main Street
Glassboro, NJ 08028
609-881-5800
Dr. Michael Bojarski, D.O.

9.4 Examining Physician

The ITS medical monitoring program is performed by or under the supervision of a physician certified in occupational medicine. The examining physician must be licensed by the state in which the physical is being performed.

9.5 Initial or Baseline Examination

This examination will provide reference information for the evaluation of subsequent periodic examination findings and will be used to determine whether each employee is medically suitable for performing assigned tasks.

9.6 Diagnostic Tests

Each individual will have the following tests performed:

9.6.1 Blood Tests

Blood count and differentials, SMAC 23 or Blood Chemistries 160, Measurement of metallic content in blood for lead, arsenic, chromium, and cadmium.

9.6.2 Urine Tests

Complete urinalysis including sedimentation (Comment: This is a standard set of tests.) including metals screening for the above listed metals.

9.6.3 Chest X-Rays

Baseline chest X-rays will consist of minimum of one standard 14 x 17 in. P-A (posterior-anterior) and one lateral view. The film should be read or reviewed by a board-certified radiologist. (Subsequent periodic chest X-rays will be performed when clinical tests or subsequent exposures indicate a need.)

9.6.4 Electrocardiogram

It will be a standard, 12-lead, resting type as a minimum and will be interpreted by an internist or cardiologist. A stress test may be administered at the discretion of the examining physician.

9.6.5 Pulmonary Function Tests

The exam consists of simple tests of lung ventilation to measure forced expiratory volume in 1 sec (FEV1) and forced vital capacity (FC); other factors such as a FEF, MMEFR, MVV, FRC, RV, and TLC may be included. Special attention should be given to the fact that the individual may be required to wear a demand respirator.

9.7. Periodic Monitoring

Individuals will receive periodic examinations because of:

9.7.1 conditions found in initial or baseline examination

9.7.2 real or possible exposure on a site such as spill, sudden release of chemicals, or failure of personal protective equipment

9.7.3 complaints from the individual which indicate a potential problem (physician's discretion)

9.7.4 part of a routine program

9.8. Exit Physical

At termination of employment or reassignment to an activity or location which does not represent a risk of exposure to hazardous exposures, an employee shall receive an exit physical. If his/her last physical was within the last six (6) months, the advising medical consultant has the prerogative to determine adequacy and necessity of an exit examination.

10. FIRE PROTECTION

10.1 Procedures

Fume, fire, and disaster procedures will be observed by ITS employees.

10.2 Smoking - Smoking on Evor Phillips sites will be evaluated on a site by site basis. Smoking will be permitted only in areas authorized by onsite Supervisors.

10.3 Flammable Materials

Storage and use of flammable materials will be subject to the approval of a the Supervisor.

10.4 Chemical Exposure

ITS will provide portable safety showers on site for immediate use. Notify supervision of exposure as soon as possible.

10.5 Fire Extinguishers

ITS shall furnish the appropriate fire extinguishers based on site requirements, to protect its work area and equipment.

10.6 Not Applicable

11. CONSTRUCTION FACILITIES

11.1 Drinking water and sanitary facilities

Drinking water, sanitary, and self-contained hand washing facilities shall be provided by ITS.

11.2 Compressed Air

If compressed air is not available within the work area, ITS shall provide its own source of compressed air.

11.3 Food, Tobacco, and Cosmetics

No food, beverages, tobacco (chewing) are to be consumed in the immediate area except as approved by ITS representative.

12. SITE CONTROL

12.1 Designation of Work Zones

A primary means of maintaining site control in order to ensure safe, efficient work and to prevent migration of hazardous materials into uncontaminated areas is by designating work areas. The work areas serve to limit site access, contain gross contamination, provide site security, and place a buffer zone between the hazardous site and the community.

There are typically three (3) types of work zones established.

