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DEPARTMENT OF THE INTERIOR

Draft Final Field Sampling Plan
Site Inspection
Additional and Uncharacterized Sites Operable Unit

Crab Orchard National Wildlife Refuge Superfund Site

Marion, Illinois (Williamson County)

March 2000

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Crab Orchard National Wildlife Refuge
8588 Route 148
Marion, IL 62959
(618) 997-3344

March 1, 2000

Mr. Nan Gowda
U.S. Environmental Protection Agency
Region V, Waste Management Division
77 West Jackson Boulevard, HSRL-6J
Chicago, IL 60604

Mr. Gary Chisholm
U.S. Army Engineer District, Louisville
600 Dr. Martin Luther King Jr. Place
Louisville, KY 40202-0059

Mr. Paul Lake
Illinois Environmental Protection Agency
Bureau of Land
1021 North Grand Ave. East
Springfield, Illinois 62794-9276

Re: Transmittal of Draft Final Field Sampling Plan/Quality Assurance Project Plan and Draft Health and Safety Plan for the Site Inspection
Additional and Uncharacterized Sites Operable Unit
Crab Orchard National Wildlife Refuge, Marion, Illinois

Dear Mr. Gowda, Mr. Lake, and Mr. Chisholm:

The U.S. Fish and Wildlife Service (Service) on behalf of the Department of the Interior is hereby transmitting the Draft Final Field Sampling Plan (FSP)/Quality Assurance Project Plan (QAPP) and Draft Health and Safety Plan (HSP) for the Site Inspection of the Additional and Uncharacterized Sites Operable Unit (AUS OU), Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois. Formal written responses to comments received from U.S. Environmental Protection Agency (USEPA) on December 6, 1999 and Illinois Environmental Protection Agency (IEPA) on January 6, 2000 are included.

Please review the responses and revisions to confirm your comments have been appropriately addressed. Site preparation activities (i.e. surveying, sample location) are underway in order that field sampling may begin on March 22, 2000.

Should you have any questions, please contact me at (618) 997-3344, Ext. 307.

Sincerely,

Elaine L Moore

Elaine L. Moore
CERCLA Coordinator

Enclosures

cc: Janet Goodwin, DOI-SOI (with enclosure)
Mary Fulghum, USEPA (without enclosure)
Todd Rettig, IEPA (without enclosure)
William G. Latka, USACE, Omaha District (without enclosure)
Margaret Lake, BOR (with enclosure)
Fred Molloy, Tech Law (with enclosure)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Crab Orchard National Wildlife Refuge
8588 Route 148
Marion, IL 62959
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March 1, 2000

Glen Heil
Supervisor of Regulatory Compliance
Primex Technologies
8820 Route 148 South
Marion, IL 62959

Re: Transmittal of Draft Final Field Sampling Plan/Quality Assurance Project Plan and Draft Health and Safety Plan for the Site Inspection
Additional and Uncharacterized Sites Operable Unit
Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois

Dear Mr. Heil,

Thank you for meeting with U.S. Fish and Wildlife Service and its contractor, URS Greiner on February 16, 2000 to discuss coordination of site access to Areas 2 and 9. We appreciate the electronic files Primex provided depicting buildings/utilities in Areas 2 and 9. This information will be helpful to us in avoiding utility lines while locating samples. As discussed, we are transmitting a copy of the Draft Health and Safety Plan for your review to ensure the planned field sampling activities can be conducted safely within Primex's facility. Enclosed for your information is a copy of the Draft Final Field Sampling Plan/Quality Assurance Project Plan for the Site Inspection at the Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois.

We will continue to work closely with Primex to minimize disruptions to facility operations and ensure work is conducted safely. Thank you for your assistance in this matter. Should you have any questions, you may contact me at (618) 997-3344, Ext 307.

Sincerely,

Elaine L. Moore

Elaine L. Moore
CERCLA Coordinator

Enclosures

cc: Janet Goodwin, SOI
Stephen Mahoney, SOI
Mimi Chesslin, DOJ

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LIST OF ACRONYMS FOR THE AUS SI FIELD SAMPLING PLAN
CRAB ORCHARD NATIONAL WILDLIFE REFUGE - MARION, ILLINOIS

ACRONYM	DEFINITION
ARAR	Applicable, Relevant and Appropriate Requirements
AUS OU	Additional Uncharacterized Sites Operable Unit
BGS	Below Ground Surface
BNA	Base-Neutral Acids
BOD	Biological Oxygen Demand
BOR	U.S. Bureau of Reclamation
BTAG	Biological Technical Assistance Group
BWT	Below Water Table
CERCLA	Comprehensive Environmental Response Compensation and Liability Act of 1980 (a.k.a. Superfund)
CLP	Contract Laboratory Program
COC	Crab Orchard Cemetery
COC	Chemical of Concern
COL	Crab Orchard Lake
COP	Crab Orchard Pond
CSC	Commercial Solvents Corporation
CTI	Central Technologies Incorporated
DERP	Defense Environmental Restoration Program
DOD	Department of Defense
DOI	U.S. Department of the Interior
DQCR	Daily Quality Control Reports
DQO	Data Quality Objective
DRO	Diesel Range Organics
EMMA OU	Explosives and Munitions Manufacturing Area Operable Unit
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FID	Flame Ionization Detector
FSP	Field Sampling Plan
FWS	U.S. Fish and Wildlife Service
GRO	Gasoline Range Organics
GSA	General Services Administration
GW	Ground Water
HMX	Her Majesty's Explosive (Cyclotetramethylenetetranitramine)
HSA	Hollow Stem Auger
HSP	Health and Safety Plan
IAC	Illinois Administrative Code
IDW	Investigation Derived Waste
IEPA	Illinois Environmental Protection Agency
IOP	Illinois Ordnance Plant
MAOU	Metals Area Operable Unit
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
mg/kg	millgrams per kilogram
mg/L	micrograms per liter
MISCA OU	Miscellaneous Areas Operable Unit
MOCA	4,4' - Methylenebis (2-chloroaniline)
MW	Monitoring Well

Section 1
Introduction

URS Greiner Woodward-Clyde (URS) has prepared this field sampling plan (FSP) for the Site Inspection (SI) for the Additional and Uncharacterized Sites Operable Unit (AUS OU) of the Crab Orchard National Wildlife Refuge (Refuge) Superfund Site. The work was executed under contract with the US Bureau of Reclamation (BOR)[1]. The US Fish and Wildlife Service (FWS) formed the AUS OU in 1997 to address potential releases of hazardous substances not included in existing OUs for the Refuge Superfund Site[2]. The Refuge is located in southern Illinois (Figure 1-1).

This FSP details the objectives and procedures for conducting an early assessment phase investigation of the AUS OU. It is a companion document to the Quality Assurance Project Plan (QAPP) prepared for this project.

1.1 OVERALL PROJECT OBJECTIVES AND DECISION STATEMENTS

The purpose of this investigation is to gather sufficient information to determine whether releases of hazardous substances to various environmental media (i.e., soils, sediment, surface water, and groundwater) have occurred, and if they have, whether they pose a potential threat to human health or the environment (early assessment decision).

Actions that could result from the decision:

- Conclude there is a potential threat and recommend a Remedial Investigation.
- Conclude that a threat is unlikely, and recommend no further action.
- Conclude that there is an imminent threat and recommend a removal action.

1.2 PHYSICAL DESCRIPTION OF REFUGE

The Refuge is located about 5 miles west of the City of Marion in Williamson, Jackson, and Union Counties. The Refuge was created in 1947, with a multiple mission, including industrial and agricultural use. The industrial part of the Refuge is the "Closed Area" shown in Figure 1-1. The Refuge includes 43,500 acres of forests, grassland areas, cropland, wetlands, and industrial areas.

1.2.1 Drainage And Surface Water Features

The major surface water feature of the Refuge is the 6,965-acre Crab Orchard Lake. It was created in the 1930s by damming the east-flowing Crab Orchard Creek. Other perennial streams that flow into the lake in the eastern part of the Refuge are Pigeon Creek, Wolf Creek, Sugar Creek, Little Grassy Creek, and Grassy Creek. Most of the industrial part of the Refuge has low relief and includes many flat lying marshy areas.

[1] Contract No. 1425-97-CA-81-20003, dated November 15, 1996. Delivery Order No. 78.
[2] Crab Orchard National Wildlife Refuge was placed on the National Priorities List (NPL) in 1987. Since that time seven operable units have been created.

Recent Alluvium

The yellow areas shown on Figure 2-1 are recent alluvial deposits (Cahokia alluvium) consisting of sand, silt, and clay. As shown in the figure, there are very few of these deposits in the area around Crab Orchard Lake.

Loess Deposits

The red contour lines on Figure 1-2 indicate the approximate thickness of loess, a silty-clay windblown material. These loess deposits do not typically have horizontal stratification, but they do have vertical fractures, which is probably the main pathway for water flow through the loess. Note that the Refuge lies between the 5-foot and the 10-foot contour, and that there are no loess deposits in the areas of the glacial lake deposits (the lakes existed at the same time the windblown loess deposits were laid down). Specific information for Williamson County[8] indicates that loess deposits are present in almost all of the AUS OU area, and for most of the area, the loess deposits range from 5.5 to 12.5 feet in thickness. In Area 6, the loess thickness is shown as less than 5 feet[9]. Unfortunately, on boring logs from the Refuge, the distinction between the loess and the underlying till is often not made. Both soils are primarily low-plastic silty clay, but they may vary significantly in structure and hydraulic properties.

Bedrock

The bedrock at the Refuge is Pennsylvanian-Age, mostly sandstone with some shale. We do not know of any rock outcrops within the AUS OU area. Rock, primarily sandstone, is exposed in many locations in the unglaciated area south of the Refuge. The Pennsylvanian Age rocks are about 600 to 800 feet thick at the Refuge[10].

1.2.3 Groundwater

Groundwater depths are generally shallow, ranging from near the ground surface to about 20 feet below ground surface (bgs), depending on season and location. There are currently no water supply wells on the Refuge. At least three of the other operable units on the Refuge are underlain by aquifers in the glacial till which are classified in accordance with 35 IAC 620[11] as Class I (potable) Groundwater, based on measured hydraulic conductivity. Although the hydraulic conductivity of the aquifer is sufficiently high for it to be Class I, yields are low. Monitoring wells in this upper aquifer can generally be bailed dry and are slow to recover. The aquifer appears to consist of thin, discontinuous sand lenses in the glacial till. The Illinois Geological Survey reported the following for Williamson County in 1956:[12]

> The glacial deposits are thin and are not water-yielding. The thickest valley-fill material is in the Big Muddy Valley, where thin sand and gravel deposits are locally present within thick sections of silt and clay.

[8] Fehrenbacher, J.B., and R.T. Odell, *Williamson County Soils*, Soil Report 79, University of Illinois Agricultural Experiment Station, 1959.
[9] Ibid.
[10] Williams, H.B., et al, *Handbook of Illinois Stratigraphy*, Illinois State Geological Survey, Bulletin 95, 1975.
[11] Illinois Adiminstrative Code, Title 35, Section 620
[12] Wayne A. Pryor, *Groundwater Geology in Southern Illinois, A Preliminary Geologic Report*, Illinois State Geological Survey Circular 212, 1956; pp. 24-25.

electrical components, machined parts, various painted products, electrical components, munitions and boats. Many of the industrial tenants, in addition to IOP, have operated waste disposal activities at the Refuge.

1.4 HISTORY RELATED TO CERCLA

The State of Illinois identified poly-chlorinated biphenyls (PCB) and cadmium contamination during a watershed-wide study at the Refuge[15]. A 1982 FWS study identified PCB and lead contamination in Area 9. On the basis of the Area 9 contamination (Sites 32/33, or the "Sangamo Dump), the Refuge was placed on the National Priority List (NPL) on July 22, 1987. Subsequently, O'Brien and Gere did a Refuge-wide remedial investigation and feasibility study (RI/FS) in 1988 and 1989,[16] respectively. These studies identified three sites with metal contamination and four sites with primarily PCB contamination requiring remediation.

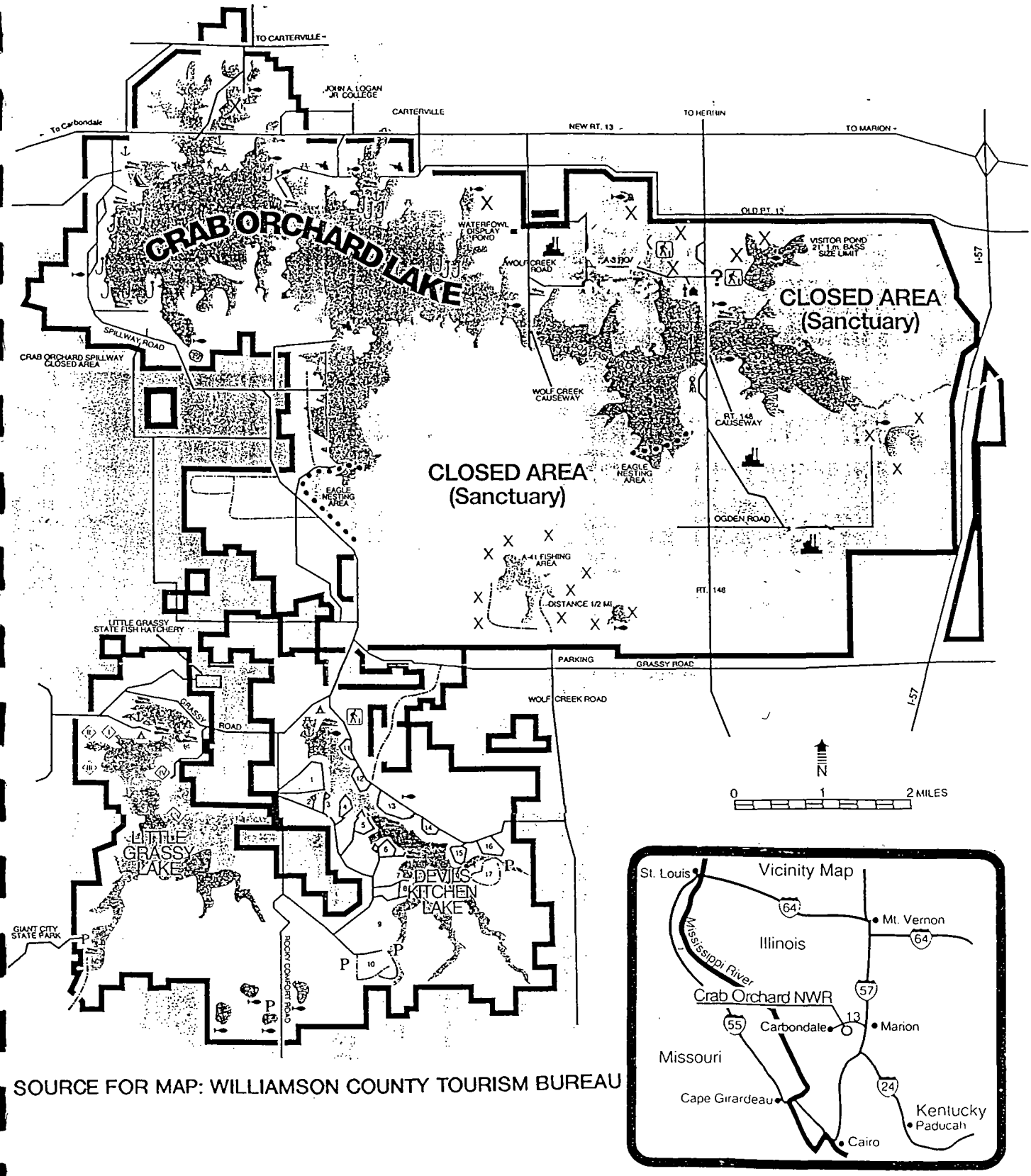
As a result of the 1987-88 RI/FS, the Metals Areas Operable Unit (MAOU) and the PCB OU were formed. Records of Decision (RODs) for both OUs were signed in 1990[17,18].

DOI, the Department of Defense (DOD), the US Environmental Protection Agency (USEPA), and the Illinois Environmental Protection Agency (IEPA) are actively involved in the site remediation process under Section 120 of the Comprehensive Environmental Response Compensation and Liability Act/Superfund Amendments and Reauthorization Act of 1986 (CERCLA/SARA) and the Defense Environmental Restoration Program (DERP). These agencies entered into a Federal Facilities Agreement[19] (FFA) in 1991, which defined roles and responsibilities for the Superfund investigations and remediation.

In addition to the PCB OU and the MAOU, the Miscellaneous Areas Operable Unit (MISCA OU) was formed to investigate sites identified by O'Brien and Gere as requiring additional investigation. The FWS was assigned the role of lead agency by the FFA. The Explosives/Munitions Manufacturing Areas Operable Unit (EMMA OU) was created to include sites for which the DOD has responsibility. The ROD for the EMMA OU was signed in 1997[20]. The MISCA OU is currently in the RI/FS stage. Additionally, the FWS has created three other OUs: Crab Orchard Lake (COL), Water Towers, and the AUS.

[15] Illinois Environmental Protection Agency, 1977. *Biological Investigation of the Crab Orchard Creek Basin, Summer 1975*, by Robert L. Hite and Marvin King.
[16] O'Brien & Gere, 1988. *Remedial Investigation Report, Crab Orchard National Wildlife Refuge*, August, 1988.
[17] U.S. Environmental Protection Agency, 1990b. *Declaration for the Record of Decision, Crab Orchard National Wildlife Refuge, PCB Areas Operable Unit*, August 1, 1990.
[18] USEPA, Region V, *Declaration for the Record of Decision, Crab Orchard National Wildlife Refuge*, Metals Areas Operable Unit, March 30, 1990.
[19] U.S. Environmental Protection Agency, Region V, and the Illinois Environmental Protection Agency, and the United States Department of the Interior, and the United States Department of the Army, 1991. Federal Facilities Agreement Under CERLCA Section 120, in the matter of the U.S. Department of the Interior's Crab Orchard National Wildlife Refuge. September 1991.
[20] Environmental Science and Engineering, Inc., 1997. Record of Decision for Crab Orchard National Wildlife Refuge Explosives/Munitions Operable Unit.