12.1.1 Support Zone

The support zone is the area furthest away from the hazardous substances. It is where the command post (CP) is located and all support activities occur. Besides being located in a known non-contaminated area several factors are considered in designating this work zone. Wind direction and speed is a prime consideration when locating the command post. Ideally, the support area should be upwind of the exclusion zone with no more than 20° deviation in direction on either side of a straight line to the exclusion zone. Practically, a deviation of 90° or an arc of 180° can be tolerated. Wind speed variations can create turbulence and/or swirling depending on the site topography. A review of local climatic conditions during the time of year that site activities will take place can provide some insight. If access roads to the site are located on the downwind side, consider obtaining permission to enter from the upwind. Otherwise, the support zone should be located downwind a distance to allow dispersion of airborne contamination. Continual air monitoring and wearing respirators by personnel in the support may be necessary. Advantage of the terrain should be taken when designating the support zone to provide:

12.1.1.1 The best means of access to the exclusion zone and allow sufficient room for the contamination reduction zone;

12.1.1.2 Provide easy access for emergency vehicles;

12.1.1.3 Utilize prominent landmarks for site boundaries and/or access points;

12.1.1.4 Provide line-of-sight to all activities in the exclusion zone;

12.1.1.5 Control site access.

12.1.1.6 The command post shall contain:

12.1.1.6.1 Command office/storage trailer;

12.1.1.6.2 Safety equipment;

12.1.1.6.3 Sanitary facilities.

12.1.2 Contamination Reduction Zone

CONTAMINATION REDUCTION ZONE (CRZ) - During operations where contaminated materials are being handled, there is a need for a transition zone or buffer between the contaminated areas and the clean areas of a site. This is also the logical location of the decontamination facilities for both personnel and equipment. The line of demarcation between the CRZ and the exclusion zone is the "Hotline". The premise of the CRZ is that equipment and personnel are as contaminated as they can be as they cross the hotline and through decon procedures become less and less contaminated as they move towards the support zone. With the exception of the protective equipment, sample containers and the decon fluids, no uncontainerized contaminated materials are to be handled any where but in the exclusion zone.

12.1.3 Exclusion Zone

The exclusion zone is defined as the area which is considered to be contaminated, potentially contaminated, or which could become contaminated in the event of fire, explosion or spill, and a buffer zone for additional safety. Defining the exclusion or "hot" zone is based on the preliminary site investigation.

No unauthorized person should be within this area. All persons within this area shall be wearing and using the designated personal protective equipment for their job function when within this area.

Typical considerations in establishing the hot area are:

12.1.3.1 types and quantities of hazardous substances on-site;

12.1.3.2 type of containerization used - drums, tanks and its present condition;

12.1.3.3 properties of the hazardous substances - flammability, reactivity, toxicity, incompatibility, radioactivity, corrosiveness;

12.1.3.4 activities which will take place within the exclusion zone - heavy equipment operation, drum staging, pressure washing, torching;

12.1.3.5 Once these contaminated or potentially contaminated areas are defined, a buffer zone must be added to ensure the safety of the surrounding populace. Again the properties of the hazardous substances must be taken into consideration. The buffer zone is to adequately protect the populace from airborne contamination or runoff contamination as a result of an accidental rupture of a container and subsequent release or generation of runoff due to rain. While the delineation of the exclusion area is necessary prior to initiating site work, it can be increased or decreased during the course of project as new data is collected and evaluated. The exclusion area must be adequately secured by fence, warning signs, terrain or security personnel to prevent any individuals from inadvertently entering the area. A well defined entrance/exit point must be specified at each site and enforced by the Site Safety Officer (SSO). (This ensures the proper levels of protection are worn down range; that adequate personnel are within this area and accounted for, and that site security is maintained. This access point also serves as control of contamination as it established the "hotline" and contamination reduction zone).

12.2 Communications

12.2.1 Internal (On-Site) Communications

The internal communications network is used among the designated work zones. It is to alert the team to emergencies, to pass along

safety information (air time left), to communicate changes in work scope or to maintain site control. Team members key in internal communications area: the command post supervisor, site safety officer, and work party members.

Means of communication which can be used are limited only by resources available and the imagination of the team. Regardless of what is used there should be a primary and back-up system. An important fact to remember is that any device used downrange for communication must be intrinsically safe so as to avoid creating a spark in a potentially explosive atmosphere. Common devices used on-site are:

12.2.1.1 noise making devices - bell, compressed air horn whistle, siren, megaphone or vehicle horn

12.2.1.2 visual signals - smoke or flares (only from support zone), flags, signal boards, lights or arm and hand signals.

12.2.1.3 Emergency communication systems should be established and used only when an emergency exists. Common emergency signals used include hand, audible or radio signals. Examples of emergency hand and audible signals are:

- clutching throat - personal distress;
- arm waved in a circle over the head - if given downrange: need assistance, or if given from command post: evacuate area;

Due to the close proximity of the exclusion zone from the support zone, response by field support and communication to field support personnel will be immediate.

13. DECONTAMINATION

13.1 Introduction

Decontamination involves physically removing contaminants and/or converting them chemically into innocuous substances. How extensive decontamination must be depends on a number of factors, the most important being the types of contaminants involved. The more harmful the contaminant, the more extensive and thorough decontamination must be. Combining decontamination with the correct doffing of protective equipment and the zoning of site work areas minimizes cross-contamination from protective clothing to wearer, equipment to personnel, and one area to another. Only general guidance can be given on methods and techniques for decontamination. The exact procedure is determined by evaluation of a number of factors specific to the type of contaminant and tasks to be performed.

13.2 Preliminary Concerns

13.2.1 Initial Planning

The initial decontamination plan is based on the assumption that all personnel and equipment leaving the Exclusion Zone (area of potential contamination) are grossly contaminated. The plan includes a system for washing and rinsing, at least once, all the protective equipment worn. The washing and rinsing are done in combination with a sequential doffing of equipment, starting at the first station with the most heavily contaminated article. Each piece of clothing or operation requires a separate station.

The spread of contaminants during the washing and doffing process is further reduced by separating each decontamination station by a minimum of three (3) feet. Ideally, contamination should decrease as a person moves from one station to another along the line.

13.2.2 Contamination Reduction Corridor

An area within the Contamination Reduction Zone is designated the Contamination Reduction Corridor (CRC). The CRC controls access into and out of the Exclusion Zone and confines personnel decontamination activities

to a limited area. The CRC zone shall be setup immediately beyond the fence which borders the tank location. A double swing gate will provide ample access to the support zone from the exclusion zone (primary work area).

TABLE I
ITS'S PERSONNEL DECONTAMINATION

Step 1	Segregated Equipment Drop
Step 2	Cover Boot and Glove Wash
Step 3	Cover Boot and Glove Rinse
Step 4	Cover Boot Removal
Step 5	Cover Glove Removal
	---------- HOTLINE ----------
Step 6	Suit and Boot Wash - Disposable
Step 7	Suit and Boot Rinse - Disposable
Step 8	Suit Removal
Step 9	Boot Removal
Step 10	Respirator Removal
Step 11	Inner Glove Wash and Rinse
Step 12	Inner Clothing Removal
Step 13	Re-Dress

The CRC boundaries should be conspicuously marked, with entry and exit restricted. The far end is the hotline, the boundary between the Exclusion Zone and the Contamination Reduction Zone. Personnel exiting the Exclusion Zone must go through the CRC. Anyone in the CRC should be wearing the Level of Protection designated for the decontamination crew. Another corridor may be required for the entrance and exit of heavy equipment needing decontamination. Within the CRC, distinct areas are set aside for the decontamination of personnel, portable field equipment, removed clothing, etc. These areas should be marked and restricted to those personnel wearing the appropriate Level of Protection. All activities within the corridor are confined to decontamination.

Protective clothing, respirators, monitoring equipment, sampling supplies, and other equipment are all maintained outside of the CRC. Personnel don their protective equipment away from the CRC and enter the Exclusion Zone through a separate access control point at the hotline.

13.3 Extent of Decontamination Required

13.3.1 Modifications of Initial Plan

The original decontamination plan must be adapted to conditions specific to each incident. These conditions may require more or less personal decontamination than planned, depending on a number of factors.

13.3.1.1 Type of Contaminant

The extent of personal decontamination depends on the effects the contaminants have on the body. All contaminants do not exhibit the same degree of toxicity (or other hazard). the more toxic a substance is, the more extensive or thorough decontamination must be. Whenever it is known or suspected that personnel may become contaminated with highly toxic or skin-destructive substances, a full decontamination procedure should be followed. If less hazardous materials are involved, the procedure can be downgraded.

13.3.1.2 Amount of Contamination

The amount of contamination on protective clothing is usually determined visually. Field personnel working within the tank will have a greater amount of contamination on PPE suits verses the support personnel. If the clothing is badly contaminated, a thorough decontamination is generally required. Gross material remaining on the protective clothing for any extended period of time may degrade or permeate it. This likelihood increases with higher air concentrations and greater amounts of liquid contamination. Gross contamination also increases the probability of personal contact. Swipe tests may help determine the type and quantity of surface contaminants.

13.3.1.3 Level of Protection

The Level of Protection and specific pieces of clothing worn determine on a preliminary basis the layout of the decontamination line. Each Level of Protection presents different problems with respect to the decontamination and doffing of the equipment. For example, the decontamination of the harness straps and backpack assembly of the self-contained breathing apparatus (SCBA) is difficult. A butyl rubber apron worn over the harness makes decontamination easier. Clothing variations and different Levels of Protection may require the addition or deletion of stations used in the original decontamination procedure.