Table 1-1 Summary of Industrial Tenants by Area			
Area	**Major Industrial Tenants**	**Industrial Category**	**Years**
1	Sherwin-Williams Defense Corporation (SWDC)	Offices and Living Quarters	1942-1945
1	Southern Illinois University (SIU), DOE	Research and Development, Coal Research, Training	1946-Present
2	SWDC	Ordnance and Explosives Manufacture	1942-1945
2	Universal Match Corporation (UMC), Olin, Central Technologies, Inc. (CTI)	Ordnance and Explosives Manufacture	1952-Present
3	SWDC	Finished Ammunition Storage	1942-1945
3	Monsanto, Olin, Schilli Transportation	Storage	1946-Present
4	SWDC	Industrial Shops	1942-1945
4	Norge, Supreme Transformer, East Side Lumber, Wilkie, Olin, Elmac	Manufacturing, Storage, Shipping and Receiving, Plating, Equipment Servicing	1947-Present
5	SWDC	Railroad Operations	1942-1945
6	SWDC	High Explosives Storage	1942-1945
6	U.S. Powder, Olin, Austin Powder, Dooley Brothers, and Others	Explosives Storage Facilities	1946-Present
7	SWDC	Inert Storage	1942-1945
7	Norge, Wilkie, Olin, Shell, Dura-Plex, Midwest Woodworking, National Tape, Pennziol, Radionic Products,	Manufacturing and Storage (Washing Machines, Oil, Fiberglass Products, Store Fixtures, Tape Products, Radio Components), metal finishing	1946-Present
8	SWDC	Bomb Loading Line	1942-1945
8	Diagraph, CTI, American Fiberlite	Various Manufacturing (Inks, Pyrotechnics, Fiberglass Products)	1946-Present
9	SWDC	Artillery Loading Line	1942-1945
9	Sangamo, Olin	Various Manufacturing (Electrical Capacitors, Pyrotechnics, Ammunition)	1946-Present
10	SWDC	Ordnance Storage	1942-1945
10	None	Firing Range, Open Burning of Ignitable Wastes	1967-Present
11	SWDC	Artillery and Tank Mine Loading	1942-1945
11	Olin, U.S. Powder	Dynamite Manufacturing, Nitroglycerin Production	1957-1984
12	SWDC	Ammonium Nitrate Manufacturing	1942-1948
13	SWDC	Ordnance and Explosives Storage	19442-1946
13	UMC, Olin, U.S. Powder, Others	Ordnance and Explosives Storage	1946-Present
14	SWDC	Explosives Storage	1942-1945
14	UMC, Jobcorp	Explosives Storage, Landfill	1946-1965

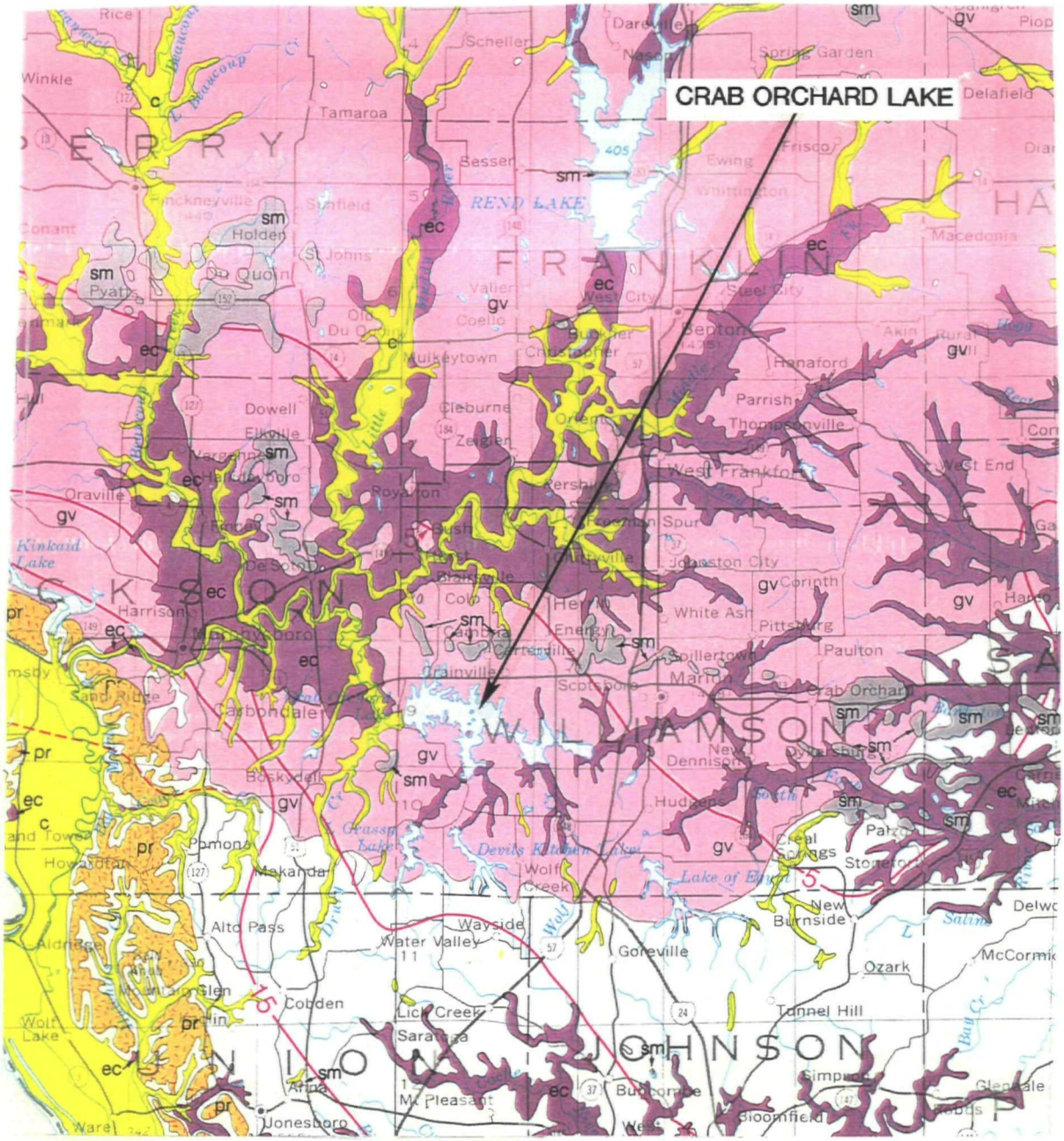


SOURCE FOR MAP: WILLIAMSON COUNTY TOURISM BUREAU

CRAB ORCHARD NATIONAL WILDLIFE REFUGE

Figure 1-1

Site Location Map



Scale 1:500,000

1 inch equals approximately 8 miles

10 0 10 20 30 40 Miles

BASE MAP: QUARTERNARY DEPOSITS OF ILLINOIS, ILLINOIS STATE GEOLOGICAL SURVEY, 1979

N

LEGEND

gv = GLACIAL TILL (GLASFORD FORMATION)

ec = GLACIAL LAKE DEPOSITS (EQUALITY FORMATION)

c = RECENT ALLUVIUM (CAHOKIA FORMATION)

sm = SURFACE MINES

5 LOESS THICKNESS (5FT. CONTOURS)

WHITE AREAS ARE UNGLACIATED

FIELD SAMPLING PLAN–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.00

URS Greiner Woodward Clyde

A Division of URS Corporation

DRN. BY: djd 11/1/99 DSGN. BY: mh CHKD. BY:	Local Quarternary Deposits	FIG. NO. 1–2

File: G:\68FOD9727800\SITE36\FIG1-2(QUARTERING).DWG.DWG Last edited: 11/01/99 @ 4:11 p.m. @ WCC-ST.LOUIS

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Figure 1-3 – Field Sampling Plan

☐ **Other:**

2.1 STEP 1: STATE THE PROBLEM

2.1.1 Problem Statement

The Department of Defense (DOD) and subsequent industrial tenant operations at the Refuge may have released hazardous substances to the environment as part of industrial activity and waste disposal practices. Environmental media of concern that may have been impacted are surficial soils, sediment, surface water and groundwater at the various AUS OU sites. These sites of potential impact have been identified through site visits, interviews with former employees, a search of the records, and interpretation of historical aerial photographs. If the media of concern have been impacted by the release of hazardous substances, contamination may be present which results in unacceptable risks to human and/or ecological receptors.

2.1.2 Members of the Data Quality Objectives (DQO) Development Team

- FWS Project Manager and technical specialists (contaminants specialists and biologists)
- USEPA Project Manager and technical specialists (chemists, biologists and others.IEPA Project Manager and technical specialists (chemists, biologists and others).
- USACE Project Manager.
- Members of the Crab Orchard biological technical assistance group (made of up project managers and technical specialists from USEPA, IEPA, Illinois Department of Natural Resources, and USACE)
- BOR Project Manager and chemist.
- URS Project Manager and technical specialists (geologists, chemists, geological engineers, civil engineers, risk assessment practitioners, and biologists).

2.1.3 Conceptual Site Model For Exposure Pathways And Receptors

The following sections present a baseline conceptual site model for exposure pathways and receptors at the Refuge. Development of site-specific conceptual models will be done in the Preliminary Screening Risk Analysis Work Plan for the AUS OU, which will be submitted as an addendum to this work plan. Information concerning waste sources, waste constituent release and transport mechanisms, and locations of potentially exposed individuals (receptors) is used to develop a conceptual understanding of the site in terms of potential human/ecological exposure pathways.

The site conceptual exposure model is a representation relating the contaminant source areas, chemical release mechanisms, environmental transport media, potential human and ecological intake routes, and potential human/ecological receptors to identify exposure pathways that are complete or incomplete. The model provides a framework for problem definition, identifying exposure pathways that may result in health risks, identifying potential data needs to evaluate those pathways, and identifying potential measures that could be used to reduce exposure and risk. An exposure pathway includes four necessary elements:

- A source of chemicals and mechanism of chemical release

- An environmental transport medium (air, surface water, etc.) and/or a mechanism of contaminant transfer from one medium to another
- An exposure point
- An intake route (e.g., ingestion, dermal contact, inhalation)

Each of these elements must be present for an exposure pathway to be complete. An incomplete pathway means that no exposure can occur. Only potentially complete pathways are addressed in subsequent risk assessments. Exposure pathways are considered to be potentially complete if there are potential chemical release and transport mechanisms and identified receptors for that exposure pathway.

The primary sources of chemical release at the Refuge are hazardous waste materials that have been released from various facilities to the soils and drainage ditches. Soil is the primary environmental medium to which receptors may be exposed. Once mixed with soils, the chemicals may be released to surface water by storm water transport, to groundwater by infiltration and percolation, to the atmosphere by volatilization or wind erosion of dust, and to receptors by direct contact. Contaminants discharged at the surface water drainage may remain in surface water, adsorb to sediments, be taken up by aquatic biota, or be released to the atmosphere via volatilization.

Groundwater

Groundwater has been identified as an incomplete exposure pathway in previous risk assessments at the Refuge.[23,24] There are currently no water wells on the Refuge that are used as a potable water source. Monitoring wells can often be bailed dry and are generally slow to recharge. However, the groundwater beneath the Refuge is typically shallow; therefore, hypothetical construction workers may be exposed to groundwater in excavations via direct contact and inhalation.

Discharge of contaminated groundwater to surface water is a potential concern, since many of the AUS sites are close to Crab Orchard Lake and other water bodies. Therefore, aquatic organisms and higher order predators, and recreational users are potential receptors via exposure to contaminated surface water and sediment (as described below).

Surface Water and Sediment

Surface water can become contaminated from runoff and direct discharge from industrial activity, including dumping and burning. Potential receptors are plankton, aquatic invertebrates, fish, and terrestrial predators that feed on aquatic organisms, including insectivores (e.g., bat and swallow), piscivores (e.g., heron and bald eagle), and herbivores (e.g., Canada goose). Recreational users are also potential human receptors. Potential human pathways include dermal contact and incidental ingestion from both surface water and sediments and inhalation of volatile emissions from surface water for both receptors. In addition, ingestion of potentially contaminated fish is considered a potentially complete pathway for recreational users.

[23] Woodward-Clyde, *Miscellaneous Areas Operable Unit Remedial Investigation*, 1996.
[24] Environmental Science & Engineering, *Final Revised Feasibility Study Report, EMMA OU, September 26, 1995.*

Soils and Air

Soil contamination can result from residual contamination from disposal, runoff, and from burn areas. Exposure to contaminants in surface soils is considered to be relevant at the Refuge because nearly all of the area is unpaved. Therefore, direct contact with soil, surface water runoff, or volatilization and dust production are potentially significant pathways for receptors. Potential receptors include terrestrial species which feed on plants, earthworms and grubs; and burrowing animals. Construction or site workers are also potential receptors, primarily from inhalation, but also from ingestion and dermal contact.

Air containing contaminants volatilized from soil or airborne particulate matter represents a potentially complete inhalation pathway to recreational users, site workers or hypothetical future construction workers involved in excavation of contaminated soils. Direct contact with contaminated soils by hypothetical construction workers represents a potentially complete ingestion and dermal contact pathway.

2.1.4 Available Resources

Sufficient sampling will be conducted to support a decision for each site. Resources are available from within URS.

2.1.5 Summary Of Contaminant Problem

The 31 AUS OU Sites are shown in Figure 2-1. These sites were identified for the site inspection as a result of a historic search investigation that started with a list of 83 sites developed by FWS. The original site list was modified during the historic search investigation (draft Historic Search Report, URS, September 1999). The AUS OU sites included in this FSP are summarized in Table 2-1. Table 2-1 includes a summary of past industrial activity, and the rationale for including the site for this investigation. Details are presented in the draft Historic Search Report; a site-by-site summary is included in this report.

2.2 STEP 2: IDENTIFY THE DECISION

2.2.1 Statement of Decision

Determine whether the concentrations of detected site-related chemicals of concern exceed action level concentrations.

2.2.2 Actions That Could Result From The Decision

- If site-related chemicals of concern exceed the action level criteria, then a Remedial Investigation will be recommended.
- If no site-related chemicals of concern exceed the action level criteria, then a no further action decision will be recommended
- If site-related chemicals of concern are judged to pose an imminent threat to human health or to the environment, then a focused feasibility study/remedial action will be

recommended. Obvious removal actions or other remedies that would eliminate the imminent threat will be recommended.

2.3 STEP 3: IDENTIFY INPUTS TO THE DECISION

2.3.1 Informational Inputs Needed To Resolve The Decision

Soil, sediment, surface water and groundwater will be sampled and analyzed at locations of known or suspected releases of potentially hazardous substances. The contents of drums left on site and other waste materials will be sampled and analyzed.

2.3.2 Basis For Establishing Contaminant-Specific Action Levels

Action levels will be developed and identified in the Preliminary Screening Risk Analysis Work Plan for the AUS OU, which will be submitted as an addendum to this work plan.

For metal concentrations in soil, sediment, and surface water, existing data will also be compared to background levels for the Refuge. Action levels will not be less than background levels. Background metal levels for sediment and surface water are being developed as part of the Crab Orchard Lake OU. Background metal levels for soil will be developed as part of this investigation. See Section 2.7, below.

For surface water, State of Illinois General Use Water Quality Criteria are regulatory standards for the AUS OU. The State of Illinois has developed site-specific General Use Water Quality Criteria for a number of constituents for the PCB OU and the MISCA OU. These are also applicable to the AUS OU.

For groundwater, the contaminant specific action levels will depend on the classification of the groundwater, for example, if field data indicate that the groundwater is classified as potable, drinking water standards will apply. Illinois groundwater quality standards (35 IAC 620) are applicable.

2.3.3 Data Quality Levels

The data quality levels for surface water and sediment will follow detection limit requirements for U.S. Environmental Protection Agency (USEPA) Region IV surface water[25] and aquatic sediment[26] screening values, or USEPA Ecotox Threshold values,[27] or Illinois General Use Water Quality Criteria (surface water only), or Canadian Sediment Quality Guidelines[28] (sediment only), whichever is the smallest value, to the extent practicable. The data quality

[25] "Region IV Waste Management Division Freshwater Surface Water Screening Values for Hazardous Waste Sites" from Table 1 of Draft Ecological Risk Assessment Bulletins, USEPA Region IV, Office of Technical Services Supplemental Guidance to RAGS, October 1996.

[26] "Region IV Waste Management Division Sediment Screening Values for Hazardous Waste Sites" from Table 3 of Draft Ecological Risk Assessment Bulletins, USEPA Region IV, Office of Technical Services Supplemental Guidance to RAGS, October 1996.

[27] "Ecotox Thresholds for 67 Chemicals Commonly Found at Superfund Sites" found in Table 2 of UESPA OSWER Publication *ECO Updates – Ecotox Thresholds* EPA 540/F-95/038, January 1996. Note that lowest freshwater surface water thresholds were used.

[28] "Canadian Sediment Quality Guidelines for the Protection of Aquatic Life—Interim Freshwater Sediment Quality Guidelines," from the Canadian Environmental Quality Guidelines from the Standards and Guidelines Division, Environmental Quality Branch of the Environmental Conservation Service, last updated September 1998.

levels for soils will follow detection limit requirements for USEPA generic soil screening levels,[29] Canadian Soil Quality Guidelines,[30] New Dutchlist Soil Optimum Levels,[31] USEPA Region IX Preliminary Remediation Goals[32], or IEPA's Tiered Approach to Corrective Action (TACO) Tier 1 Soil Remediation Objectives for residential properties[33], whichever is the smallest value, to the extent practical. The data quality levels for groundwater will follow detection limit requirements for USEPA Maximum Contaminant Levels (MCLs)[34], USEPA Secondary Maximum Contaminant Levels (SMCLs), or IEPA Class I Groundwater Standards[35], whichever is less.

Tables 2-2 through 2-10b present analytes, method detection limits (MDLs) and laboratory reporting limits (RLs), along with the lowest applicable screening level.[36]. A number of constituents are included in these tables, the QAPP, and the laboratory SOPs, that are not presently included in the FSP. These constituents are included as a contingency.

For some base-neutral acid compounds (BNAs), the screening values are well below the MDL and the RL. Different laboratory methodologies could achieve lower detections, but these methodologies are approximately three times more expensive than those listed. At this stage, the additional cost was not considered justifiable. Some other target analytes (other than BNAs) have screening values that fall between the MDL and the RL, or just below the MDL. In these cases, the results are limited by available technology and potential sample matrix interference.

Screening levels for explosives will be calculated based on surface water criteria (to be provided by IEPA)[37].

2.3.4 Potential Sampling Techniques And Analytical Methods

Samples will be collected by several different methods. These are identified in the specific sampling plans for each site, in Sections 3 through 13 of this report. Standard operating procedures (SOPs) for each sampling technique are included in Appendix A.

Analytical methods are referenced in the specific sampling plans. Laboratory analytical methods are summarized in Table 2-2. The Quality Assurance Project Plan (QAPP) for the analytical methods proposed is a companion volume to this FSP.

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[29] From Appendix A of USEPA's "Soil Screening Guidance: Technical Background Document," EPA/540/R95/128, May 1996. The lowest SSL value was chosen from the inhalation, ingestion, and migration to groundwater pathways.

[30] "Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health—Residential/Parkland Land Use," from the Canadian Environmental Quality Guidelines from the Standards and Guidelines Division, Environmental Quality Branch of the Environmental Conservation Service, last updated September 1998.

[31] Optimum Soil Levels from the New Dutchlist.

[32] Region IX Preliminary Remediation goals used were updated as of May 1, 1998.

[33] TACO Tier 1 levels are presented in Title 35 of the Illinois Administrative Code (IAC) Part 742.

[34] USEPA MCLs used were updated as of October 1996.

[35] IEPA Class I groundwater standards are presented in 35 IAC 620.410.

[36] Note that all screening values are equal to or less than the National Ambient Water Quality Criteria (NAWQ), where applicable, except for phenol (NAWQ value = 110 ug/l), which is not expected to be present. In any case, the reporting limit is well below 110 ug/l.

[37] The IEPA PM has indicated by email correspondence that sediment values for nitroaromatics are to be calculated as follows: Surface Water Criteria from Bureau of Water multiplied by K (oc) multiplied by TOC. Reference source needed.

2.4 STEP 4: DEFINE THE BOUNDARIES OF THE STUDY

All potential contaminant release areas and the accompanying environmental media that may have been impacted, as defined during the historic records search, air photo interpretation, or from other sources, will be sampled for chemical analysis of constituents that are known or suspected to have been used at a site.

2.4.1 Lateral Domain for Sampling

The lateral domain for sampling will be the site boundaries as defined specifically for each site in Sections 3 through 13 of this FSP.

2.4.2 Vertical Domain for Soil/Sediment Sampling

The vertical domain for soil sampling will be the depth of soil over bedrock. However, the majority of the soil samples will be shallow, as discussed below. The vertical domain for sediment will be the full depth of the sediment[38]. In any given boring, sample locations are targeted at those zones judged to be most likely to have the highest contamination. No attempt will be made to delineate the vertical extent of contamination.

The majority of the soil/sediment samples will be collected from the 0- to 6-inch depth for the following reasons:

- In most locations, except as noted below, contamination is expected due to spillage or dumping of materials on the ground and in ditches. In these cases, the surficial soils and sediments are expected to have generally higher levels of contamination than deeper soils, unless fill has been placed in the area.
- Surficial soils are also in general more available to potential receptors than deeper soils. As discussed above, direct contact with soil, sediment, surface water runoff, or volatilization and dust production are potentially significant pathways for receptors. Ingestion, inhalation, and dermal contact are potentially significant exposure routes. These pathways and exposure routes are, in general, most likely to occur with surface soils.

Deeper samples will also be obtained, as follows:

- Where volatile organic analysis is planned, this sample will come from either the 6- to 12-inch or the 1- to 2-foot interval, depending on the site; deeper samples are also planned at a number of locations. Past experience indicates that the soil in the upper six inches is likely to have lower concentrations of volatiles (due to volatilization from near-surface soils), particularly if the spill occurred some years ago, which is the case for the AUS OU sites.

[38] In most cases, the depth of sediment is expected to be much less than two feet. However, if a location is identified as a sediment sampling location by the designator SD in the sample number, the designator will not change, even though a deeper sample may be soil beneath the sediment rather than sediment. Sediment depths will be documented in the field so that for samples with the "SD" designator, those that are soil and not sediment can be identified and evaluated as soil rather than sediment.

- In borings for monitoring wells, deeper soil samples will be obtained and analyzed; for example, samples will be collected at or below the water table to evaluate soil contamination that may be associated with groundwater contamination.
- At locations such as burn pits or suspected dumps or burial areas, where contamination levels are not expected to be depth-dependent within the material present, samples will be obtained through the extent of the material in the pit (or dump/burial ground), if practical. Samples will be obtained in many of these areas from test pits.
- In areas of known fill, samples depths are increased to obtain samples from beneath the fill.