13.3.1.4 Work Function

The type work that each person does determines the potential for contact with hazardous materials. In turn, this dictates the layout of the decontamination line. Observers, photographers, operators of air samplers, or others in the Exclusion Zone performing tasks that will not bring them in contact with contaminants may not need, for example, to have their garments washed and rinsed. Others in the Exclusion Zone with a potential for direct contact with the hazardous material will require more thorough decontamination. Different decontamination lines could be set up for different job functions, or certain stations in a line could be omitted for personnel performing certain tasks.

13.3.1.5 Location of Contamination

Contamination on the upper areas of protective clothing poses a greater risk to the worker because volatile compounds could make breathing hazardous both for the worker and for the decontamination personnel. There is also an increased probability of contaminant contact with the skin when the worker is doffing the upper part of the clothing.

13.4 Effectiveness of Decontamination

There is no method of determining immediately how effective decontamination is in removing contaminants. Discoloration, stains, corrosions, and residues on objects may indicate that contaminants have not been removed. However, observable effects only indicate surface contamination and not permeation (absorption) into clothing. Many contaminants are not easily observed. One method for determining the effectiveness of surface decontamination

is swipe testing. Cloth or paper patches/swipes are wiped over predetermined surfaces of the suspect object and later analyzed in a laboratory. both the inner and outer surfaces of protective clothing should be swipe tested. Positive results for both sets of swipe tests would indicate that surface contamination has not been removed and substances have penetrated or permeated the garment. Swipe tests can also be performed on skin or inside clothing. Laboratory analysis is required to determine if protective garments have been permeated. Both swipe and permeation testing provide after-the-fact information. Along with visual observations, results of these tests can help in ascertaining the effectiveness of decontamination.

Swipe tests will be performed on a random basis during buried drum and tank removal operations. The swipe samples will be analyzed at a certified lab for appropriate parameters. An estimated two samples per week will be taken to confirm effectiveness of decontamination procedures.

13.5 Equipment

Decontamination equipment, materials, and supplies are generally selected on the basis of availability. The ease of equipment decontamination and disposal are also considered. Most equipment and supplies can be easily procured. Soft-bristle scrub brushes or long-handle brushes are used to remove contaminants. Buckets of water or garden sprayers are used for rinsing. Large galvanized was tubs, stock tanks, or children's wading pools can also be used as containers for wash and rinse solutions. Large plastic garbage cans or similar containers lined with plastic garbage bags are useful for the storage of contaminated clothing and equipment, and metal or plastic cans or drums are convenient for the temporary storage of contaminated liquids. Other gear includes paper or cloth towels for drying protective clothing and equipment.

ITS shall swipe sample the excavation equipment after the buried drum removal operation is completed. Analysis shall further confirm the effectiveness of the decontamination procedures.

13.6 Decontamination Solution

Protective equipment, sampling tools, and other equipment are usually decontaminated by scrubbing with detergent water using a soft-bristle brush, followed by rinsing with copious amounts of water. While this process may not be fully effective in removing some contaminants (in some cases, the contaminants may react with water), it is a relatively safe option compared to the use of a decontaminating solution. The contaminant must be identified before a decon chemical is used, and reactions of such a chemical with unidentified substances or mixtures could be especially troublesome.

13.7 Decontamination During Medical Emergencies

13.7.1 Basic Considerations

Part of the overall planning for incident response is managing medical emergencies. The plan should provide for the following:

13.7.1.1 Response Team members certified in First Aid/cardiopulmonary resuscitation.

13.7.1.2 Arrangements with the nearest medical facility for transportation and treatment of the injured, and for the treatment of personnel suffering from exposure to chemicals. Consultation

13.7.1.3 Emergency eye washes.

13.7.1.4 First aid kits, blankets, a stretcher, and a resuscitator.

13.7.1.5 In addition, the plan should have established methods for decontaminating personnel with medical problems and injuries. There is the possibility that decontamination may aggravate a health problem or cause more serious problems.

If prompt life-saving first aid and/or medical treatment is required, decontamination procedures should be omitted. Whenever possible, response personnel should accompany contaminated victims to the medical facility to advise on matters involving decontamination.

13.7.2 Physical Injury

Physical injuries can range from a sprained ankle to a compound fracture, or from a minor cut to massive bleeding. Depending on the seriousness of the injury, treatment may be given at the site by trained response personnel. For some serious injuries may be required at the site or the victim may have to be treated at a medical facility.

Life-saving care should be instituted immediately without considering decontamination. The outside garments can be removed (depending on the weather) if this does not cause delays, interfere with treatment,

or aggravate the problem. Respiratory masks and backpack assemblies must always be removed. Fully encapsulating suits or chemical-resistant clothing can be cut away. If the outer contaminated garments cannot be safely removed, the individual should be wrapped in plastic, rubber, or blankets to help prevent contaminating medical personnel and/or the inside of ambulances. (This equipment will be stored in the first aid area to be designated by ITS's Site Supervisor.) Outside garments are then removed at the medical facility. No attempt should be made to wash or rinse the victim unless it is known that he has been contaminated with an extremely toxic or corrosive material that could also cause severe injury or loss of life. For minor medical problems or injuries, the normal decontamination procedure should be followed.

13.8 Decontamination of Equipment

13.8.1 Basic Considerations

All possible measures should be taken to prevent the contamination of sampling and monitoring equipment. Sampling devices become contaminated, but monitoring instruments, unless they are splashed, usually do not. Once contaminated, instruments are difficult to clean without damaging their integrity. Any delicate instrument that cannot be decontaminated easily should be protected while it is being used. It should be bagged, and the bag should be taped and secured around the instrument. Openings are made in the bag for sample intake.

13.8.2 Decontamination Procedures

13.8.2.1 Respirators

Certain parts of contaminated respirators, such as the harness assembly and leather or cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. Regulators must be maintained according to the manufacturers' recommendations. Persons responsible for decontaminating respirators should be thoroughly trained in respirator maintenance.

13.8.2.2 Heavy Equipment

Bulldozers, trucks, backhoes, bulking chambers, and other heavy equipment are difficult to decontaminate. The method generally used is to wash them with water under high pressure and/or to scrub accessible parts with a detergent/water solution under pressure. In some cases, shovels, scoops, and lifts have been sandblasted or steam-cleaned. Particular care must be given to tires, scoops, and other components in direct contact with contaminants. Swipe tests should be used to determine effectiveness of the decontamination process.

13.8.2.3 Decon equipment (sample)

13.8.3 Sanitizing of Personnel Protective Equipment

In addition to being decontaminated, all respirators, protective clothing, and other personal articles must be sanitized before they can be used again. The insides of masks and clothing become soiled from exhalation, body oils, and perspiration. The manufacturers' instructions should be followed in sanitizing the respirator mask. If practicable, protective clothing should be machine washed after a thorough decontamination; otherwise, it should be cleaned by hand.

13.8.4 Persistent Contamination

In some instances, clothing and equipment will become contaminated with substances that cannot be removed by normal decontamination procedures. A solvent may be used to remove such contamination from personal protective equipment if it does not destroy or degrade the protective material. If persistent contamination is expected, disposable garments should be used. Testing for persistent contamination of protective clothing and appropriate decontamination must be done by qualified laboratory personnel.

13.9 Disposal of Contaminated Material

All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets brushes, and all other equipment that is contaminated must be secured in drums or other containers and labeled. Clothing not completely decontaminated on the site should be secured in plastic bags before it is removed from the site.

Contaminated wash and rinse solutions can be kept temporarily in a step-in container (for example, child's wading pool) or in a plastic-lined trench about 4 in. deep. Such solutions are ultimately transferred to labeled drums and disposed of with other substances on the site.

13.10 Decontamination of Sampling Equipment

All equipment used in the collection of samples will be decontaminated on a daily basis. This will be performed following the procedure outlined below.

- All equipment will be washed in a solution of water and "alconox".
- All equipment will be rinsed using a solution of distilled water.
- All equipment will be final rinsed with a 1% nitric acid solution. This rinse will be followed by a rinse of a polar solvent such as hexane.
- All decontamination equipment will be allowed to air dry in an environment free from contamination.
- All decontamination effluent will be collected, containerized, and disposed along with the remainder of the onsite generated waste.

14.0 HEAT STRESS CONTROL

Adverse climate conditions, primarily heat, are important considerations in planning and conducting site operations. The effects of ambient temperature can cause physical discomfort, loss of efficiency, personal injury, and increased accident probability. In particular, heat stress due to protective clothing decreasing body ventilation is an important factor.