2.4.3 Sediment and Surface Water Sampling

Sediment and surface water in site-related drainage ditches and ponded areas will be sampled. Not every site-related drainage ditch will be sampled. In cases where there are a large number of ditches, those judged most likely to be contaminated, based on the historic record search, will be sampled, and those judged less likely to be contaminated may not be sampled. The intent is not to determine the extent of contamination, but to determine if it is present. For example, if there are two ditches associated with the same activity, and based on the available information, one is judged to be much more likely to have been adversely impacted, the other ditch may not be sampled, even though it may also have been impacted.

2.4.4 Groundwater Sampling

Groundwater samples will be taken from any existing monitoring wells located in Areas 11 and 12, as indicated in this plan. The sampling plan for Area 9 West is not included in this draft because the extent of previous remediation has not been defined. It will be submitted as an addendum to this FSP. It will include sampling of some of the existing wells in Area 9, for constituents not currently being analyzed for at that location. Groundwater samples will also be collected from monitoring wells that are to be installed as a part of this investigation. Groundwater samples will also be collected from test pits using a surface water sampler, if it is encountered during trenching activities.

2.4.5 Temporal Domain for Sampling

All proposed samples are planned to be taken only during the time scheduled for the field investigation ***(March to June, 2000).*** Multiple groundwater and surface water sampling events at the same locations are not planned as part of this investigation. However, additional groundwater samples may be obtained in the future.

2.5 STEP 5: DEVELOP A DECISION RULE

Decision rules based on human health and ecological impacts will be developed in the Preliminary Screening Risk Analysis Work Plan for the AUS OU, which will be an addendum to this document. As part of the review of the Preliminary Screening Risk Assessment Work Plan, the BTAG and FFA members will evaluate the criteria for making a decision to do, or not to do a remedial investigation.

State of Illinois General Use Water Quality Criteria and groundwater quality standards (35 IAC 620) are potential Applicable or Relevant and Appropriate Requirements (ARARs) for this OU and need to be incorporated into both human health and ecological decision rules. Federal drinking water standards may also be ARARs.

2.6 STEP 6: SPECIFY LIMITS ON DECISION ERRORS

2.6.1 Types of Errors

A false positive error results when it is determined that contaminants identified present a threat to human health and the environment when in fact they do not. A false negative error results when it is determined that contaminants identified do not present a threat to human health and the environment when in fact they do; or, as is probably more often the case, when contaminants are present which do pose a threat and they are not discovered. The consequence of a false positive error is unnecessary expenditure of money on an RI and allocation of FWS resources away from protecting other valuable resources. The consequence of a false negative error is environmental damage and negative human health impacts.

Decision errors will be addressed in more detail in the Preliminary Screening Risk Analysis Work Plan.

2.7 STEP 7: OPTIMIZE THE DESIGN

The key to optimizing the design is having appropriate coverage based on understanding the site history, as much as possible (not all site history is available).

Proposed sample locations, depths, analytes, and the rationale for the sample are presented for each site in Sections 3 through 13.

2.8 BACKGROUND LEVELS FOR METALS

2.8.1 Surface Water and Sediment

Background metals data for surface water and sediment samples from the on-going Crab Orchard Lake OU investigation will be used for background values for surface water and soils for the AUS OU.

2.8.2 Soils

Background metals data for surficial soils will be collected as part of this investigation. These data will be used only for comparison with other surficial soil samples (samples obtained within the upper one foot below ground surface). Metals contamination is most likely to be close to the surface.

Four criteria were established for the background soil locations for the AUS OU. They are as follows:

1. The locations must have no known or suspected sources of contamination.
2. The locations should have similar geology and soil chemistry.
3. The locations should be grass-covered rather than forested. Most AUS OU locations are primarily grass-covered. Soil chemistry is more likely to be similar at other grass-covered areas
4. The locations should be on the Refuge. Refuge personnel have more information about past usage, and have more control over usage, compared with sites around the Refuge. Also, sampling on the Refuge avoids the necessity of making arrangements with other property owners. (Property owners are often unwilling to allow sampling because of the liability it represents).

To meet criterion No. 1, the industrial part of the Refuge was eliminated. As shown in Figure 2-1, the industrial areas of the Refuge generally coincide with the AUS OU sites. Also, locations which drain the developed areas to the north and east of the Refuge (including all of Route 13 and the communities nearby) were eliminated due to the potential for contamination. Former strip mines and areas which drain the strip mines were also eliminated. Strip mines are shown with purple or brown shading in Figure 2-1.

Criterion No. 2: Figure 2-2 shows soil types on the Refuge. Soil types differ by geologic origin and soil chemistry. As shown in the figure, the predominant soil types for the AUS OU sites are 165A (Wier silt loam with 0 to 1.5% slopes) and 164B (Stoy silt loam with 1.5 to 4% slopes). Both these soil types are developed on 5.5 to 12.5 feet of loess[39]. (Virtually all the soil types shown in Figure 2-2 that are within the AUS OU are developed on loess, except for 108 and 382, which are developed on sediment deposits). Comparisons to background will be made only with samples also taken in surficial loess soils.

Criterion No. 3: for the northern part of the Refuge, grass covered areas are shown in white in Figure 2-1, and forested areas are shown in green. Most candidate areas that meet Criterion No. 2 are grass-covered.

Criterion No. 4: the Refuge boundary is shown in Figure 1-1. Most candidate areas that meet Criterion No. 2 are not on the Refuge. Only a few areas on the Refuge meet all three above criteria.

Five areas that meet the criteria listed above are shown on Figure 2-2. A total of 30 soil samples taken from the depth interval 0- to 6-inches, will be distributed through these areas and analyzed for metals and total organic carbon (TOC) as presented in Table 2-11. Specific sample locations will be based on field conditions, visual observation, and accessibility. Samples will not be obtained from any area with visible signs of debris or potential contamination sources.

2.8.3 Groundwater

Based on previous investigation at Crab Orchard, the most likely location for groundwater contamination is in the glacial till. A significant amount of groundwater data has been obtained from the onsite Metals/PCB landfills south of Area 7. As long as the leachate in both landfills

[39] Fehrenbacher, J.B., and R.T. Odell, *Williamson County Soils*, Soil Report 79, University of Illinois Agricultural Experiment Station, 1959.

does not show signs of contamination, and the upgradient wells do not differ significantly from downgradient wells, all the monitoring wells at the landfills will be presumed to be clean and representative of background conditions. Data from these wells will be used for background comparison. The investigation for the landfill location established that no previous industrial activity had occurred in this area.

The results from these landfill wells may not be representative of the glacial deposits on the entire Refuge, but the data are judged to be the best available. In any case, only a few constituents are known or suspected to be present at background levels that are above MCLs or Illinois Class I standards (standards which may be applicable at AUS OU sites). For these constituents, the landfill data will at least provide an indication that elevated levels may not be related to contamination.

2.9 BEDROCK MONITORING WELLS

A total of eleven bedrock monitoring wells will be located throughout the Refuge. These wells will be placed in areas of similar geologic conditions as those found in the various AUS sites as seen in Figure 2-2. Three of these wells will be located in the area surrounding Area 2, three will be located in the area surrounding Areas 11 and 12, and the remaining five wells will be scattered across the Refuge near the Refuge boundaries. Table 2-12 shows the sample analyses for each location. Only TOC samples will be collected from the soils in these locations as found in Table 2-12, unless an area of obvious contamination is encountered during drilling. If obvious contamination above bedrock is encountered during drilling, bedrock will not be penetrated, and the boring will be moved.

Groundwater measurements in these wells will provide information on the Refuge-wide as well as the local gradient. Slug tests will be conducted in all wells to measure hydraulic conductivity.

If an area of obvious contamination is encountered, other analyses may be analyzed for as appropriate.

Table 2-1
AUS Sites Recommended for Site Inspection

Site	Approximate Size, Acres	Description	Comments
AUS-0001	< 1	Fire and Police Headquarters	Potential for two on-site petroleum underground storage tanks (USTs) based on site visit and site usage. On-site industrial demolition debris. EPA (1998) sample results exceeded site screening levels (SSLs) for semi-volatile compounds (SVOCs), and exceeded Refuge background and screening levels for some metals.
AUS-0002	<1	Former WWTP	Based on IOP sewer diagrams, WWTP appears to have served part of the industrial area (part of Area 2) in addition to the Administrative Area. Because of this, there is a likelihood of metals, explosives compounds, and other industrial contaminants in the lagoons.
AUS-0A2B (Area 2B)	100	Booster load line	Area of industrial activity since 1942. Used for booster loading (IOP); various uses by subsequent ordnance manufacturers, including propellant manufacturing and explosive waste incineration. Concentrations of several SVOCs were detected above EPA SSLs, and metal concentrations were detected above both EPA SSLs and Refuge background levels (EPA, 1998).
AUS-0A2D (Area 2D)	100	Detonator load line	Area of industrial activity since 1942. Used for detonator loading (IOP) and for R&D, pyrotechnic manufacturing, propellant mixing, machining, and milling by later industrial tenants. Reports of improper disposal of solvents and burning of explosive waste by previous employees. Several SVOC compounds detected above EPA SSLs. Mercury and zinc concentrations were detected above both EPA SSLs and Refuge background levels (EPA, 1998).
AUS-0A2F (Area 2F)	100	Fuse load line	Area of industrial activity since 1942. Used for fuze loading (IOP) and various uses by subsequent ordnance manufacturers, including milling, machining, and R&D. Improper disposal of TCE and cutting oil reported by former employees. Metal concentrations were detected above both EPA SSLs and Refuge background levels (EPA, 1998).
AUS-0A2P (Area 2P)	100	Primer loading line	Industrial area used for artillery primer production for IOP; and for gas generator development and production, propellant development and production, agricultural chemical storage, metal working/machining by later industrial tenants.

Table 2-1
AUS Sites Recommended for Site Inspection

Site	Approximate Size, Acres	Description	Comments
AUS-0A4E & AUS-0A4W (Area 4)	60	Shop Area	Area of industrial activity from 1942 to 1980s. Area includes former gas station, dry cleaners, electric and communication building (with reported use of carbon tetrachloride), wash and degreasing building, IOP laboratory, and other industrial activities. Also includes former plating operation. Ditches and sewers around plating operation were remediated with MAOU remediation; however, results from EPA sampling (1998) indicate that surficial soils in the area of the former plating operation still have some residual cadmium contamination above previous cleanup levels (this area was remediated as an add-on to the Old Refuge Shop, MAOU Site 22). Cadmium was detected at concentrations of 29 mg/kg and 21 mg/kg in the vicinity of the former plating operation. (The MAOU cleanup level for cadmium was 10 mg/kg). Other know areas of cadmium contamination in excess of current screening level of 1.4 mg/kg.
AUS-0018	30	RR classification yard	Concentrations of cadmium, mercury, lead, and zinc exceeded EPA SSLs and Refuge background.
AUS-00A6 (Area 6)	550	Explosive Storage	Storage of explosives by IOP and later industrial tenants. USEPA 1998 analytical results above site screening levels at RR loading docks .
AUS-00A7 (Area 7)	100	IOP Inert Storage	Area consists of 30 large buildings which had been leased to at least 30 different industrial tenants. Activities included plating, painting, metal forming, oil transfer, and warehousing.
AUS-0021	<1	Fire station Area 7	Ordnance/explosive waste identified on site.
AUS-0A8S (Area 8 South)	150	IOP Load Line III, south	Location of IOP TNT melt Load Line III. Subsequently used by industrial tenants for explosive/ordnance manufacturing and manufacturing of fiberglass boats.
AUS-0A9W (Area 9 West)	100	IOP Load Line I	Location of IOP TNT melt Load Line I. Subsequently used by industrial tenants for transformer/capacitor manufacturing and explosive/ordnance manufacturing. Significant remediation and investigation have been done, but not all areas of potential contamination have been investigated. (Note: Area remediated for PCBs is not included in total).
AUS-0A10 (Area 10)	40	IOP Fuze & Booster storage	Location of fuse and booster storage (IOP). Site later used for firing range and burn pits. Exceedances of screening criteria.
AUS-0043	<1	Fire Station east of Area 10	Possible burning area noted. Two sumps noted in former building area. Some metals exceeded Refuge background and screening criteria.

Table 2-1
AUS Sites Recommended for Site Inspection

Site	Approximate Size, Acres	Description	Comments
AUS-A11A (Area 11--Acid/AN)	40	Former IOP Load Line II; later area of industrial acid and ammonium nitrate (AN) manufacturing	Part of IOP ammunition load line (Group II Load Line). From 1950s to 1980s, area was used for manufacture and storage of nitric acid, sulfuric acid, and ammonium nitrate for explosives. Includes disposal pond.
AUS-A11H (Area 11--High Explosives)	60	High explosives manufacturing.	Area used from 1950s to 1980s for manufacture of high explosives, including dynamite, ANOIL, and products containing PETN, TNT, and RDX. Includes waste disposal areas.
AUS-A11N (Area 11--NG)	30	Nitroglycerin manufacturing.	Area used from 1950s to 1980s for manufacture of nitroglycerin. Includes holding ponds for wash water.
AUS-A11P (Area 11--Cap/Propellant)	20	Former IOP Load Line II; later area of propellant research and blasting cap manufacturing.	Part of IOP ammunition load line (Group II Load Line). IOP area used for cleaning and painting shells. From 1950s to 1980s, area was used for propellant research (Olin) and cap manufacturing (Trojan).
AUS-A11S (Area 11--Support)	30	Former IOP Load Line II; later industrial support area	Part of IOP ammunition load line (Group II Load Line). From 1950s to 1980s, support area for explosives manufacturing plant. Included machine shop, scrap yard, boiler, tanks, storage areas.
AUS-0A12 (Area 12)	80	AN/RDX manufacturing. Burn pits for ignitable wastes.	Area used during IOP for AN manufacturing. RDX manufacturing from 1960s to 1980s. Includes ponds used for explosive storage. Burn pit used for explosive waste disposal from 1950s to 1980s. Includes dump sites.
AUS-0A13 (Area 13)	500	Explosives Storage Area	Area used during IOP and later by industrial tenants for explosives storage
AUS-0060	30	Area 14 fulminate storage	Original use as storage for mercury fulminate (IOP). Later used for lead azide storage. Former employee believed spill of lead azide had occurred during unpacking of materials. Lead concentration well in excess of background and site screening levels (USEPA 1998). Abandoned drums on site.
AUS-0061	<1	Explosive testing structures N of Area 14	Concrete structures used for testing explosives. Large number of exceedances of screening criteria for SVOCs and metals (USEPA 1998).
AUS-0062	unknown	Mounds & Pits 100 yds W of COC1	Detections of metals above soil screening levels (USEPA 1998).

Table 2-1
AUS Sites Recommended for Site Inspection

Site	Approximate Size, Acres	Description	Comments
AUS-0063	<1	Fenced Areas W of Site 62 (COC12)	Ordnance scrap noted. Detections above soil screening levels (USEPA 1998).
AUS-0065	unknown	Foundations NE of COC-1	Several samples had exceedances of screening levels for SVOCs and metals (USEPA 1998).
AUS-0066	unknown	Berm w/red brick Rubble COC-14	Brick appears to be from change houses; danger sign posted nearby; creek water has reddish tinge suggesting TNT contamination.
AUS-0067	<1	Fence w/"cont. area" NW COC-6	"Danger: Contaminated Area" sign and rubble warrant investigation.
AUS-0069	unknown	Dump near south shore COL	55-gallon drums and brick with appearance of change house brick suggests industrial dumping.
AUS-106A	1	Drum Disposal	Disposal area with about 50 to 100 rusted drums of unknown material

TABLE 2-2

LABORATORY ANALYTICAL METHODS

Parameter	Analyte List	Preparation Method		Method Reference
		Water	Soil/Sediment	
Metals	TAL + Boron	3010A/3020A	3050B	USEPA SW-846 6010C, 7000
Volatile Organic Compounds	TCL + Hexane	5030B	5030A/5035	USEPA SW-846 8260B
Semivolatile Organic Compounds	TCL + MOCA	3520C	3540C	USEPA SW-846 8270C
Organochlorine Pesticides	SW-846 24 Compounds	3520C	3540C	USEPA SW-846 8081A
Polychlorinated Biphenyls	SW-846 7 Aroclors (total)	3520C	3540C	USEPA SW-846 8082
Polychlorinated Biphenyls - Congeners	SW-846 26 Compounds	NA	3540C	USEPA SW-846 8082
Polynuclear Aromatic Hydrocarbons (PAHs)	SW-846 17 Compounds	3520C	3540C	USEPA SW-846 8310
Explosives	SW-846 14 Compounds + PETN + Nitroglycerin	Method	Method	USEPA SW-846 8330
Dioxins/Furans	SW-846 17 Compounds	Method	Method	USEPA SW-846 8290
Cyanide	Free Cyanide (Weak Acid Dissociable)	Method	NA	SM 4500-CN I
Cyanide	Total Cyanide	NA	Method	USEPA SW-846 9012A
Ammonia	Ammonia as N	Method	Method	MCAWW 350.1
Nitrate-Nitrite	Nitrate-Nitrite as N	Method	SSE	MCAWW 353.2
Phosphorous, orthophosphate	Phosphorous, orthophosphate	Method	SSE	MCAWW 365.3
Sulfate	Sulfate	Method	Method	MCAWW 300.0
Alkalinity	Carbonate and Bicarbonate	Method	NA	MCAWW 310.1
Total Organic Carbon (TOC)	TOC	NA	Method	MCAWW 415.1
Total Organic Carbon	TOC	NA	Method	USEPA SW-846 9060
Total Dissolved Solids (TDS)	TDS	Method	NA	MCAWW 160.1
Perchlorate	Perchlorate	Method	Method	STL-M-ClO4
Total Suspended Solids (TSS)	TSS	Method	NA	MCAWW 160.2
Picric Acid	Picric Acid	Method	Method	STL-SOP-PICRIC-REV.0

Note: All metals will be analyzed by Method 6010C, except mercury (7470A/7471A) and thallium (7841).
TAL - Target analyte list identified in the Inorganic CLP Statement of Work
TCL - Target compound list identified in the Organic CLP Statement of Work
MOCA - 4,4'-Methylenebis (2-chloroaniline)
N - Nitrogen
PETN - Pentaerythritol tetranitrate
USEPA SW-846 - USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Properties, Final Update III
MCAWW - Methods for Chemical Analysis of Water and Waste, March 1983
SSE - Soluble Salt Extraction
STL - Severn Trent Laboratory

TABLE 2-3a

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR AQUEOUS SAMPLES ANALYZED FOR METALS

Metals (µg/L)	MDL	RL	Screening Levels for Surface Water	Screening Levels for Groundwater
Aluminum	57.6	200	87 (e)	50 (g)
Antimony	3.0	6.0	160 (e)	6 (g)
Arsenic	1.7	10.0	90 (e)	5 (h)
Barium	12.3	200	3.9 (d)	2000 (g)
Beryllium	0.083	5.0	0.53 (e)	4 (g)
Boron	16.600	100.0	--	2000
Cadmium	0.24	5.0	0.66 (e)	0.033 (h)
Calcium	55.6	1000	--	--
Chromium	0.74	10.0	117 (e)	1 (i)
Cobalt	7.5	50.0	3 (d)	20 (i)
Copper	1.9	10.0	6.54 (e)	2 (h)
Iron	42.8	100	1000 (d,e)	300 (g,h)
Lead	1.1	3.0	1.32 (e)	2 (h)
Magnesium	95.6	1000	--	--
Manganese	6.6	20.0	80 (d)	50 (g)
Mercury	0.039	0.20	0.012 (e)	0.05 (i)
Nickel	2.4	10.0	87.71 (e)	15 (i)
Potassium	174	1000	--	--
Selenium	1.8	5.0	5 (d,e)	1 (h)
Silver	3.2	10.0	0.012 (e)	0.1 (h)
Sodium	278	1000	--	--
Thallium	2.4	10.0	4.0 (e)	0.8 (h)
Vanadium	5.6	50.0	19 (d)	--
Zinc	2.3	20.0	58.9 (e)	30 (h)

MDL - Method Detection Limit
RL - Reporting Limit
µg/L - micrograms per liter
(d) USEPA EcoTox Thresholds
(e) USEPA Region IV Screening Values
(g) USEPA Drinking Water MCLs
(h) Canadian Water Quality Guidelines
(i) New Dutchlist Groundwater Optimum Levels
-- No screening levels identified.
Shaded samples have screening levels that are less than reporting limits.