Plenty of liquids will be provided to replace loss of body fluids.. Employees will replace water and salts lost from sweating.

A work schedule will be established to provide sufficient rest period for cooling down. This will require shifts of workers when wearing Level C and Level B equipment during elevated ambient temperatures.

14.1 Heat Exhaustion

14.1.1 Symptoms: Usually begins with muscular weakness, dizziness, nausea, and staggering. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, his skin is clammy, and he may perspire profusely. The pulse is weak and fast, his breathing is shallow. He may faint unless he lies down. Some or all symptoms may pass, but sometimes they remain and could progress to heat stroke.

14.1.2 First Aid: Immediately remove the victim to the Decontamination Reduction Zone in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock. (Make him lie down, raise his feet 6-12 inches, and keep him warm but loosen all clothing.) If the victim is conscious, it may be helpful to give him sips of a water solution. Transport victim to a medical facility.

14.2 Heat Stroke

14.2.1 Symptoms: This is the most serious stage of heat stress casualties due to the fact that the body excessively overheats. Body temperatures often are between 107 - 110°F. First, there is often pain in the head, dizziness, nausea,

oppression, and a dryness of the skin and mouth. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly.

14.3 Cold Stress Monitoring

Stages of the site remediation may encounter outdoor temperatures at or below freezing. Individuals working in this temperature regime are at risk for frostbite. Exposure to extreme cold for a short time may cause severe injury to exposed skin or cause hypothermia. Prolonged hypothermia can result in death. Areas of the body that have high surface area-to-volume ratio such as fingers, toes, ears, are the most susceptible to frostbite.

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind shill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18°F.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. This, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration-soaked.

Local injury resulting from cold is included in the generic term "frostbite". There are several degrees of damage. Frostbite of the extremities can be categorized as:

- Frost nip or incipient frostbite: characterized by sudden blanching or whitening of skin;

- Superficial frostbite: skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient; and

- Deep frostbite: tissues are cold, pale, and solid: and extremely serious injury.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Symptoms of hypothermia are exhibited typically in five stages:

14.5 When protective clothing is grossly contaminated, contaminants may be transferred to the wearer or to treatment personnel and cause injuries. Unless severe medical problems could be created by splashing, the protective clothing should be washed off as rapidly as possible and carefully removed.

14.6 Indicators of Toxic Exposure

The following indicators of toxic exposure are generally observable by others and should be reported to the SSO if observed in a worker:

- Change in complexion of skin discoloration;
- Lack of coordination;
- Changes in demeanor;
- Excessive salivation or pupillary response; and
- changes in speech pattern.

The following symptoms of toxic exposure are generally not oberservable by others and should be reported to the SSO if experienced:

- Headaches;
- Dizziness;
- Blurred vision;
- Cramps or other gastro-intestinal irregularity; and
- Irritation of eyes, skin, or respiratory tract.

14.7 Protection for Decontamination Workers

14.7.1 Determination of Level of Protection

The Level of Protection worn by decontamination workers is determined by:

14.7.1.1 Expected or visible contamination on workers.

14.7.2 Type of contaminant and associated respiratory and skin hazards.

14.7.3 Total vapor/gas concentrations in the CRC.

14.7.4 Particulates and specific inorganic or organic vapors in the CRC.

14.7.5 Results of swipe tests.

14.7.6 The presence (or suspected presence) of highly toxic or skin-destructive materials.

14.8 Level B Protection

Decontamination workers should wear Level B protection wherever they may be contaminated with highly volatile liquids, highly toxic materials, or other hazardous substances.

Level B protection includes an SCBA, a hard hat with face shield, chemical-resistant gloves, and protective clothing. The clothing suggested is chemical-resistant overalls, a jacket, and a rubber apron. The rubber apron protects the SCBA harness assembly and regulator from contamination.

15. EMERGENCY RESPONSE/CONTINGENCY PLAN

This section describes general contingencies and emergency planning procedures for ITS.

15.1 Pre-Emergency Planning

During the site briefing held periodically or daily, all employees will be trained in and reminded of provisions of the emergency response plan, communication systems, and evacuation routes.

The plan will be reviewed and revised if necessary, on a regular basis by the Site Safety Officer (SSO). This will ensure that the plan is adequate and consistent with prevailing site conditions.

15.2 Lines of Authority

As the administrator of the project, the SSO and Instrument Tech has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measures to ensure safety of site personnel and the public. Possible actions may involve evacuation of personnel from the site area and evacuation of adjacent residents. The SSO is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed.