TABLE 2-3b

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR METALS

Metals (mg/kg)	MDL	RL	Screening Levels for Soil	Screening Levels for Sediment
Aluminum	3.7	20.0	--	--
Antimony	0.22	0.6	0.3 (a)	2 (e)
Arsenic	0.093	1.0	0.4 (a)	7.24 (e)
Barium	1.1	20.0	82 (a)	--
Beryllium	0.065	0.5	0.1 (a)	--
Cadmium	0.022	0.5	0.4 (a)	0.6 (f)
Calcium	6.9	100	--	--
Chromium	0.30	1.0	64 (b)	37.3 (f)
Cobalt	0.71	5.0	20 (c)	--
Copper	0.31	1.0	36	18.7 (a)
Iron	3.1	10.0	--	--
Lead	1.2	20.0	85 (c)	30.2 (e)
Magnesium	8.6	100	--	--
Manganese	0.78	2.0	--	--
Mercury	0.027	0.10	0.1 (a)	0.13 (e)
Nickel	1.1	4.0	7 (a)	15.9 (e)
Potassium	21.9	100	--	--
Selenium	0.13	0.50	0.3 (a)	--
Silver	0.28	1.0	2 (a)	0.733 (e)
Sodium	16.0	100	--	--
Thallium	0.15	1.0	0.04 (a)	--
Vanadium	0.70	5.0	13 (b)	--
Zinc	0.79	2.0	140 (c)	123 (f)

MDL - Method Detection Limit
RL - Reporting Limit
mg/kg - milligrams per kilogram
(a) USEPA General Soil Screening Levels
(b) Canadian Soil Quantity Guidelines
(c) New Dutchlist Soil Optimum Levels
(e) Region IV Screening Values
(f) Canadian Sediment Quality Guidelines
-- No screening levels identified.
Shaded samples have screening levels that are less than reporting limits.

TABLE 2-4a

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR AQUEOUS SAMPLES ANALYZED FOR VOCs

TCL Volatile Organic Compounds (µg/L)	MDL	RL	Screening Level for Surface Water	Screening Level for Groundwater
Acetone	1	5	--	--
Benzene	0.3	1	46 (d)	0.2 (i)
Bromodichloromethane	0.3	1	--	80 (g)
Bromoform	0.3	1	293 (e)	80 (g)
Bromomethane	0.4	1	110 (e)	--
2-Butanone	0.9	5	--	--
Carbon disulfide	0.3	1	--	--
Carbon tetrachloride	0.4	1	352 (e)	5 (g)
Chlorobenzene	0.3	1	130 (d)	--
Chloroethane	0.3	1	--	--
Chloroform	0.3	1	289 (e)	1.8 (h)
Chloromethane	0.4	1	5500 (e)	--
Dibromochloromethane	0.3	1	--	80 (g)
1,1-Dichloroethane	0.3	1	47 (d)	--
1,2-Dichloroethane	0.3	1	2000(d)	0.01(i)
1,1-Dichloroethene	0.4	1	303 (e)	7 (g)
1,2-Dichloroethene (cis)	0.3	1	--	--
1,2-Dichloroethene (trans)	0.3	1	--	--
1,2-Dichloropropane	0.3	1	525 (e)	5 (g)
Ethylbenzene	0.3	1	290 (d)	0.2 (i)
Hexane	TBD	TBD	--	--
2-Hexanone	0.8	5	--	--
4-Methyl-2-pentanone	0.8	5	--	--
Methylene Chloride	0.5	1	1930 (e)	0.01(i)
Styrene	0.3	1	--	0.5 (i)
1,1,2,2-Tetrachloroethane	0.4	1	240 (e)	0.01 (i)
Tetrachloroethene	0.5	1	84 (e)	5 (g)
Toluene	0.3	1	130 (d)	0.2 (i)
cis-1,3-Dichloropropene	0.3	1	24.4 (e)	--
trans-1,3-Dichloropropene	0.3	1	24.4 (e)	--
1,1,1-Trichloroethane	0.3	1	62 (d)	200 (g)
1,1,2-Trichloroethane	0.4	1	940(e)	0.01(i)
Trichloroethene	0.3	1	350 (d)	0.7 (i)
Vinyl chloride	0.4	1	--	0.2 (i)
Xylenes(total)	0.5	1	1.8 (k)(m-xylene only)	10000 (g)

VOCs = Volatile Organic Compounds
MDL - Method Detection Limit
RL - Reporting Limit
µg/L - micrograms per liter
TCL - Target Compound List
(d) USEPA EcoTox Thresholds
(e) USEPA Region IV Screening Values
(g) USEPA Drinking Water MCLs
(h) Canadian Water Quality Guidelines
(i) New Dutchlist Groundwater Optimum Levels
-- No screening levels identified.
TBD - To Be Determined
Shaded samples have screening levels that are less than reporting limits.

TABLE 2-4b

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR VOCs

TCL Volatile Organic Compounds (µg/kg)	5030A MDL	5035 MDL	RL	Screening Level for Soil	Screening Level for Sediment
Acetone	2	3	10	800 (a)	--
Benzene	0.6	0.8	5	2 (a)	57 (d)
Bromodichloromethane	0.7	1	5	30 (a)	--
Bromoform	0.9	2	5	40 (a)	--
Bromomethane	0.6	0.7	5	10 (a)	--
2-Butanone	2	2	10	--	--
Carbon disulfide	0.4	1	5	2000 (a)	--
Carbon tetrachloride	0.5	0.6	5	3 (a)	--
Chlorobenzene	0.9	1	5	70 (a)	820 (d)
Chloroethane	1	0.8	5	--	--
Chloroform	0.6	0.9	5	30 (a)	--
Chloromethane	0.6	0.5	5	--	--
cis-1,3-Dichloropropene	0.6	1	5	0.2 (a) total	--
Dibromochloromethane	1	2	5	20 (a)	--
1,1-Dichloroethane	0.4	0.8	5	1000 (a)	--
1,2-Dichloroethane	0.6	0.9	5	1 (a)	--
1,1-Dichloroethene	0.5	0.9	5	3 (a)	--
1,2-Dichloroethene(total)	0.6	0.8	5	5000 (b)	--
cis-1,2-Dichloroethene	0.6	0.8	5	20 (a)	--
trans-1,2-Dichloroethene	0.6	0.7	5	30 (a)	--
1,2-Dichloropropane	0.6	1	5	1 (a)	--
Ethylbenzene	0.5	0.7	5	50 (c)	3600(d)
Hexane	TBD	TBD	TBD	--	--
2-Hexanone	2	3	10	--	--
4-Methyl-2-pentanone	1	3	10	--	--
Methylene Chloride	0.9	2	5	1 (a)	--
Styrene	1	0.6	5	100 (c)	--
1,1,2,2-Tetrachloroethane	0.6	0.8	5	0.2 (a)	940 (d)
Tetrachloroethene	0.6	0.9	5	3 (a)	530 (d)
Toluene	0.7	1	5	50 (c)	670 (d)
trans-1,3-Dichloropropene	0.9	1	5	0.2 (a) total	--
1,1,1-Trichloroethane	0.5	0.7	5	100 (a)	170 (d)
1,1,2-Trichloroethane	0.6	2	5	0.9 (a)	--
Trichloroethene	0.7	0.6	5	1 (c)	1600 (d)
Vinyl chloride	0.5	0.8	5	0.7 (a)	--
Xylenes(total)	1	1	5	50 (c)	25 (d) (m-xylene only)

VOCs - Volatile Organic Compounds
MDL - Method Detection Limit
RL - Reporting Limit
TCL - Target Compound List
µg/kg - microgram per kilogram
(a) USEPA Generic Soil Screening Levels
(b) Canadian Soil Quality Guidelines
(c) New Dutchlist Soil Optimum Levels
(d) USEPA EcoTox Thresholds
-- No screening levels identified.
TBD - To Be Determined
Shaded samples have screening levels that are less than reporting limits.

TABLE 2-5a
METHOD DETECTION LIMITS AND REPORTING LIMITS
FOR AQUEOUS SAMPLES ANALYZED FOR BNAs

TCL Semivolatiles + MOCA (µg/L) by 8270C	MDL	RL	Screening Levels for Surface Water	Screening Levels for Groundwater Samples
Acenaphthene	2	10	17.0 (e)	5.8 (h)
Acenaphthylene	2	10	--	--
Anthracene	2	10	--	0.012 (h)
Benzo[a]anthracene	2	10	--	0.018 (h)
Benzo[b]fluoranthene	3	10	--	0.003 (i)
Benzo[k]fluoranthene	3	10	--	0.001 (i)
Benzo[a]pyrene	2	10	0.014 (d)	0.001 (i)
Benzo[ghi]perylene	2	10	--	0.0002 (i)
bis(2-chloroethyl) ether	2	10	2380 (e)	--
bis(2-chloroethoxy) methane	2	10	--	--
bis(2-ethylhexyl) phthalate	2	10	0.3 (e)	16 (h)
4-Bromophenyl phenyl ether	3	10	1.5 (d)	--
Butylbenzylphthalate	2	10	19.0 (d)	--
Carbazole	3	10	--	--
4-Chloroaniline	8	20	--	--
4-Chloro-3-methylphenol	1	10	0.3 (d)	--
2-Chloronaphthalene	2	10	--	6 (i)
2-Chlorophenol	1	10	43.8 (e)	--
4-Chlorophenyl phenyl ether	2	10	--	--
Chrysene	2	10	--	0.002 (i)
Dibenzo[a,h]anthracene	3	10	--	--
Dibenzofuran	2	10	20.0 (d)	--
Di-n-butyl phthalate	4	10	9.4 (e)	19 (h)
1,2-Dichlorobenzene	2	10	14.0 (d)	0.7 (h)
1,3-Dichlorobenzene	2	10	50.2 (e)	150 (h)
1,4-Dichlorobenzene	2	10	11.2 (e)	26 (h)
3,3'-Dichlorobenzidine	7	20	--	--
2,4-Dichlorophenol	2	10	36.5 (e)	0.08 (i)
Diethyl phthalate	3	10	220 (d)	--
4,6-Dinitro-2-methylphenol	5	50	2.3 (e)	--
2,4-Dimethylphenol	4	10	21.2 (e)	--
Dimethyl phthalate	3	10	330 (e)	--
2,4-Dinitrophenol	23	50	6.2 (e)	--
2,4-Dinitrotoluene	2	10	310 (e)	--
2,6-Dinitrotoluene	2	10	--	--
Di-n-octyl phthalate	3	10	--	--
Fluoranthene	3	10	8.1 (d)	8.1 (d)
Fluorene	2	10	3.9 (d)	0.005 (i)
Hexachlorobenzene	3	10	--	0.01 (i)
Hexachlorobutadiene	2	10	0.93 (e)	1.3 (h)
Hexachloroethane	2	10	9.8 (e)	--
Hexachlorocyclopentadiene	4	10	0.07 (e)	50 (g)
Indeno[1,2,3-cd]pyrene	2	10	--	0.0004 (i)
Isophorone	2	10	1170 (e)	--
2-Methylnaphthalene	1	10	--	--
2-Methylphenol	2	10	--	--
4-Methylphenol	2	10	--	--
Naphthalene	2	10	24 (d)	0.1 (i)

TABLE 2-5a
METHOD DETECTION LIMITS AND REPORTING LIMITS
FOR AQUEOUS SAMPLES ANALYZED FOR BNAs

TCL Semivolatiles + MOCA (µg/L) by 8270C	MDL	RL	Screening Levels for Surface Water	Screening Levels for Groundwater Samples
2-Nitroaniline	3	50	--	--
3-Nitroaniline	2	50	--	--
4-Nitroaniline	1	50	--	--
Nitrobenzene	3	10	270 (e)	--
2-Nitrophenol	3	10	3500 (e)	--
4-Nitrophenol	4	50	82.8 (e)	--
N-Nitrosodiphenylamine	4	10	58.5 (e)	--
N-Nitroso-di-n-propylamine	4	10	--	--
2,2'-Oxybis(1-chloropropane)	1	10	--	--
Pentachlorophenol	2	50	13 (d,e)	0.02 (i)
Phenanthrene	2	10	6.3 (d)	0.03 (i)
Phenol	2	10	256 (d)	0.2 (i)
Pyrene	3	10	--	0.025 (h)
1,2,4-Trichlorobenzene	2	10	44.9 (e)	24 (h)
2,4,5-Trichlorophenol	3	50	--	0.025 (i)
2,4,6-Trichlorophenol	2	10	3.2 (e)	0.025 (i)
4,4'-Methylenebis (2-chloraniline) - MOCA	3	10	--	--
Polynuclear Aromatic Hydrocarbons (µg/L) by 8310				
Acenaphthene	0.39	1.0	17.0 (e)	5.8 (h)
Acenaphthylene	0.38	2.0	--	--
Anthracene	0.034	0.15	--	0.012 (h)
Benzo(a)anthracene	0.031	0.15	--	0.018 (h)
Benzo(a)pyrene	0.047	0.15	0.014 (d)	0.001 (i)
Benzo(b)fluoranthene	0.034	0.20	--	0.003 (i)
Benzo(ghi)perylene	0.066	0.20	--	0.0002 (i)
Benzo(k)fluoranthene	0.053	0.15	--	0.001 (i)
Chrysene	0.024	0.15	--	0.002 (i)
Dibenzo(a,h)anthracene	0.065	0.25	--	--
Fluoranthene	0.047	0.20	8.1 (d)	8.1 (b)
Fluorene	0.064	0.20	3.9 (b)	0.005 (i)
Indeno(1,2,3-cd)pyrene	0.035	0.15	--	0.0004 (i)
2-Methylnaphthalene	0.21	1.0	--	--
Naphthalene	0.32	1.0	24 (d)	0.1 (i)
Phenanthrene	0.034	0.15	6.3 (d)	0.03 (i)
Pyrene	0.063	0.20	--	0.025 (h)

SVOCs - Semivolatile Organic Compounds
MDL - Method Detection Limit
RL - Reporting Limit
µg/L - micrograms per liter
TCL - Target Compound List
(d) USEPA EcoTox Thresholds
(e) USEPA Region IV Screening Values
(g) USEPA Drinking Water MCLs
(h) Canadian Water Quality Guidelines
(i) New Dutchlist Groundwater Optimum Levels
-- No screening levels identified.

Shaded samples have screening levels that are less than reporting limits.

TABLE 2-5b
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR BNAs

TCL Semivolatiles + MOCA (µg/kg) by 8270C	MDL	RL	Screening Levels for Soil	Screening Levels for Sediment
Acenaphthene	68	330	29000 (a)	6.71 (e,f)
Acenaphthylene	71	330	--	5.87 (e,f)
Anthracene	40	330	590000 (a)	46.9 (e,f)
Benzo[a]anthracene	52	330	80 (a)	31.7 (f)
Benzo[b]fluoranthene	58	330	200 (a)	--
Benzo[k]fluoranthene	73	330	1000 (b)	--
Benzo[a]pyrene	40	330	90 (a)	31.9 (f)
Benzo[ghi]perylene	61	330	--	--
Bis(2-chloroethyl) ether	63	330	0.02 (a)	--
Bis(2-chloroethoxy)methane	69	330	--	--
Bis(2-ethylhexyl) phthalate	53	330	46000 (a)	182 (e)
4-Bromophenyl phenyl ether	61	330	--	1300 (d)
Butylbenzylphthalate	56	330	810000 (a)	11000 (d)
Carbazole	46	330	30 (a)	--
4-Chloroaniline	68	330	30 (a)	--
4-Chloro-3-methylphenol	70	330	--	--
2-Chloronaphthalene	74	330	10000 (c)	--
2-Chlorophenol	64	330	200 (a)	--
4-Chlorophenyl phenyl ether	71	330	--	--
Chrysene	57	330	8000 (a)	57.1 (f)
Dibenzo[a,h]anthracene	72	330	80 (a)	6.22 (e,f)
Dibenzofuran	73	330	--	2000 (d)
Di-n-butyl phthalate	46	330	--	11000 (d)
1,2-Dichlorobenzene	54	330	900 (a)	340 (d)
1,3-Dichlorobenzene	72	330	1000 (b)	1700 (d)
1,4-Dichlorobenzene	73	330	100 (a)	350 (d)
3,3'-Dichlorobenzidine	47	330	0.3 (a)	--
2,4-Dichlorophenol	68	330	50 (a)	--
Diethyl phthalate	47	330	23000 (a)	630 (d)
4,6-Dinitro-2-Methylphenol	64	1700	1000 (b)	--
2,4-Dimethylphenol	130	330	400 (a)	--
Dimethyl phthalate	55	330	--	--
2,4-Dinitrophenol	630	1700	10 (a)	--
2,4-Dinitrotoluene	51	330	0.04 (a)	--
2,6-Dinitrotoluene	58	330	0.03 (a)	--
Di-n-octyl phthalate	64	330	1600000 (a)	--
Fluoranthene	34	330	210000 (a)	111 (f)
Fluorene	67	330	28000 (a)	21.2 (e,f)
Hexachlorobenzene	59	330	100 (a)	--
Hexachlorobutadiene	67	330	100 (a)	--
Hexachlorocyclopentadiene	130	330	10000 (a)	--
Hexachloroethane	61	330	20 (a)	1000 (d)
Indeno[1,2,3-cd]pyrene	63	330	700 (a)	--
Isophorone	81	330	30 (a)	--
2-Methylnaphthalene	63	330	--	20.2 (e,f)
2-Methylphenol	77	330	800 (a)	--
4-Methylphenol	160	330	1000 (b)	--
Naphthalene	59	330	600 (b)	34.6 (e,f)
2-Nitroaniline	64	1700	--	--
3-Nitroaniline	51	1700	--	--
4-Nitroaniline	45	1700	--	--

TABLE 2-5b
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR BNAs

TCL Semivolatiles + MOCA (µg/kg) by 8270C	MDL	RL	Screening Levels for Soil	Screening Levels for Sediment
Nitrobenzene	72	330	7(a)	--
2-Nitrophenol	55	330	1000 (b)	--
4-Nitrophenol	52	1700	1000 (b)	--
N-Nitrosodiphenylamine	57	330	7 (a)	--
N-Nitroso-di-n-propylamine	86	330	60 (a)	--
2,2'-Oxybis(1-chloropropane)	83	330	--	--
Pentachlorophenol	310	1700	1 (a)	--
Phenanthrene	61	330	5000 (b)	41.9 (f)
Phenol	66	330	3800 (b)	--
Pyrene	66	330	10000 (b)	53 (f)
1,2,4-Trichlorobenzene	75	330	300 (a)	9200 (d)
2,4,5-Trichlorophenol	65	1700	1 (c)	--
2,4,6-Trichlorophenol	77	330	1 (c)	--
4,4'-Methylenebis (2-chloraniline) - MOCA	53	330	--	--
Polynuclear Aromatic Hydrocarbons (µg/kg) by 8310				
Acenaphthene	9.6	33	29000 (a)	6.71 (e,f)
Acenaphthylene	20	67	--	5.87 (e,f)
Anthracene	0.73	5.0	590000 (a)	46.9 (e,f)
Benzo(a)anthracene	0.85	5.0	80 (a)	31.7 (f)
Benzo(a)pyrene	1.1	5.0	90 (a)	31.9 (f)
Benzo(b)fluoranthene	1.8	6.7	1000 (b)	--
Benzo(ghi)perylene	2.1	6.7	--	--
Benzo(k)fluoranthene	2.1	5.0	1000 (b)	--
Chrysene	1.3	5.0	8000 (a)	57.1 (f)
Dibenzo(a,h)anthracene	3.4	8.3	80 (a)	6.22 (e,f)
Fluoranthene	2.6	6.7	210000 (a)	111 (f)
Fluorene	1.3	6.7	28000 (a)	21.2 (e,f)
Indeno(1,2,3-cd)pyrene	1.1	5.0	700 (a)	--
2-Methylnaphthalene	7.8	33	--	20.2 (e,f)
Naphthalene	7.4	33	600 (b)	34.6 (e,f)
Phenanthrene	1.3	5.0	5000 (b)	41.9 (f)
Pyrene	0.63	6.7	10000 (b)	53 (f)

SVOCs - Semivolatile Organic Compounds
MDL - Method Detection Limit
RL - Reporting Limit
µg/kg - micrograms per kilogram
TCL - Target Compound List
(a) USEPA General Screening Levels
(b) Canadian Soil Quality Guidelines
(c) New Dutchlist Soil Optimum Levels
(d) USEPA EcoTox Thresholds
(e) USEPA Region IV Screening Values
(f) Canadian Sediment Quality Guidance
-- No screening levels identified.
Shaded samples have screening levels that are less than reporting limits.

TABLE 2-6a

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR AQUEOUS SAMPLES ANALYZED FOR PESTICIDES

TCL Pesticides (µg/L)	MDL	RL	Screening Levels for Surface Water	Screening Levels for Groundwater
Aldrin	0.0046	0.010	--	--
a-BHC	0.0020	0.010	--	--
b-BHC	0.0022	0.010	--	--
d-BHC	0.0024	0.010	--	--
g-BHC (Lindane)	0.0016	0.010	--	--
a-Chlordane	0.0032	0.010	--	--
g-Chlordane	0.0034	0.010	--	--
Chlordane (Technical)	0.020	0.20		
4,4'-DDD	0.0036	0.020	--	--
4,4'-DDE	0.0048	0.020	--	--
4,4'-DDT	0.0040	0.020	0.013 (b)	0.013 (b)
Dieldrin	0.0020	0.020	0.062 (b)	0.062 (b)
Endosulfan I	0.0038	0.010	0.051 (b)	0.051 (b)
Endosulfan II	0.0048	0.020	0.051 (b)	0.051 (b)
Endosulfan sulfate	0.0058	0.020	--	--
Endrin	0.0066	0.020	0.061 (b)	0.061 (b)
Endrin aldehyde	0.0064	0.020	--	--
Endrin ketone	0.0028	0.020	--	--
Heptachlor	0.0046	0.010	--	--
Heptachlor epoxide	0.0038	0.010	--	--
Hexachlorobenzene	0.0092	0.020	--	0.01 (i)
Isodrin	0.0072	0.020		
Methoxychlor	0.017	0.10	--	--
Toxaphene	0.098	1.0	--	--

MDL - Method Detection Limit
RL - Reporting Limit
TCL - Target Compound List
µg/L - micrograms per liter
(b) USEPA EcoTox Thresholds
(i) New Dutchlist Groundwater Optimum Levels
-- No screening levels identified.
Note: MDLs and RLs are based on 2 ml final extract volume as opposed to the 10 ml volume identified in the SOP.

Shaded samples have screening levels that are less than reporting limits.

TABLE 2-6b

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR PESTICIDES

TCL Pesticides (µg/kg)	MDL	RL	Screening Levels For Soil	Screening Levels For Sediment
Aldrin	0.10	0.33	--	--
a-BHC	0.076	0.33	--	--
b-BHC	0.098	0.33	--	--
d-BHC	0.098	0.33	--	--
g-BHC (Lindane)	0.090	0.33	--	--
a-Chlordane	0.14	0.33	--	--
g-Chlordane	0.070	0.33	--	--
Chlordane (Technical)	0.32	6.7		
4,4'-DDD	0.084	0.67	--	--
4,4'-DDE	0.080	0.67	--	--
4,4'-DDT	0.13	0.67	1.6 (b)	1.6 (b)
Dieldrin	0.086	0.67	52.0 (b)	52.0 (b)
Endosulfan I	0.14	0.33	2.9 (b)	2.9 (b)
Endosulfan II	0.072	0.67	14 (b)	14 (b)
Endosulfan sulfate	0.17	0.67	--	--
Endrin	0.30	0.67	20 (b)	20 (b)
Endrin aldehyde	0.18	0.67	--	--
Endrin ketone	0.14	0.67	--	--
Heptachlor	0.12	0.33	--	--
Heptachlor epoxide	0.16	0.33	--	--
Hexachlorobenzene	0.17	0.67	100 (a)	--
Isodrin	0.11	0.67		
Methoxychlor	0.52	3.3	--	--
Toxaphene	2.8	33	--	--

MDL - Method Detection Limit
RL - Reporting Limit
TCL - Target Compound List
µg/kg - micrograms per kilogram
(a) USEPA General Screening Levels
(b) Canadian Soil Quality Guidelines
-- No screening levels identified.
* MDLs and RLs are based on 2 ml final volume as opposed to the 10 ml identified in the SOP.

TABLE 2-7a

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR AQUEOUS SAMPLES ANALYZED FOR PCBs

PCBs (µg/L)	MDL	RL	Screening Levels for Surface Water	Screening Levels for Groundwater
Aroclors				
Aroclor 1016	0.066	0.20	0.014 (e)	0.01 (i) total PCBs
Aroclor 1221	0.064	0.40	0.014 (e)	0.01 (i) total PCBs
Aroclor 1232	0.058	0.20	0.014 (e)	0.01 (i) total PCBs
Aroclor 1242	0.060	0.20	0.014 (e)	0.01 (i) total PCBs
Aroclor 1248	0.019	0.20	0.014 (e)	0.01 (i) total PCBs
Aroclor 1254	0.088	0.20	0.014 (e)	0.01 (i) total PCBs
Aroclor 1260	0.082	0.20	0.014 (e)	0.01 (i) total PCBs

PCBs - Polychlorinated Biphenyls
MDL - Method Detection Limit
RL - Reporting Limit
µg/L - micrograms per liter
(e) Region IV Screening Values
(i) New Dutchlist Groundwater Optimum Levels
-- No screening levels identified.

Note: MDLs and RLs for PCB Aroclors were determined using a final extract volume of 2 ml, as opposed to the 10 ml identified in the SOP.

Shaded samples have screening levels that are less than reporting limits.

TABLE 2-7b
METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR PCBs

PCBs (µg/kg)	MDL	RL	Screening Levels for Soil	Screening Levels for Sediment
Aroclors				
Aroclor 1016	1.1	6.7	20 (c) total PCBs	21.6 (e) total PCBs
Aroclor 1221	1.4	13	20 (c) total PCBs	21.6 (e) total PCBs
Aroclor 1232	2.4	6.7	20 (c) total PCBs	21.6 (e) total PCBs
Aroclor 1242	1.8	6.7	20 (c) total PCBs	21.6 (e) total PCBs
Aroclor 1248	0.52	6.7	20 (c) total PCBs	21.6 (e) total PCBs
Aroclor 1254	1.6	6.7	20 (c) total PCBs	21.6 (e) total PCBs
Aroclor 1260	0.98	6.7	20 (c) total PCBs	21.6 (e) total PCBs
Congeners				
2,4'-dichlorobiphenyl (BZ # 8)	0.10	1.0	--	--
2,2',5-trichlorobiphenyl (BZ # 18)	0.10	1.0	--	--
2,4,4'-trichlorobiphenyl (BZ # 28)	0.037	1.0	--	--
2,2',3,5'-tetrachlorobiphenyl (BZ # 44)	0.11	1.0	--	--
2,2',4,5'-tetrachlorobiphenyl (BZ # 49)	0.17	1.0	--	--
2,2',5,5'-tetrachlorobiphenyl (BZ # 52)	0.10	1.0	--	--
2,3',4,4'-tetrachlorobiphenyl (BZ # 66)	0.056	1.0	--	--
3,3',4,4'-tetrachlorobiphenyl (BZ # 77)	0.082	1.0	--	--
2,2',3,4,5'-pentachlorobiphenyl (BZ # 87)	0.042	1.0	--	--
2,2',4,5,5'-pentachlorobiphenyl (BZ # 101)	0.058	1.0	--	--
2,3,3',4,4'-pentachlorobiphenyl (BZ # 105)	0.18	1.0	--	--
2,3',4,4',5-pentachlorobiphenyl (BZ # 118)	0.069	1.0	--	--
3,3',4,4',5-pentachlorobiphenyl (BZ # 126)	0.049	1.0	--	--
2,2',3,3',4,4'-hexachlorobiphenyl (BZ # 128)	0.048	1.0	--	--
2,2',3,4,4',5'-hexachlorobiphenyl (BZ # 138)	0.043	1.0	--	--
2,2',4,4',5,5'-hexachlorobiphenyl (BZ # 153)	0.037	1.0	--	--
2,3,3',4,4',5-hexachlorobiphenyl (BZ # 156)	0.080	1.0	--	--
3,3',4,4',5,5'-hexachlorobiphenyl (BZ # 169)	0.095	1.0	--	--
2,2',3,3',4,4',5-heptachlorobiphenyl (BZ # 170)	0.071	1.0	--	--
2,2',3,4,4',5,5'-heptachlorobiphenyl (BZ # 180)	0.087	1.0	--	--
2,2',3,4,4',5',6-heptachlorobiphenyl (BZ # 183)	0.051	1.0	--	--
2,2',3,4,4',6,6'-heptachlorobiphenyl (BZ # 184)	0.056	1.0	--	--
2,2',3,4',5,5',6-heptachlorobiphenyl (BZ # 187)	0.060	1.0	--	--
2,2',3,3',4,4',5,6-octachlorobiphenyl (BZ # 195)	0.087	1.0	--	--
2,2',3,3',4,4',5,5',6-nonachlorobiphenyl (BZ # 206)	0.13	1.0	--	--
2,2',3,3',4,4',5,5',6,6'-decachlorobiphenyl (BZ # 209)	0.16	1.0	--	--

PCBs - Polychlorinated biphenyls
MDL - Method Detection Limit
RL - Reporting Limit
µg/kg - micrograms per kilogram
(c) New Dutchlist Soil Optimum Values
(e) USEPA Region IV Screening Values
-- No screening levels identified.
Note: MDLs and RLs for PCB Aroclors were determined using a final extract volume of 2 ml.

TABLE 2-8a

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR AQUEOUS SAMPLES ANALYZED FOR EXPLOSIVES

Explosives (µg/L)	MDL	RL	Screening Levels for Surface Water	Screening Levels for Groundwater
HMX	0.12	0.50	--	--
RDX	0.12	0.50	--	--
1,3,5-Trinitrobenzene	0.11	0.25	--	--
1,3-Dinitrobenzene	0.11	0.25	--	--
Nitrobenzene	0.046	0.25	--	--
Tetryl	0.29	0.75	--	--
2,4,6-Trinitrotoluene	0.17	0.50	--	--
2-Amino-4,6-Dinitrotoluene	0.15	0.50	--	--
4-Amino-2,6-Dinitrotoluene	0.18	0.50	--	--
2,4-Dinitrotoluene	0.12	0.25	--	--
2,6-Dinitrotoluene	0.24	0.50	--	--
2-Nitrotoluene	0.23	0.50	--	--
3-Nitrotoluene	0.20	0.50	--	--
4-Nitrotoluene	0.21	0.50	--	--
Nitroglycerin	0.19	1.0	--	--
Pentaerythritol tetranitrate (PETN)	0.60	2.0	--	--
Picric Acid	0.21	1.0	--	--

MDL - Method Detection Limit
RL - Reporting Limit
µg/L - micrograms per liter
HMX - Cyclotetramethylenetetranitramine
RDX - Cyclonite
-- No Screening Levels identified

TABLE 2-8b

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR EXPLOSIVES

Explosives (µg/kg)	MDL	RL	Screening Levels For Soil	Screening Levels For Sediment
HMX	190	500	4190 (j)	4190 (j)
RDX	180	500	4130 (j)	4130 (j)
1,3,5-Trinitrobenzene	83	250	2250 (j)	2250 (j)
1,3-Dinitrobenzene	73	250	--	--
Nitrobenzene	110	250	--	--
Tetryl	240	750	--	--
2,4,6-Trinitrotoluene	180	500	2110 (j)	2110 (j)
2-Amino-4,6-Dinitrotoluene	140	500	--	--
4-Amino-2,6-Dinitrotoluene	220	500	--	--
2,4-Dinitrotoluene	86	250	--	--
2,6-Dinitrotoluene	200	500	--	--
2-Nitrotoluene	150	500	--	--
3-Nitrotoluene	230	500	--	--
4-Nitrotoluene	120	500	--	--
Nitroglycerin	240	1000	--	--
Pentaerythritol tetranitrate (PETN)	660	2000	--	--
Picric Acid	240	1000	--	--

MDL - Method Detection Limit
RL - Reporting Limit
µg/kg - micrograms per kilograms
HMX - Cyclotetramethylenetetranitramine
RDX - Cyclonite
(j) Proposed Remedial Goal
-- No Screening Levels identified

TABLE 2-9

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR DIOXINS/FURANS

Analyte (ng/kg)	MDL	TDL	Screening Levels
2,3,7,8-TCDD	0.7469	1	--
1,2,3,7,8-PeCDD	0.4764	2.5	--
1,2,3,4,7,8-HxCDD	0.3563	2.5	--
1,2,3,6,7,8-HxCDD	1.2366	2.5	--
1,2,3,7,8,9-HxCDD	0.5202	2.5	--
1,2,3,4,6,7,8-HpCDD	0.8432	2.5	--
OCDD	5.8648	5	--
2,3,7,8-TCDF	0.1795	1	--
1,2,3,7,8-PeCDF	0.3026	2.5	--
2,3,4,7,8-PeCDF	0.275	2.5	--
1,2,3,4,7,8-HxCDF	0.3914	2.5	--
1,2,3,6,7,8-HxCDF	0.3144	2.5	--
2,3,4,6,7,8-HxCDF	0.3991	2.5	--
1,2,3,7,8,9-HxCDF	0.5357	2.5	--
1,2,3,4,6,7,8-HpCDF	1.5578	2.5	--
1,2,3,4,7,8,9-HpCDF	0.5991	2.5	--
OCDF	1.7737	5	--

ng/kg - nanograms per kilogram
MDL - Method Detection Limit
TDL - Target Detection Limit
RL - Reporting Limit

-- No Screening Levels identified

Shaded samples have screening levels that are less than reporting limits.

TABLE 2-10a

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR AQUEOUS SAMPLES ANALYZED FOR WET CHEMISTRY PARAMETERS

Inorganics (mg/L)	MDL	RL	Screening Levels for Surface Water	Screening Levels for Groundwater
Alkalinity	0.33	1.0	--	--
Ammonia, Nitrogen	0.028	0.10	--	--
Cyanide (Weak Acid Dissociable)	5.0	10.0	5.2 (a,b)	5 (c,d)
Nitrate+Nitrite, Nitrogen	0.020	0.050	--	--
Perchlorate	0.091	0.50	--	--
Phosphorus, orthophosphate	0.0077	0.050	--	--
Sulfate	0.049	0.10		
Total Dissolved Solids (TDS)	2.2	10.0	--	--
Total Suspended Solids (TSS)	1.3	5.0	--	--
Total Organic Carbon (TOC)	0.080	1.0	--	--

MDL - Method Detection Limit
RL - Reporting Limit
mg/L - milligrams per liter
-- No Screening Levels identified
(a) USEPA ECOTOX Threshold
(b) USEPA Region IV Screening Values
(c) Canadian Water Quality Guidelines
(d) New Dutchlist Groundwater Optimum Levels
Shaded samples have screening levels that are less than reporting limits.

TABLE 2-10b

METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR WET CHEMISTRY PARAMETERS

Analyte (mg/kg)	MDL	RL	Screening Levels for Soil	Screening Levels for Sediment
Ammonia, Nitrogen	1.4	5.0	--	--
Cyanide	0.065	0.21	0.9 (a)	--
Nitrate+Nitrite, Nitrogen	0.035	0.50	--	--
Phosphorus, orthophosphate	ND	5.0	--	--
Sulfate	0.22	1.0		
Total Organic Carbon (TOC)	547	6000	--	--

MDL - Method Detection Limit
RL - Reporting Limit
mg/kg - milligram per kilogram
-- No Screening Levels identified
(a) Canadian Soil Quality Guidelines

TABLE 2-11
SAMPLE ANALYSES FOR BACKGROUND SOIL SAMPLE LOCATIONS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
BKGD-001 through BKGD-006	AUS-BKGD-001-SS-0X through AUS-BKGD-006-SS-0X	Designated background area #5 – located south of Area 12 (Figure 2-2)	Hand auger	0-6 in.	TAL Metals, Cyanide, TOC	Soil samples will be used to determine background values for AUS sites – background areas were chosen in areas of no known contamination, and in areas with similar soil types as those identified at the AUS sites
BKGD-007 through BKGD-012	AUS-BKGD-007-SS-0X through AUS-BKGD-012-SS-0X	Designated background area #4 – located southwest of Area 12 (Figure 2-2)	Hand auger	0-6 in.	TAL Metals, Cyanide, TOC	Soil samples will be used to determine background values for AUS sites – background areas were chosen in areas of no known contamination, and in areas with similar soil types as those identified at the AUS sites
BKGD-013 through BKGD-018	AUS-BKGD-013-SS-0X through AUS-BKGD-018-SS-0X	Designated background area #3 – located south of Area 13 (Figure 2-2)	Hand auger	0-6 in.	TAL Metals, Cyanide, TOC	Soil samples will be used to determine background values for AUS sites – background areas were chosen in areas of no known contamination, and in areas with similar soil types as those identified at the AUS sites
BKGD-019 through BKGD-024	AUS-BKGD-019-SS-0X through AUS-BKGD-024-SS-0X	Designated background area #2 – located north of the Lost Branch (creek) (Figure 2-2)	Hand auger	0-6 in.	TAL Metals, Cyanide, TOC	Soil samples will be used to determine background values for AUS sites – background areas were chosen in areas of no known contamination, and in areas with similar soil types as those identified at the AUS sites
BKGD-025 through BKGD-030	AUS-BKGD-025-SS-0X through AUS-BKGD-030-SS-0X	Designated background area #1 – located north of Crab Orchard Lake and west of Cartersville on north side of Route 13 (Figure 2-2)	Hand auger	0-6 in.	TAL Metals, Cyanide, TOC	Soil samples will be used to determine background values for AUS sites – background areas were chosen in areas of no known contamination, and in areas with similar soil types as those identified at the AUS sites

TABLE 2-12
SAMPLE ANALYSES FOR BEDROCK MONITORING WELL LOCATIONS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
BDRK-001	AUS-BDRK-001-GW-00	West of AUS-002 and south of Old Route 13 (Figure2-2)	Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer
BDRK-002	AUS-BDRK-002-SS-??	Northeast of Area 2D and north of Old Route 13 (Figure2-2)	Loess Sample	Determine in field	TOC	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer
	AUS-BDRK-002-SS-??		Till Sample	Determine in field	TOC	
	AUS-BDRK-002-GW-00		Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	

TABLE 2-12
SAMPLE ANALYSES FOR BEDROCK MONITORING WELL LOCATIONS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
BDRK-003	AUS-BDRK-003-GW-00	North of Area 6 and just south of Old Route 13 (Figure2-2)	Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer
BDRK-004	AUS-BDRK-004-GW-00	Southeast of AUS-060 and west of Wolf Creek Road (Figure 2-2)	Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer
BDRK-005	AUS-BDRK-005-GW-00	Just north of Crab Orchard Lake and west of Route 148 (Figure 2-2)	Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer

TABLE 2-12
SAMPLE ANALYSES FOR BEDROCK MONITORING WELL LOCATIONS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

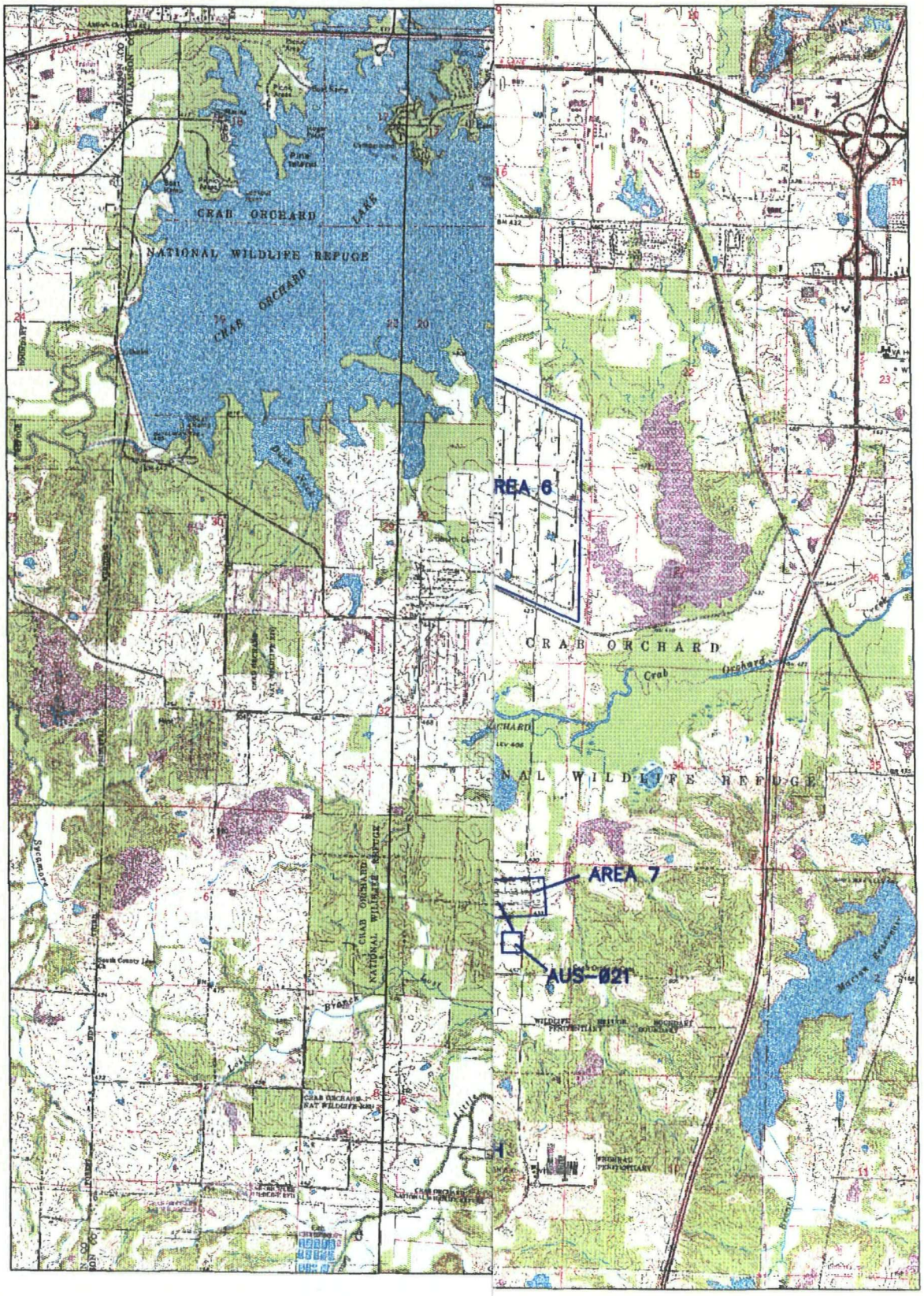
LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
BDRK-006	AUS-BDRK-006-SS-??	Public access area on west side of Crab Orchard Lake, just west of AUS-066 (Figure 2-2)	Loess Sample	Determine in field	TOC	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer
	AUS-BDRK-006-SS-??		Till Sample	Determine in field	TOC	
	AUS-BDRK-006-GW-00		Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	
BDRK-007	AUS-BDRK-007-SS-??	Northwest of Area 8 and south of Ogden Road (Figure 2-2)	Loess Sample	Determine in field	TOC	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer
	AUS-BDRK-007-SS-??		Till Sample	Determine in field	TOC	
	AUS-BDRK-007-GW-00		Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	

TABLE 2-12
SAMPLE ANALYSES FOR BEDROCK MONITORING WELL LOCATIONS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
BDRK-008	AUS-BDRK-008-GW-00	Northwest of Area 11 on west side of roadway that connects Area 11 to Ogden Road (Figure 2-2)	Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer
BDRK-009	AUS-BDRK-009-GW-00	East of northern portion of Area 8, near corner of Refuge boundary (Figure 2-2)	Monit. Well		TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer
BDRK-010	AUS-BDRK-010-GW-00	Near intersection of Grassy Road and Rocky Comfort Road??? just south of lookout tower (Figure 2-2)	Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer

TABLE 2-12
SAMPLE ANALYSES FOR BEDROCK MONITORING WELL LOCATIONS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
BDRK-011	AUS-BDRK-011-GW-00	South of Area 12 near homestead located north of Grassy Road (Figure 2-2)	Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Alkalinity, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate), TSS, Sulfates	Monitoring well to be completed in sandstone bedrock – this monitoring well is intended to determine if the sandstone aquifer has been impacted by industrial operations at CONWR and if it has not, then it will serve as a background monitoring well for the sandstone aquifer



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AUS OU Sites

FIG. NO.
2-1

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SOIL TYPES

2	CISNE SILT LOAM	70	BEAUCOUP SILTY CLAY LOAM, BOTTOM	167	LUKIN SILT LOAM
3	HOYLETON SILT LOAM	71	DARWIN CLAY, BOTTOM	176	MARISSA SILT LOAM
4	RICHVIEW SILT LOAM	72	SHARON SILT LOAM, BOTTOM	214	HOSMER SILT LOAM
5	BLAIR SILT LOAM	84	OKAW SILT LOAM	287	CHAUNCEY SILT LOAM
8	HICKORY LOAM	85	JACOB CLAY, BOTTOM	288	PETROLIA SILTY CLAY LOAM
8-14	HICKORY LOAM - AVA SILT LOAM, COMPLEX	108	BONNIE SILT LOAM, BOTTOM	301	GRANTSBURG SILT LOAM
8-214	HICKORY LOAM - HOSMER SILT LOAM, COMPLEX	109	RACOON SILT LOAM	335	ROBBS SILT LOAM
9	STEEP ROCKY LAND, SANDSTONE MATERIAL	122	COLP SILT LOAM	337	CREAL SILT LOAM
11	LOY SILT LOAM	132	STARKS SILT LOAM	338	HURST SILT LOAM
12	WYNOOSE SILT LOAM	134	CAMDEN SILT LOAM	339	WELLSTON SILT LOAM
13	BLUFORD SILT LOAM	164	STOY SILT LOAM	340	MANITOU SILT LOAM
14	AVA SILT LOAM	165	WEIR SILT LOAM	382	BELKNAP SILT LOAM, BOTTOM

SLOPE SYMBOLS

A : 0 TO 1.5% SLOPE

B : 1.5 TO 4% SLOPE

C : 4 TO 7% SLOPE

D : 7 TO 12% SLOPE

E : 12 TO 18% SLOPE

F : 18 TO 30% SLOPE

G : OVER 30% SLOPE

EROSION SYMBOLS

SLOPE SYMBOL FOLLOWED BY + SIGN (FOR EXAMPLE, A+) DENOTES LIGHT-COLORED SILTY SEDIMENT 8 TO 15 INCHES THICK ON A NORMAL SURFACE SOIL. ALSO, IN THE VICINITY OF HERRIN, + ON SMALL BOTTOMLANDS INDICATES MINE-WASH MATERIAL HAS COVERED THE AREA.

SLOPE SYMBOL ALONE (FOR EXAMPLE, C) DENOTES NONE TO SLIGHTLY ERODED (OVER 7 INCHES OF SURFACE AND SUBSURFACE SOIL REMAINING).

SLOPE SYMBOL OVERSCORED (FOR EXAMPLE, $\bar{C}$) DENOTES MODERATELY ERODED (3 TO 7 INCHES OF SURFACE AND SUBSURFACE REMAINING).

SLOPE SYMBOL UNDERSCORED (FOR EXAMPLE, $\underline{C}$) DENOTES SEVERELY ERODED (LESS THAN 3 INCHES OF SURFACE AND SUBSURFACE SOIL REMAINING).

★ STAR FOLLOWING SLOPE SYMBOL DENOTES PRESENCE OF NUMEROUS MINE SINKS IN AREA.

CONVENTIONAL SYMBOLS

PAVED ROAD
BLACKTOP OR 1-LANE PAVED ROAD
GRAVEL OR MINE-WASTE ROAD
IMPROVED DIRT ROAD
PRIVATE LANE
RAILROAD
RAILROAD (2 OR MORE TRACKS)
ABANDONED RAILROAD
LEVEE (TICKS: PROTECTED SIDE)
SANDSTONE OUTCROP
COUNTY BOUNDARY
TOWNSHIP BOUNDARY

LARGE RIVER
SMALL FLOWING STREAM
NONCROSSABLE DRAINAGE
CROSSABLE DRAINAGE
P POND OR LAKE
SWAMPY AREA
P DAM
MD MINE DUMP
BP BORROW PIT
SM SURFACE MINE

TOWN
TOWN
HOUSE
SCHOOL
CHURCH
BUSINESS ESTABLISHMENT
LARGE BUILDING
SHAFT MINE
CEMETERY

SCALE

0 1/4 1/2 1 2 MILES

A. J. CLINE, SOIL CORRELATOR
UNITED STATES DEPARTMENT OF AGRICULTURE

R. T. ODELL, IN CHARGE OF SOIL SURVEY
UNIVERSITY OF ILLINOIS AGRICULTURAL EXP. STATION

SOILS SURVEYED BY J. B. FEHRENBACHER, IN CHARGE, J. D. ALEXANDER, R. A. BOHANNON, W. R. OSCHWALD AND R. H. RUST
UNIVERSITY OF ILLINOIS AGRICULTURAL EXPERIMENT STATION, AND H. R. MCCULLOCH, SOIL CONSERVATION SERVICE, U.S.D.A.

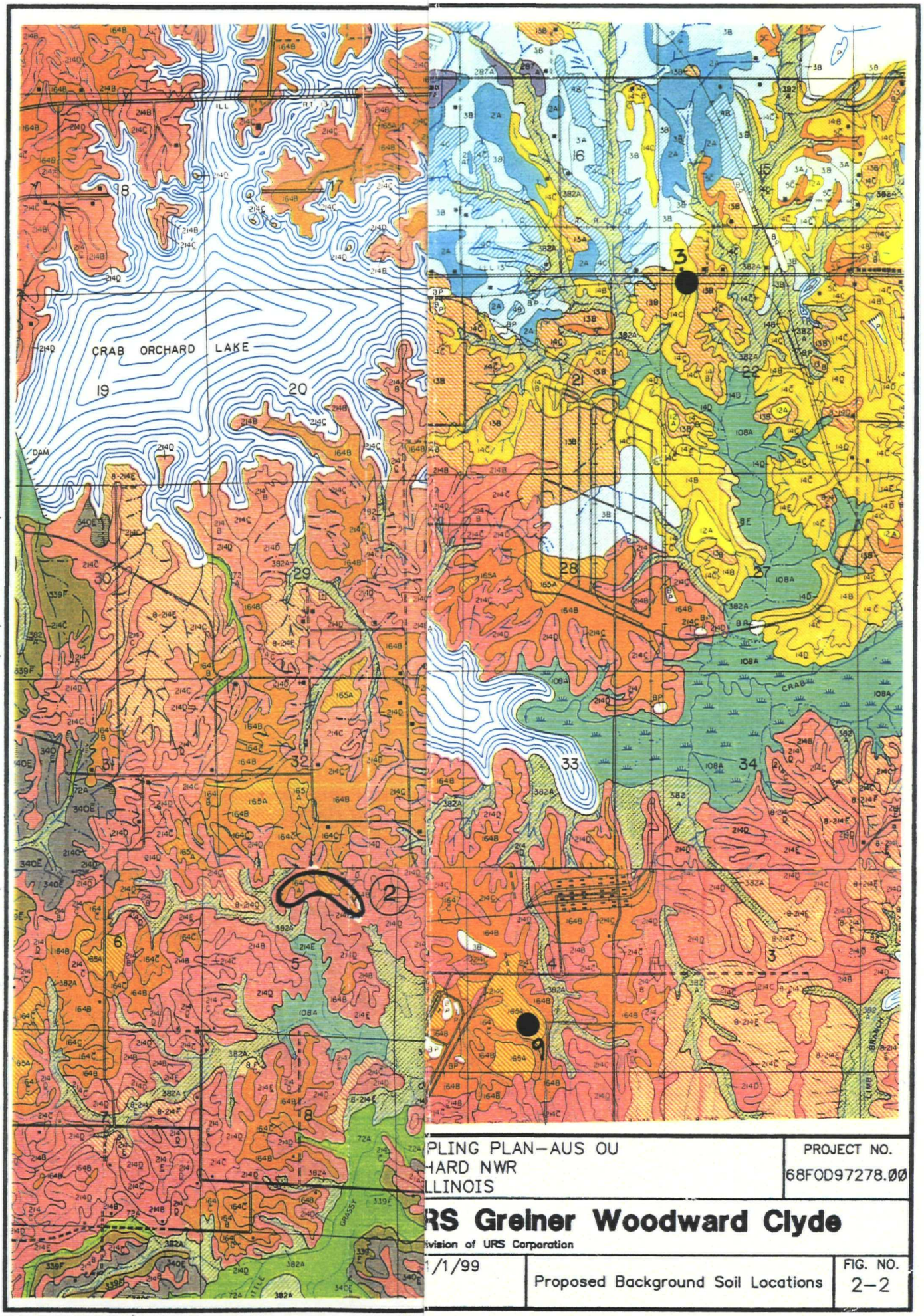
SOIL SURVEY MAP OF WILLIAMSON COUNTY, ILLINOIS

UNIVERSITY OF ILLINOIS AGRICULTURAL EXPERIMENT STATION
IN COOPERATION WITH
UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

10 ● Bedrock Monitoring Well Locations

① ⬭ Background Soil Sample Locations

KEY TO FIGURE 2-2



PLING PLAN–AUS OU
HARD NWR
LLINOIS

PROJECT NO.
68F0D97278.00

RS Greiner Woodward Clyde
ivision of URS Corporation

/1/99

Proposed Background Soil Locations

FIG. NO.
2–2

File: G:\68F0D9727800\SITE36\FIG2-2(QUARTERING).DWG.DWG Last edited: 11/01/99 @ 4:26 p.m. @ WCC-ST.LOUIS

Area 2 consists of four IOP load lines in close proximity to each other just north of Crab Orchard Lake. Area 2 is shown on Figure 3-1 with each of the four load lines highlighted and labeled. These load lines are the Booster Load Line labeled as Area 2B, the Detonator Load Line labeled as Area 2D, the Fuse Load Line labeled as Area 2F, and the Primer Load Line labeled as Area 2P. Each of these areas is described in the sections below.

3.1 AREA 2B – IOP BOOSTER LOAD LINE (AUS-0A2B)

Site Location and Boundaries

The site is located on the eastern side of Wolf Creek Road approximately 0.4 miles south of Old Highway 13. To enter the site you have to travel on Wolf Creek Road for approximately 0.3 miles south of Old Highway 13 and go east on an unnamed road for 0.2 miles. To the south of this road is a fenced area with a guard shack. This is the entrance to Areas 2D, 2B, and 2F. Area 2B is south of Area 2D. Area 2B is bounded on all four sides by a 6-foot chain link fence and entrance to the site is controlled because it is an active industrial facility. Area 2B is shown on Figure 3-2 with sample locations. Information on each sample is contained in Table 3-1.

Site History

This site is the former IOP Booster Load Line. The facility was designed and built for the purpose of loading boosters involving the preparation, mixing, and loading of tetryl. Since World War II, ordnance manufacturers have used the facility for their production operations. Post war production activities at Area 2B included explosive fuse trains, pyrotechnics, large explosives, propellant mixes, and gas generators.

The southern and eastern portions of the load line were razed in the 1980s. The remaining buildings at the site are part of Primex Corporations' ongoing production operations at the refuge. Visual inspection of the site revealed building debris, abandoned drums and ordnance waste scattered at the southern end of the site outside the current fenceline. Aerial photo interpretation identified a suspicious pond to the southwest of the load line and excavation activity to the east of the load line. Previous sampling at the site indicated the presence of elevated levels of metals and several BNA compounds.

Sampling Information Specific to Area 2B

Area 2B has several areas of specific interest during this site inspection. Building B-2-13 in the northeast section of Area 2B is one of them. This building is a propellant mix house. The southern end of the building has propellant mixing machines in the east and west bays and propellant has been identified on the ground outside both of these bays in the past. In addition, to the east of this building is a hexane tank which supplies solvent to the mixing bays for use in propellant mixes.

In the southern portion of Area 2B several buildings were involved in the screening, pressing and loading of high explosives and pyrotechnic mixes. These buildings have all been flashed and razed. Because volatile solvents like $MeCl_2$ and TCE were used extensively in production operations by the industrial tenants, dioxin is a chemical of potential concern (COPC) in these

locations. It is also a COPC at the burn pad in the southwest corner of this load line. Other COPCs in this area include TNT and tetryl (explosives), MeCl2 (volatile solvents), Hexane, lead (metals), and burn site residues (BNAs).

To the east of the load line a magnetometer survey is planned during the sampling event. Aerial photo interpretations identified this area as having been regraded at approximately the same time as the demolition of the buildings in Area 2B. It is possible that building debris from the demolished buildings is buried in this location. The magnetometer survey and subsequent sample designated in this area will either prove or disprove this possibility.

3.2 AREA 2D – IOP DETONATOR LOAD LINE (AUS-0A2D)

Site Location and Boundaries

The site is located on the eastern side of Wolf Creek Road approximately 0.3 miles south of Old Highway 13. To enter the site take Wolf Creek Road approximately 0.3 miles south from Old Highway 13 and go east on an unnamed road for 0.2 miles. To the south of this road is a fenced area with a guard shack. This is the entrance to Areas 2D, 2B, and 2F. Area 2D is the northernmost area with Areas 2B and 2F to the southwest and southeast respectively. Area 2D is bounded on all four sides by a 6-foot chain link fence and entrance to the site is controlled because it is an active industrial facility. Area 2D is shown on Figure 3-3 with sample locations. Information on each sample is contained in Table 3-2.

Site History

This site is the former IOP Detonator Load Line. The facility was designed and built for the purpose of loading detonators involving the preparation, mixing, and loading of primary explosives. Since World War II ordnance manufacturers have used the facility for their production operations. Post war production activities at Area 2D included explosive fuse trains, pyrotechnics, large explosives, propellant products, gas generators and ammunition mixes (e.g. tracers and igniters). Currently Primex Corporation is using the load line for its ongoing production activities.

On the southeast corner of the load line a small building pad was used for several years as a burning ground for ignitable wastes. In addition, several of the production buildings previously contained open sumps that were emptied out on to the grounds in the area of the sumps during cleaning activities. Other cleaning activities at the site included the sweeping of wash waters in production buildings to the grounds just outside the building on a weekly basis. These wash waters reportedly ended up flowing into the ditches near the buildings. Previous sampling at the site indicated the presence of elevated levels of mercury, zinc and several BNA compounds.

Sampling Information Specific to Area 2D

Six buildings (D-1-8, D-1-25, D-1-43, D-1-44, D-1-46, D-1-47) have sumps and all sumps will have soil borings/monitoring wells installed nearby. In addition a soil boring has been placed near building D-1-11 in an area where white phosphorus is believed to contaminate the soils. In the southeast portion of the load line the chemicals of potential concern include mercury fulminate and lead (reactivity and metals), burn site residues (Dioxin and BNAs), and propellant

and pyrotechnic mixes (explosives, metals, VOCs, and BNAs). On the southwest portion of the load line COPCs include lead azide (metals), acetone (VOCs), and propellant and pyrotechnic mixes (explosives, metals, VOCs, and BNAs). On the north end of the load line COPCs include propellant and pyrotechnic mixes (explosives, metals, VOCs, and BNAs), TNT, tetryl, RDX, and NG (explosives), and lead azide (metals).

In the center of the D area load line is a large area which has not been developed. A magnetometer survey is planned for this area to either prove or disprove a rumor of buried equipment and debris from WWII.

3.3 AREA 2F – IOP FUSE LOAD LINE (AUS-0A2F)

Site Location and Boundaries

The site is located east of Area 2B and entrance to the site is obtained by entering through the security entrance for Area 2D. To enter the site you have to travel on Wolf Creek Road for approximately 0.3 miles south of Old Highway 13 and go east on an unnamed road for 0.2 miles. To the south of this road is a fenced area with a guard shack. This is the entrance to Areas 2D, 2B, and 2F. Area 2F is south of Area 2D and east of Area 2B. Area 2F is bounded on all four sides by a 6-foot chain link fence and entrance to the site is controlled because it is an active industrial facility. Area 2F is shown on Figure 3-4 with sample locations. Information on each sample is contained in Table 3-3.

Site History

This site is the former IOP Fuse Load Line. The facility was designed and built for the purpose of loading fuses involving the preparation and loading of black powder, lead azide, potassium chlorate, and tetryl. Since World War II, ordnance manufacturers have used the facility for their production operations. Post war production activities at Area 2F included pyrotechnics, gas generators, and artillery projectiles. Currently, Primex Corporation is using the facility for its ongoing production operations.

Visual inspection of the site revealed the northern portion of the load line has been used as a dumping ground for construction debris over the years. In addition, several areas of stressed vegetation were observed around production buildings. Previous sampling at the site indicated the presence of elevated levels of metals.