15.2.1 Emergency Procedures

Emergency Medical Treatment - In the event of an employee's injury or illness requiring emergency medical care beyond the capabilities of onsite CPR and first aid trained personnel, the following resources will be utilized as necessary:

First Aid Squad/Ambulance -	908-721-4000
Fire -	911 Emergency 908-721-4000 Non-Emergency
Police -	911 Emergency 908-679-3400 Non-Emergency

Hospital-	908-721-1000 Memorial Medical Center at South Amboy Bordentown Rd. & Rte. 35 North South Amboy, NJ
Poison Control Center -	800-962-1253
U.S. EPA National Response Center -	800-438-2474
Chemtrec -	800-424-9300

15.2.2 Evacuation Procedures

15.2.2.1 General

If evacuation procedures are employed during work activities, all routes from the exclusion zone will exit through the decontamination and support zones. Throughout the project phases, the majority of the exclusion zone will be located on the southeast and northwest parcel of the property (behind previous located houses/office).

15.2.2.2 Exclusion Zone Personnel

All workers within the exclusion will egress through the decon pad to the support trailer and storage container. The support Zone is located directly east of the decon pad. Initial evacuation point shall be to the northeast part of the property. This area is considered the open space parking lot area.

If necessary, all personnel onsite will be instructed to leave the premises via the main gate located at the northeast corner of the property adjacent to Cheesequake Road.

An area just outside of the gate along the road can be utilized for ultimate refuge depending upon the extent of the emergency.

15.3 Personal Injury in the Exclusion Zone

Upon notification of an injury in the exclusion zone, the designated emergency signal 3 short-3 long-3 short blasts of a horn shall be sounded. All site personnel shall assemble at the decontamination line. The rescue team will enter the exclusion zone (if required) to remove the injured person to the hotline. The Site Safety Officer and

Project Team Leader shall evaluate the nature of the injury, and the affected person should be decontaminated to the extent possible prior to movement to the support zone. The SSO or his designee shall contact the designated medical facility for an ambulance (if required). No persons shall re-enter the exclusion zone until the cause of the injury or symptoms is determined.

15.4 Personnel Injury in the Support Zone

Upon notification of an injury in the support zone, the Site Safety Officer will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance of site personnel, operations may continue, with the on-site SSO initiating the appropriate first aid and necessary follow-up as stated above. If the injury increases the risk to others, all site personnel shall move to the decontamination line for further instructions. Activities on-site will stop until the added risk is removed or minimized. A hospital route map is provided in Figure 2.

15.5 Medical Emergencies

Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patients condition is serious, at least partial decontamination should be completed (i.e., complete disrobing or removal of protective garment and redressing in clean coveralls or wrapping in blanket). First aid should be administered while awaiting an ambulance. All injuries and illnesses must be reported immediately to the SSO or PM.

Any person being transported to a medical facility should take with them information on the identity of the chemical(s) to which they have been exposed (if possible).

Any vehicle used to transport contaminated personnel will be treated and cleaned as necessary.

15.6 Fire or Explosion

If it is safe to do so, area personnel may:

15.6.1 Use fire-fighting equipment available on-site to control or extinguish the fire

15.6.2 Remove or isolate flammable or other hazardous materials which may contribute to the fire.

15.7 Spills or Leaks

In the event of a spill or leak, area personnel will:

15.7.1 Inform their supervisor immediately

15.7.2 Locate the source of the spill and stop the flow if it can be done safely.

15.8 Personal Protective Equipment Failure

If any site worker experiences a failure or alteration of protective equipment that affects the protection factor, that person and his/her buddy shall immediately leave the exclusion zone. Re-entry shall not be permitted until the equipment has been repaired or replaced.

15.9 Other Equipment Failure

If any other equipment on site fails to operate properly, the Project Team leader and Site Safety Officer shall be notified and then determine the effect of this failure on continuing operations on-site. If the failure affects the safety or personnel or prevents completion of the work plan tasks, all personnel shall leave the exclusion zone until the situation is evaluated and appropriate actions taken.

15.10 Significant, Prolonged Wind Shifts

Significant wind shifts are those conditions in which the result of on-site activity produces air contaminants of high concentration that are carried beyond the basin area, and as a consequence, threatens unprotected persons at the plant or community. Such occurrences will dictate cessation of on-site activity.