Sampling Information Specific to Area 2F

Fuse production involved the use of tetryl (explosives), lead azide (metals), and nitrocellulose. Other activities at the load line include the use of volatile solvents for metals cleaning activities. It is believed that the disposal of these chemicals was via dumping in the areas around the building involved (F-2-2).

3.4 AREA 2P – IOP PRIMER LOAD LINE (AUS-0A2P)

Site Location and Boundaries

The site is located 0.6 miles east of Wolf Creek Road on Stringtown Road. Stringtown Road is 1.4 miles south of Old Highway 13 on Wolf Creek Road. Area 2P is south of Areas 2D, 2B, and 2F. Area 2P is bounded on all four sides by a 6-foot chain link fence and entrance to the site is controlled because it is an active industrial facility. Area 2P is shown on Figure 3-5 with sample locations. Information on each sample is contained in Table 3-4.

Site History

This site is the former IOP Primer Load Line. The facility was designed and built for the purpose of loading primers involving the preparation and loading of black powder. Since World War II an ordnance manufacturer has used the facility for its research and development and production operations. Post war production activities at Area 2P included solid propellants, pyrotechnics, gas generators, and ammunition mixes. Primex Corporation is currently using the facility for its ongoing operations at the Refuge.

Sampling Information Specific to Area 2P

Previous sampling at the site indicated the presence of RDX in surface water effluents as well as elevated levels of metals and BNA compounds. Surface water at the site is transported off the site either to the northwest or the southeast by numerous ditches at the site. In addition, building P-1-1 formerly contained an open sump from which water was discharged to the ground during cleaning operations.

Soil borings/monitoring wells have been placed on the north and south of each of the main loading buildings as well as near a mix facility to the north and near building P-1-10 which has been used for gas generator testing and ammunition R&D. The remaining samples in Area 2P have been designated for ditches.

TABLE 3-1
SAMPLE LOCATIONS FOR AUS AREA 2B-IOP BOOSTER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2B-001	AUS-0A2B-001-SD-0X	South end drainage ditch	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This ditch collects the drainage from the entire south end of the facility where mercury fulminate, TNT, Tetryl, Baryta, and pyrotechnic compounds were screened, pressed and loaded.
	AUS-0A2B-001-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-002	AUS-0A2B-002-SS-0X	Building pad for building B-2-9	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) + PETN Perchlorates	UMC and CTI used pad as a burning pad for the disposal of ignitable wastes. Approximately 10-15 drums remain at the site in a small area in various states of decay. Debris from the drums has been poured out and apparently burned on the pad.
	AUS-0A2B-002-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2B-002-DRUM		Drum sample	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	
0A2B-003	AUS-0A2B-003-SS-0X	Building pad for building B-2-8 and former location of building exit	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	Building used for the screening and pressing of tetryl, melting of baryta, loading of pyrotechnics.
	AUS-0A2B-003-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-004	AUS-0A2B-004-SD-0X	East of former building B-2-6	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Drainage adjacent to building used for the pressing of tetryl pellets.
	AUS-0A2B-004-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-005	AUS-0A2B-005-SS-0X	East of former building B-2-9	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Area east of building B-2-9 which shows scarring in aerial photo interpretations from 1971 to 1980.
	AUS-0A2B-005-SS-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-1
SAMPLE LOCATIONS FOR AUS AREA 2B-IOP BOOSTER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2B-006	AUS-0A2B-006-SS-0X	East of building B-2-2 near any of the exit doors	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for loading activities and the use of solvents is likely. Cleaning activities included the discharge of cleaning fluids to the grounds outside of buildings.
	AUS-0A2B-006-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-007	AUS-0A2B-007-SD-0X	East of building B-2-1 near any of the exit doors	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for loading activities and the use of solvents is likely. Cleaning activities included the discharge of cleaning fluids to the grounds outside of buildings.
	AUS-0A2B-007-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-008	AUS-0A2B-008-SD-0X	North end drainage ditch	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) TOC (9060) SW846 Explosives (8330)	This ditch collects the drainage from the entire north end of the main portion of the original loading line.
	AUS-0A2B-008-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-009	AUS-0A2B-009-SS-0X	Western entrance to building B-2-15	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Propellant identified on the ground to the west of building B-2-15.
	AUS-0A2B-009-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-010	AUS-0A2B-010-SS-0X	Western entrance to building B-2-13 mixer bay	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Mixing of propellants and inhibitors occurred in building B-2-13 in the mixer bay near this exit door. Cleaning activities involved the discharge of cleaning fluids to the grounds outside the building
	AUS-0A2B-010-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-011	AUS-0A2B-011-SS-0X	Eastern entrance to building B-2-13 mixer bay	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Mixing of propellants and inhibitors occurred in building B-2-13 in the mixer bay near this exit door. Cleaning activities involved the discharge of cleaning fluids to the grounds outside the building
	AUS-0A2B-011-SS-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-1
SAMPLE LOCATIONS FOR AUS AREA 2B-IOP BOOSTER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2B-012	AUS-0A2B-012-SD-0X	Drainage ditch west of plant road west of building B-2-1	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for loading activities and the use of solvents is likely. Cleaning activities included the discharge of cleaning fluids to the grounds outside of buildings.
	AUS-0A2B-012-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-013	AUS-0A2B-013-SS-0X	Area east of the load line in an area determined by magnetometer survey	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Area identified by aerial photo interpretation as having ground scarring of a significant size.
	AUS-0A2B-013-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-014	AUS-0A2B-014-SD-0X	Area east of the load line in drainage ditch at spot determined by aerial photo interpretation	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Area identified by aerial photo interpretation as having ground scarring of a significant size in drainage from the site.
	AUS-0A2B-014-SD-01			6-12 in.	TCL Volatiles (8260B)	
A2B-015	AUS-0A2B-015-SW-00	Area southwest of the load line in depressed area with some ponding.	Surface Water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	Area identified by aerial photo interpretation as having a pond that dries up at the approximate time that activity at the load line decreases.
	AUS-0A2B-015-SD-0X		Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	
0A2B-016	AUS-0A2B-016-SD-0X	Drainage ditch west of former building B-2-8	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Drainage adjacent to building used for the screening and pressing of tetryl and other loading activities.
	AUS-0A2B-016-SD-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-1
SAMPLE LOCATIONS FOR AUS AREA 2B-IOP BOOSTER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2B-017	AUS-0A2B-017-SD-0X	Drainage ditch east of load line between former buildings B-2-7 and B-2-6	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Drainage adjacent to load line in between blended tetryl rest house and tetryl pelleting building.
	AUS-0A2B-017-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-018	AUS-0A2B-018-SD-0X	Drainage ditch northeast of former building B-2-6	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Drainage for the adjacent building used for the storage of tetryl pellets.
	AUS-0A2B-018-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-019	AUS-0A2B-019-SD-0X	Drainage ditch southwest of building B-2-2	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for loading activities and the use of solvents is likely. Cleaning activities included the discharge of cleaning fluids to the grounds outside of buildings.
	AUS-0A2B-019-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-020	AUS-0A2B-020-SD-0X	Drainage ditch north of building B-2-1	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for loading activities and the use of solvents is likely. Cleaning activities included the discharge of cleaning fluids to the grounds outside of buildings.
	AUS-0A2B-020-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-021	AUS-0A2B-021-SD-0X	North of building B-2-13 near exit door	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	Mixing of propellants and inhibitors occurred in building B-2-13 and propellants were reported on the ground near a north exit door. Cleaning activities involved the discharge of cleaning fluids to the grounds outside the building
	AUS-0A2B-021-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2B-022	AUS-0A2B-022-SD-0X	North of building B-2-13 near exit door	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	Mixing of propellants and inhibitors occurred in building B-2-13 and propellants were reported on the ground near a north exit door. This bay is used for the mixing of propellants and contamination in this area is likely. Cleaning activities involved the discharge of cleaning fluids to the grounds outside the building
	AUS-0A2B-022-SD-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-1
SAMPLE LOCATIONS FOR AUS AREA 2B-IOP BOOSTER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2B-W01	AUS-0A2B-W01-SS-0X	Southeast corner of the loading line where water ponding occurs	Soil Boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) + PETN	This area is where drainage from the eastern portion of the loading line ultimately ponds until absorbed into the ground.
	AUS-0A2B-W01-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2B-W01-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2B-W01-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2B-W01-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B) Perchlorates	
0A2B-W02	AUS-0A2B-W02-SS-0X	Loading area for the hexane storage tank	Soil boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Hexane storage tank loading activities take place in this area and spills in this area are likely.
	AUS-0A2B-W02-SS-01			6-12 in.	TCL Volatiles (8260B) + Hexane	
	AUS-0A2B-W02-SS-05			4-5 ft	TCL Volatiles (8260B) + Hexane	
	AUS-0A2B-W02-SS-??			BWT	TCL Volatiles (8260B) + Hexane	
	AUS-0A2B-W02-GW-00		Monit. Well	NA	SW846 Explosives (8330) TCL Volatiles (8260B) + Hexane Perchlorates	

TABLE 3-1
SAMPLE LOCATIONS FOR AUS AREA 2B-IOP BOOSTER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2B-W03	AUS-0A2B-W03-SS-0X	Loading area for the fuel tank	Soil boring	0-6 in.	TAL Metals (6010/7000)	Fuel storage tank loading activities take place in this area and spills in this area are likely.
	AUS-0A2B-W03-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2B-W03-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2B-W03-SS-??			BWT	TCL Volatiles (8260B) TAL Metals (6010/7000)	
	AUS-0A2B-W03-GW-00		Monit. Well	NA	SW846 Explosives (8330) TAL Metals (6010/7000) TCL Volatiles (8260B)	

NA = Not applicable

BWT = Below water table

Shaded samples will be collected by the UXO subcontractor.

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-001	AUS-0A2D-001-SS-0X	South side of building D-1-35	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	UMC and OLIN used building for R&D and unknown production activities. Primary and secondary SW846 Explosives were handled in the building as were pyrotechnics. Volatile solvents and other cleaning solutions contaminated with Metals, propellants, and binders were likely discharged to the grounds around the building.
	AUS-0A2D-001-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-002	AUS-0A2D-002-SS-0X	Building D-1-1 drainage location	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	UMC used building pad for the burning of ignitable wastes including primary SW846 Explosives containing lead, Some volatile solvents and oils were likely used to transport and ignite the SW846 Explosives for burning.
	AUS-0A2D-002-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-003	AUS-0A2D-003-SS-0X	South side of building D-1-4	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for the pressing of tetryl and the manufacture and loading of high SW846 Explosives including Barytol (Barium Nitrate and TNT). Unknown plasticizers were used along with volatile cleaning solvents.
	AUS-0A2D-003-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-004	AUS-0A2D-004-SS-0X	North side of building D-1-4	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for the pressing of tetryl and the manufacture and loading of high SW846 Explosives including Barytol (Barium Nitrate and TNT). Unknown plasticizers were used along with volatile cleaning solvents.
	AUS-0A2D-004-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-005	AUS-0A2D-005-SS-0X	West side of building D-1-6	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs + MOCA (8270c) SW846 Explosives (8330) Perchlorates	Building used for the loading, pressing, curing and grinding of SW846 Explosives, pyrotechnics and propellants. Pyrotechnics contain Metals, perchlorates and plastic binders. MOCA used to bind propellant grains together. Volatile cleaning solvents used in the building also.
	AUS-0A2D-005-SS-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-006	AUS-0A2D-006-SS-0X	East side of building D-1-6	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs + MOCA (8270c) SW846 Explosives (8330) Perchlorates	Building used for the loading, pressing, curing and grinding of SW846 Explosives, pyrotechnics and propellants. Pyrotechnics contain Metals, perchlorates and plastic binders. MOCA used to bind grains together. Volatile cleaning solvents used in the building also.
	AUS-0A2D-006-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-007	AUS-0A2D-007-SS-0X	West side of building D-1-7	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs + MOCA (8270c) SW846 Explosives (8330) Perchlorates	Building used for the loading, pressing, curing and grinding of SW846 Explosives, pyrotechnics and propellants. Pyrotechnics contain Metals, perchlorates and plastic binders. MOCA used to bind grains together. Volatile cleaning solvents used in the building also.
	AUS-0A2D-007-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-008	AUS-0A2D-008-SS-0X	East side of building D-1-7	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs + MOCA (8270c) SW846 Explosives (8330) Perchlorates	Building used for the loading, pressing, curing and grinding of SW846 Explosives, pyrotechnics and propellants. Pyrotechnics contain Metals, perchlorates and plastic binders. MOCA used to bind grains together. Volatile cleaning solvents used in the building also.
	AUS-0A2D-008-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-009	AUS-0A2D-009-SS-0X	West side of building D-1-8	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs + MOCA (8270c) SW846 Explosives (8330) Perchlorates	Building used for the loading, pressing, curing and grinding of SW846 Explosives, pyrotechnics and propellants. Pyrotechnics contain Metals, perchlorates and plastic binders. MOCA used to bind grains together. Volatile cleaning solvents used in the building also.
	AUS-0A2D-009-SS-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-010	AUS-0A2D-010-SS-0X	East side of building D-1-8	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs + MOCA (8270c) SW846 Explosives + Nitroglycerin (8330) Perchlorates	Building used for the loading, pressing, curing and grinding of SW846 Explosives, pyrotechnics and propellants. Pyrotechnics contain Metals, perchlorates and plastic binders. MOCA used to bind grains together. Volatile cleaning solvents used in the building also.
	AUS-0A2D-010-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-011	AUS-0A2D-011-SS-0X	West side of building D-1-11 near entrance	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	Building used for the mixing of high SW846 Explosives and igniter mixes and grounds near this building have been involved in a ground fire indicating the possibility of white phosphorus contamination. Metals, perchlorates, plastic binders, and volatile solvents are possible contaminants as well.
	AUS-0A2D-011-SS-01			6-12 in.	TCL Volatiles (8260B) Phosphorus (365.3)	
0A2D-012	AUS-0A2D-012-SS-0X	South east side of building D-1-11 near entrance	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	Building used for the mixing of high SW846 Explosives and igniter mixes and grounds near this building have been involved in a ground fire indicating the possibility of white phosphorus contamination. Metals, perchlorates, plastic binders, and volatile solvents are possible contaminants as well.
	AUS-0A2D-012-SS-01			6-12 in.	TCL Volatiles (8260B) Phosphorus (365.3)	
0A2D-013	AUS-0A2D-013-SD-0X	South east of building D-1-11 in drainage ditch	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for the mixing of high SW846 Explosives and igniter mixes and grounds near this building have been involved in a ground fire indicating the possibility of white phosphorus contamination. Metals, perchlorates, plastic binders, and volatile solvents are possible contaminants as well.
	AUS-0A2D-013-SD-01			6-12 in.	TCL Volatiles (8260B) Phosphorus (365.3)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-014	AUS-0A2D-014-SD-0X	Eastern drainage Area 2D drainage ditch south of building D-1-15.	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the eastern portion of Area 2D around buildings D-1-15, D-1-14, D-1-11, and D-1-12. Contaminants of potential concern include SW846 Explosives, Metals, plastic binders, volatile solvents, and white phosphorus.
	AUS-0A2D-014-SD-01			6-12 in.	TCL Volatiles (8260B) Phosphorus (365.3)	
0A2D-015	AUS-0A2D-015-SD-0X	North west drainage ditch located north of plant road	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the northern and western portions of the facility where a burn site was located, Tetryl was loaded, and lead azide was unloaded from shipping containers. Other chemicals of concern include solvents used for cleaning and plastic binders.
	AUS-0A2D-015-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-016	AUS-0A2D-016-SD-0X	Northwest drainage ditch located south of plant road.	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	This drainage ditch receives surfacewater runoff from the northern portions of the facility where a burn site was located, and Tetryl was loaded. Other chemicals of concern include solvents used for cleaning and plastic binders.
	AUS-0A2D-016-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-017	AUS-0A2D-017-SS-0X	South west end of facility near plant road between two concrete building pads.	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) Dioxin	SWDC used the former buildings for the unloading, and preparation of lead azide for drying. Suspected location where packing fluids were allowed to flow to the ground including acetone. Area also used to decontaminate equipment using propane torches-COPC-Dioxin.
	AUS-0A2D-017-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-018	AUS-0A2D-018-SS-0X	Entrance to building D-1-56	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Building used for unknown operations. Soil barracade around building suggests the presence of ignitable materials such as SW846 Explosives, pyrotechnics (Metals), volatile solvents and/or propellants.
	AUS-0A2D-018-SS-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-019	AUS-0A2D-019-SS-0X	Entrance to building D-1-57	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for the screening and mixing of smoke candles. Chemicals of potential concern include lead, di-n-octylphthalate, SW846 Explosives, and volatile solvents.
	AUS-0A2D-019-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-020	AUS-0A2D-020-SS-0X	Entrance to building D-1-58	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building used for the screening and mixing of smoke candles. Chemicals of potential concern include lead, di-n-octylphthalate, SW846 Explosives, and volatile solvents.
	AUS-0A2D-020-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-021	AUS-0A2D-021-SD-0X	Drainage ditch just south of buildings D-1-57 and D-1-58	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the middle of the facility and around buildings D-1-57, D-1-58, D-1-17, and the southern portions of D-1-6, D-1-7, and D-1-8. Chemicals of potential concern include Metals, plastic binders, di-n-octylphthalate, SW846 Explosives, and volatile solvents.
	AUS-0A2D-021-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-022	AUS-0A2D-022-SS-0X	Building D-1-47 sump discharge location.	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330) Perchlorates	Building used as a mix house for igniter mixes, propellant mixes, pyrotechnic flares and smoke markers. A sump was formerly located in this area and reportedly the fluids from the sump were discharged to the grounds surrounding the sump. Fluids reportedly discharged to the sump contained propellants, Metals, perchlorates, plastic binders, di-n-octylphthlate and volatile solvents.
	AUS-0A2D-022-SS-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-023	AUS-0A2D-023-SS-0X	Building D-1-44 sump discharge location.	Hand Auger or Trowel	0-6 in	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330) Perchlorates	Building used as a mix house for igniter mixes, propellant mixes, pyrotechnic flares and smoke markers. A sump was formerly located in this area and reportedly the fluids from the sump were discharged to the grounds surrounding the sump. Fluids reportedly discharged to the sump contained propellants, Metals, perchlorates, plastic binders, di-n-octylphthlate and volatile solvents.
	AUS-0A2D-023-SS-01			6-12 in	TCL Volatiles (8260B)	
0A2D-024	AUS-0A2D-024-SS-0X	North end of building D-1-25 near entrance to building	Hand Auger or Trowel	0-6 in	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330) Perchlorates	Building used as a control building for mixing buildings. Raw materials were weighed out in this building and then transported to mixers. Spills of raw materials are likely. Cleaning solutions were reportedly discharged to the grounds around the buildings. Chemicals of potential concern include Metals, plastic binders, di-n-octylphthalate, nitroglycerin, and volatile solvents.
	AUS-0A2D-024-SS-01			6-12 in	TCL Volatiles (8260B)	
0A2D-025	AUS-0A2D-025-SS-0X	South end of building D-1-25 near entrance to building	Hand Auger or Trowel	0-6 in	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	Building used as a control building for mixing buildings. Raw materials were weighed out in this building and then transported to mixers. Spills of raw materials are likely. Cleaning solutions were reportedly discharged to the grounds around the buildings. Chemicals of potential concern include Metals, plastic binders, di-n-octylphthalate, nitroglycerin, and volatile solvents.
	AUS-0A2D-025-SS-01			6-12 in	TCL Volatiles (8260B)	
0A2D-026	AUS-0A2D-026-SS-0X	North end of building D-1-27 near entrance to building	Hand Auger or Trowel	0-6 in	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	Building used for the casting of nitroglycerin based propellants. Possible use as a fulminate preparation building also. Chemicals of potential concern include nitroglycerin, Metals, volatile cleaning solvents, and
	AUS-0A2D-026-SS-01			6-12 in	TCL Volatiles (8260B)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-027	AUS-0A2D-027-SS-0X	South end of building D-1-27 near entrance to building	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330)	Building used for the casting of nitroglycerin based propellants. Possible use as a fulminate preparation building also. Chemicals of potential concern therefore include SW846 Explosives + Nitroglycerin, Metals (Mercury fulminate, lead azide), and volatile cleaning solvents.
	AUS-0A2D-027-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-028	AUS-0A2D-028-SS-0X	Building D-1-32 pad drainage location	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) Dioxin	Olin and UMC used this building pad for the burning of ignitable wastes including primary SW846 Explosives containing lead. Potential for dioxin contamination because of burning. Volatile solvents may have been dumped on site prior to burning.
	AUS-0A2D-028-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-029	AUS-0A2D-029-SD-0X	Drainage ditch just south of facility road and north of Area 2B	Sedi-ment	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	This drainage ditch receives surfacewater runoff from the southern end of the facility. Potential contaminants include Metals, plastic binders, SW846 Explosives + Nitroglycerin, and volatile solvents.
	AUS-0A2D-029-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-030	AUS-0A2D-030-SD-0X	Drainage ditch just north of the southern facility road and east of D-1-45	Sedi-ment	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the middle portion of the facility. . Potential contaminants include Metals, plastic binders, SW846 Explosives + Nitroglycerin, and volatile solvents.
	AUS-0A2D-030-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-031	AUS-0A2D-031-SS-0X	Eastern portion of the middle of the facility in a location showing settlement	Soil	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This area of the facility was rumored to have received surplus waste from the WWII. No building has taken place in this portion of the facility to prove or disprove the rumor. Magnetometer survey will also be performed in this area. MeTNT, Tetryl and volatile cleaning solvents are portential contaminants.
	AUS-0A2D-031-SS-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-032	AUS-0A2D-032-SD-0X	Drainage ditch just south west of facility road	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the western side of the facility and may have been impacted by SWDC's lead azide operations. Chemicals of potential concern include Metals, acetone, and SW846 Explosives.
	AUS-0A2D-032-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-033	AUS-0A2D-033-SS-0X	Outside the building D-1-47 berm area.	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	Building D-1-47 contained a sump and sump waters were reportedly discharged to the soils both inside and outside the berm. Building used as a mix house for pyrotechnics and propellants.
	AUS-0A2D-033-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-034	AUS-0A2D-034-SS-0X	Outside the building D-1-43 berm area.	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	Building D-1-43 contained a sump and sump waters were reportedly discharged to the soils both inside and outside the berm. Building used as a mix house for pyrotechnics and propellants.
	AUS-0A2D-034-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-035	AUS-0A2D-035-SS-0X	Southeast corner of Area 2D just south of concrete pad	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) Dioxin	Building D-1-32 was the former location of a burning pad on which pyrotechnic and explosive wastes were burned. Aerial photo interpretations show the area south of the burn pad as potentially affected.
	AUS-0A2D-035-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-036	AUS-0A2D-036-SS-0X	Southeast corner of Area 2D just east of plant road south of concrete pad	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) Dioxin	Building D-1-32 was the former location of a burning pad on which pyrotechnic and explosive wastes were burned. Aerial photo interpretations show the area south of the burn pad as potentially affected.
	AUS-0A2D-036-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-037	AUS-0A2D-037-SD-0X	Drainage ditch just north of facility road on northwest side of facility.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the northern portion of the facility and may have been impacted by operations at the facility.
	AUS-0A2D-037-SD-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-038	AUS-0A2D-038-SD-0X	Drainage ditch on west side of facility, west of plant road	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the western side of the facility and may have been impacted by SWDC's lead azide operations. Chemicals of potential concern include Metals, SW846 Explosives and acetone.
	AUS-0A2D-038-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-039	AUS-0A2D-039-SD-0X	Drainage ditch on west side of facility, east of plant road	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the western side of the facility and may have been impacted by SWDC's lead azide operations.
	AUS-0A2D-039-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-040	AUS-0A2D-040-SD-0X	Drainage ditch on west side of facility, east of plant road and northeast of concrete pad	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the western side of the facility and may have been impacted by SWDC's lead azide operations.
	AUS-0A2D-040-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-041	AUS-0A2D-041-SD-0X	Drainage ditch on south side of facility, east of plant road to Area 2B	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the southern side of the facility and may have been impacted by SWDC's lead azide operations or propellant mixing operations in building D-1-44.
	AUS-0A2D-041-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-042	AUS-0A2D-042-SD-0X	Drainage ditch on south side of facility, southeast of building D-1-44	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the southern side of the facility and may have been impacted by SWDC's lead azide operations or propellant mixing operations in building D-1-44.
	AUS-0A2D-042-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2D-043	AUS-0A2D-043-SD-0X	Drainage ditch on south side of facility, southeast of building D-1-43	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives surfacewater runoff from the southern side of the facility and may have been impacted by propellant mixing operations in building D-1-43.
	AUS-0A2D-043-SD-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-044	AUS-0A2D-044-SW-00	Drainage ditch on eastern side of facility, south of building D-1-15	Surf. Water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	This drainage ditch receives surfacewater runoff from the southern side of the facility and may have been impacted by propellant mixing operations in building D-1-43.
	AUS-0A2D-044-SD-0X		Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	
0A2D-045	AUS-0A2D-045-SS-0X	East of building D-1-12 near sidewalk.	Hand Auger or Trowel	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Documented evidence of a solvent spill containing high SW846 Explosives and high explosive igniter mixes in this area impacting the soils near the building and sidewalk. The solvent would be volatile solvents and the igniter mixes would contain Metals, perchlorates and a plasticizer.
	AUS-0A2D-45-SS-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-W01	AUS-0A2D-W01-SS-0X	Northeast end of building D-1-8 near former location of sump pit	Soil boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs + MOCA (8270c) SW846 Explosives + Nitroglycerin (8330) Perchlorates	Building used for the loading, pressing, curing and grinding of SW846 Explosives, pyrotechnics and propellants. Pyrotechnics contain Metals, perchlorates and plastic binders. MOCA used to bind grains together. Volatile cleaning solvents used in the building also. A sump was formerly located in this area and reportedly the fluids from the sump were discharged to the grounds surrounding the sump.
	AUS-0A2D-W01-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2D-W01-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2D-W01-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2D-W01-GW-00		Monit. Well	NA	TAL Metals (6010/7000) BNAs+MOCA (8270c) TCL Volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates, nitrate+nitrites	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-W02	AUS-0A2D-W02-SS-0X	South end of building D-1-8 near former location of sump pit	Soil boring	0-6 in.	TAL Metals (6010/7000), TCL BNAs + MOCA (8270c), SW846 Explosives + Nitroglycerin (8330), Perchlorates	Building used for the loading, pressing, curing and grinding of SW846 Explosives, pyrotechnics and propellants. Pyrotechnics contain Metals, perchlorates and plastic binders. MOCA used to bind grains together. Volatile cleaning solvents used in the building also. A sump was formerly located in this area and reportedly the fluids from the sump were discharged to the grounds surrounding the sump.
	AUS-0A2D-W02-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2D-W02-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2D-W02-SS-??			B.W.T	TCL Volatiles (8260B)	
	AUS-0A2D-W02-GW-00		Monit. Well	NA	TAL Metals (6010/7000), BNAs+MOCA (8270c), TCL Volatiles (8260b), SW846 Explosives + Nitroglycerin (8330), Perchlorates, alkalinity, ammonia as N, phosphorus, TDS, TSS	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-W03	AUS-0A2D-W03-SS-0X	North east side of building D-1-11 near entrance	Soil boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	Building used for the mixing of high SW846 Explosives and igniter mixes and grounds near this building have been involved in a ground fire indicating the possibility of white phosphorus contamination. Metals, perchlorates, plastic binders, and volatile solvents are possible contaminants as well.
	AUS-0A2D-W03-SS-05			4-5 ft	TCL Volatiles (8260B) Phosphorus (365.3)	
	AUS-0A2D-W03-SS-??			BWT	TCL Volatiles (8260B) Phosphorus (365.3)	
	AUS-0A2D-W03-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330) Perchlorates Phosphorus (365.3) Ammonia as N, Nitrates + Nitrites	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-W04	AUS-0A2D-W04-SS-0X	Building D-1-46 sump discharge location.	Soil Boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330) Perchlorates	Building was used for measuring components for propellants, igniters, pyrotechnic flares and smoke markers. It was also used for the curing of propellants containing nitroglycerin. A sump was formerly located in this area and reportedly the fluids from the sump were discharged to the grounds surrounding the sump. Fluids reportedly discharged to the sump contained propellants, Metals, perchlorates, plastic binders, di-n-octylphthlate and volatile solvents.
	AUS-0A2D-W04-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2D-W04-SS-05			4-5 ft.	TCL Volatiles (8260B)	
	AUS-0A2D-W04-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2D-W04-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-W05	AUS-0A2D-W05-SS-0X	Southwest of building D-1-44 safety berm.	Soil Boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330), Perchlorates	Building used as a mix house for igniter mixes, propellant mixes, pyrotechnic flares and smoke markers. A sump was formerly located in this area and reportedly the fluids from the sump were discharged to the grounds surrounding the sump. Fluids reportedly discharged to the sump contained propellants, Metals, perchlorates, plastic binders, di-n-octylphthlate and volatile solvents.
	AUS-0A2D-W05-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2D-W05-SS-05			4-5 ft.	TCL Volatiles (8260B)	
	AUS-0A2D-W05-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2D-W05-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates, alkalinity, ammonia as N, nitrates + nitrites, phosphorus, TDS, TSS	