16. HOUSEKEEPING

16.1 Clean Up

ITS will be responsible for prompt clean-up and daily disposal of all scrap materials and waste materials that accumulate from its operations. All such materials are to be disposed of in appropriate containers provided by ITS. ITS shall have a 5-cubic yard dumpster staged onsite for all trash and debris.

16.2 Waste Material Control

No oil or foreign substance may be dumped in tanks, trenches, or ditches.

17. SECURITY

17.1 Search

All personnel, vehicles, and equipment will be subject to search upon entering or leaving the site premises.

17.2 Visitor Control

All visitors must be escorted by ITS's site supervision. ITS's employees shall be constantly aware of strangers in the delineated zones of a typical hazardous waste site. All strangers will be routed to the administrative office for assignment of an escort and office registration.

18. COORDINATION WITH SITE PERSONNEL

18.1 Pre-Work Meeting

The site safety officer and/or contract administrator will hold a daily safety pre-work meeting to discuss work schedules, safety performance, and other relevant matters.

18.2 Permits

Work permits and flame permits will be required daily. The permits will be issued before the start of work each day. Requests for work and flame permits must be made to the site safety officer.

18.3 Prohibited Activities

- Playing
- Fooling Around/Horseplay
- Entering no-work related areas
- Eating in Non-Designated Areas

19.0 LOCATION OF BURIED UTILITIES

Local utilities will be contacted to identify active lines in the site area. The following utility companies have been contacted and have marked their active line as indicated herein: (to be completed by CM)

UTILITY	COMPANY	DATE CONTACTED	MARKED (Y or N)	COLOR CODE
Electric	PSE&G			
Gas	PSE&G			
Water	City of Old Bridge			
Sewer	City of Old Bridge			
Phone	New Jersey Bell			
Other				

ITS or agent will also use metal detectors and/or pipe locators for site screening. Excavation will proceed carefully at shallow depths to avoid rupturing a line that may be present but was not detected.

20.0 TRENCHING HAZARDS

During the removal of buried drums and underground storage tanks, specific procedures and precautionary measures must be followed during excavation activities below surface grade.

ITS anticipates relatively shallow excavations during the removal of buried drums (less than 6 feet deep). However, due to the sizes of the underground tanks, excavations as deep as 12 to 14 feet can be expected. In addition, based upon site walks and surrounding soils, the soil matrix expected will be a sandy/silty makeup. Therefore, ITS can anticipate unstable side slopes with excavations deeper than 5 feet.

ITS shall implement the following safety measures during the excavation of subsurface soils during the removal of underground storage tanks and the buried drums.

20.1 Any excavations deeper than 5 feet will be sloped back at a 2 to 1 slope in accordance with OSHA 1926.52 recommendations.

20.2 No personnel shall enter an excavation deeper than 5 feet unless the excavation sides are shored or a slope of 2 to 1 is constructed.

20.3 During excavation activities, any utilities encountered will be either remove or supported to prevent any soil erosion.

20.4 Any excavations opened overnight will be protected by orange safety fence and caution tape.

20.5 Any excavations opened longer than 2 days will have silt fence installed where soil erosion can occur.

20.6 No heavy loads will be placed along excavation banks to prevent soil erosion. Due to soil matrix and potential depths of the UST excavations (up to 15 feet), ITS shall initially use appropriate sloping techniques to protect the excavation from side erosion. However, if the excavation exhibits unstable slopes during long durations of open voids, ITS will evaluate the need for further stabilization of the banks. One method will be interlocking sheetpiling. ITS shall utilize Mr. Chris Kluk, an in-house professional engineer, to evaluate and determine the safest and cost-effective technique to stabilize the excavation's perimeter banks.

The installation of interlocking shoring will be utilized for deep excavations if conventional sloping of sides is not feasible and it is determined that an unsafe work area is apparent. This decision will be made based upon actual work activities in the excavation.

20.7 If heavy rains are expected during open excavations, a soil berm will be constructed along the perimeter of the excavation to prevent and redirect runoff water away from the area.

HEALTH AND SAFETY PLAN

21. DEBRIS COLLECTION/DEMOLITION ACTIVITIES

During debris collection activities, field personnel shall wear Level D personal protective gear. The debris collection activities will restrict the work to only trash, pallets, steel and miscellaneous debris. Any drum carcasses .or/an containers will be left inplace until proper air monitoring activities are performed.

Throughout the demolition and debris collection tasks, workers shall wear dust masks due to possible generation of airborne particles from movement of heavy debris.