TABLE 3-2
SAMPLE LOCATIONS FOR AREA 2D – IOP DETONATOR LOAD LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2D-W06	AUS-0A2D-W06-SS-0X	Building D-1-43 sump discharge location.	Soil Boring	0-6 in	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330) Perchlorates	Building used as a mix house for igniter mixes, propellant mixes, pyrotechnic flares and smoke markers. A sump was formerly located in this area and reportedly the fluids from the sump were discharged to the grounds surrounding the sump. Fluids reportedly discharged to the sump contained propellants, Metals, perchlorates, plastic binders, di-n-octylphthlate and volatile solvents.
	AUS-0A2D-W06-SS-01			6-12 in	TCL Volatiles (8260B)	
	AUS-0A2D-W06-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2D-W06-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2D-W06-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates	

NA = Not applicable

BWT = Below water table

COPCs = Chemicals of Potential Concern
Shaded samples will be collected by the UXO subcontractor.

Notes:

1. Propellant mixing operations include many chemicals of potential concern refer to Tables 4-2 and 4-3 for a list of those chemicals.
2. Pyrotechnic Mixes contain Metals for fuel, perchlorates for oxidizers, binders (volatile plastics), and Di-n-octyl phthalate (BNA).
3. Primary SW846 Explosives can contain the Metals lead or mercury.

TABLE 3-3
SAMPLE LOCATIONS FOR AREA 2F-IOP FUSE LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2F-001	AUS-0A2F-001-SS-0X	Building F-2-3 drainage area	Shovel sample	0-6 in.	TAL Metals (6010/7000)	This building was formerly used for the storage of paints and solvents and the walkover survey of the building area showed some stressed vegetation.
	AUS-0A2F-001-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2F-002	AUS-0A2F-002-SS-0X	North end dump area	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Large amounts of construction debris and boiler equipment have been dumped on site. . Chemicals of potential concern include Metals (lead), Explosives (tetryl) and BNA compounds from the boilers.
	AUS-0A2F-002-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2F-003	AUS-0A2F-003-SS-0X	South end of building F-2-2	Shovel sample	0-6 in.	TAL Metals (6010/7000)	Cutting oils from a metal working operation were allowed to discharge to the ground in the area south of building F-2-2.
	AUS-0A2F-003-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2F-004	AUS-0A2F-004-SS-0X	East side of building F-2-1	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Building was used for the loading of fuses and stressed vegetation is evident around the building. Chemicals of potential concern include lead azide, tetryl, nitrocellulose, and volatile cleaning solvents.
	AUS-0A2F-004-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2F-005	AUS-0A2F-005-SS-0X	East side of concrete pad.	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Stressed vegetation is evident around the building pad. Concrete pad was used for the storage of tetryl boosters during WWII. Chemicals of potential concern include lead azide, tetryl, and volatile cleaning solvents.
	AUS-0A2F-005-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2F-006	AUS-0A2F-006-SD-OX	South end drainage ditch near building F-2-1	Shovel sample	0-6 in.	TAL Metals (6010/7000) TOC (9060) SW846 Explosives (8330)	This drainage ditch receives the runoff from the area east of building F-2-1. Chemicals of potential concern include Explosives, Metals, and volatile cleaning solvents.
	AUS-0A2F-006-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2F-007	AUS-0A2F-007-SW-00	North end drainage ditch	Surface water	NA	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives the surface water runoff from the entire northern end of the facility. Chemicals of potential concern include Metals (lead), and Explosives (tetryl).
	AUS-0A2F-007-SD-0X		Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	

TABLE 3-3
SAMPLE LOCATIONS FOR AREA 2F-IOP FUSE LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2F-008	AUS-0A2F-008-SW-00	Drainage ditch on east side of the facility near F-2-9	Surface water	NA	TAL Metals (6010/7000) SW846 Explosives (8330) Perchlorates	This drainage ditch receives the surface water runoff from the eastern side of the facility near the former black powder buildings. Chemicals of potential concern include Metals (lead), Explosives (tetryl), and perchlorates.
	AUS-0A2F-008-SD-0X		Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	
0A2F-009	AUS-0A2F-009-SD-0X	Drainage ditch on northeast side of building F-2-2	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives the surface water runoff from the area east of building F-2-2. Chemicals of potential concern include Metals (lead), Explosives (tetryl), and volatile solvents.
	AUS-0A2F-009-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2F-010	AUS-0A2F-010-SD-0X	Drainage ditch east of building F-2-2 just south of dumping grounds.	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330) TOC (9060)	This drainage ditch receives the surface water runoff from the area around the dumping grounds.
	AUS-0A2F-010-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2F-W01	AUS-0A2F-W01-SS-0X	East side of building F-2-2	Soil boring	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Building was used for the loading of fuses and also for metal working operations. Solvent disposal operations in the building were questionable. Chlorinated solvents used as degreasers, Metals (lead) and Explosives (tetryl) are associated with IOP fuse production. Well is positioned so as to potentially be an upgradient well for either Area 2B or 2P or a downgradient well for 2D.
	AUS-0A2F-W01-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2F-W01-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2F-W01-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2F-W01-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL volatiles (8260b) SW846 Explosives (8330) Perchlorates	

TABLE 3-3
SAMPLE LOCATIONS FOR AREA 2F-IOP FUSE LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2F-W02	AUS-0A2F-W02-SS-0X	South end of building F-2-2	Soil boring	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Cutting oils were allowed to discharge to the ground in the area south of building F-2-2. IOP used the building for the loading of fuses containing tetryl, lead azide, and nitrocellulose.
	AUS-0A2F-W02-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2F-W02-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2F-W02-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2F-W02-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL volatiles (8260b) SW846 Explosives (8330)	
0A2F-W03	AUS-0A2F-W03-SS-0X	West of building F-2-10	Soil boring	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Primer loading occurred in building F-2-10 involving the use of lead azide, tetryl, nitrocellulose, and volatile cleaning solvents. This well will also provide up gradient values for Perchlorates for either Area 2B of 2P samples.
	AUS-0A2F-W03-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2F-W03-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2F-W03-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2F-W03-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL volatiles (8260b) SW846 Explosives (8330) Perchlorates	

NA = Not applicable

BWT = Below water table

TABLE 3-4
SAMPLE LOCATIONS FOR AREA 2P-IOP PRIMER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2P-001	AUS-0A2P-001-SD-0X	Drainage ditch northwest of building P-1-6	Shovel Sample	0-6 in.	TOC (9060) TAL Metals (6010/7000) SW846 Explosives (8330)	This building was used for the screening of black powder and as a utility building. Cleaning activities may have impacted nearby soils.
	AUS-0A2P-001-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-002	AUS-0A2P-002-SD-0X	Drainage ditch north of building P-1-79 near entranceway.	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This building was used for the processing of propellants. Cleaning activities may have impacted nearby soils. Chemicals of potential concern include Metals, Explosives, and volatile solvents.
	AUS-0A2P-002-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-003	AUS-0A2P-003-SS-0X	Soils to the east of building P-1-79	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This building was used for the processing of propellants. Cleaning activities may have impacted nearby soils. Chemicals of potential concern include Metals, Explosives, and volatile solvents.
	AUS-0A2P-003-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-004	AUS-0A2P-004-SD-0X	Drainage ditch to the east of building P-1-81	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This building was used for the casting of propellants. Cleaning activities may have impacted nearby soils. Chemicals of potential concern include Metals, Explosives, and volatile solvents.
	AUS-0A2P-004-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-005	AUS-0A2P-005-SD-0X	Drainage ditch to the south of building P-1-79 and P-1-6	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch collects runoff from the northern and western sides of the facility. COPCs include Metals, Explosives, and volatile solvents.
	AUS-0A2P-005-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-006	AUS-0A2P-006-SD-0X	Drainage ditch northeast of building P-1-3 near entrance.	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330)	The loading of primers and gas generators took place in building P-1-3. Cleaning activities may have impacted nearby soils. COPCs include Metals, Explosives, and volatile solvents.
	AUS-0A2P-006-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-007	AUS-0A2P-007-SD-0X	Drainage ditch to the east of building P-1-3	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch collects runoff from the building P-1-3 loading dock area. COPCs include Metals, Explosives, and volatile solvents.
	AUS-0A2P-007-SD-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-4
SAMPLE LOCATIONS FOR AREA 2P-IOP PRIMER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2P-008	AUS-0A2P-008-SD-0X	Drainage ditch to the east of the building P-1-1 to P-1-3 walkway.	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	This drainage ditch collects runoff from the building P-1-1 area including the area believed to have a sump. Building P-1-1 used for R&D of products listed in Table 4-3 of the Historic Search Report.
	AUS-0A2P-008-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-009	AUS-0A2P-009-SD-0X	Drainage ditch northeast of building P-1-1 near entranceway.	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	The loading of primers, R&D, and propellant mixing took place in building P-1-1. Cleaning activities may have impacted nearby soils. COPCs include Metals, Explosives, BNAs, and volatile solvents.
	AUS-0A2P-009-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-010	AUS-0A2P-010-SD-0X	Drainage ditch west of plant road on west side of the plant -southwest of P-1-10	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from the western side of the facility. Area is used for the storage of propellants and Explosives.
0A2P-011	AUS-0A2P-011-SD-0X	Drainage ditch to the west of building P-1-3	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	This drainage ditch collects runoff from the area west of buildings P-1-1 and P-1-3. COPCs include Metals, Explosives, BNAs, and volatile solvents.
	AUS-0A2P-011-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-012	AUS-0A2P-012-SD-0X	Drainage ditch south of building P-1-8 near entranceway.	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330)	The screening of nitrocellulose took place in building P-1-8. Cleaning with volatile solvents may have impacted nearby soils. Metals from primary Explosives included as COPC.
	AUS-0A2P-012-SD-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-4
SAMPLE LOCATIONS FOR AREA 2P-IOP PRIMER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2P-013	AUS-0A2P-013-SS-0X	Area north of building P-1-10.	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330)	The pelleting of nitrocellulose took place in building P-1-10 as well as gas generator testing and solvent metal cleaning. Building cleaning activities may have impacted nearby soils.
	AUS-0A2P-013-SS-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-014	AUS-0A2P-014-SD-0X	Drainage ditch to the southeast of building P-1-10	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330)	This drainage ditch collects runoff from the area south of buildings P-1-10. The pelleting of nitrocellulose took place in building P-1-10 as well as gas generator testing and solvent metal cleaning. Building cleaning activities may have impacted nearby soils.
	AUS-0A2P-014-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-015	AUS-0A2P-015-SD-0X	Drainage ditch to the west of building P-1-3	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	This drainage ditch collects runoff from the area west of buildings P-1-1 and P-1-3. COPCs include Metals, Explosives, BNAs, and volatile solvents.
	AUS-0A2P-015-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-016	AUS-0A2P-016-SD-0X	Drainage ditch to the north of the southern plant road.	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330)	This drainage ditch collects surface water runoff from the southwest portion of the facility.
	AUS-0A2P-016-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-017	AUS-0A2P-017-SD-0X	Drainage ditch south of building P-1-1 just east of walkway	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	The loading of primers and gas generators took place in building P-1-1 along with R&D activities. COPCs include Metals, Explosives, BNAs, and volatile solvents.
	AUS-0A2P-017-SD-01			6-12 in.	TCL Volatiles (8260B)	

TABLE 3-4
SAMPLE LOCATIONS FOR AREA 2P-IOP PRIMER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2P-018	AUS-0A2P-018-SD-0X	Drainage ditch northwest of plant road where the southern and eastern plant drainage combine	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330) TOC (9060)	This drainage ditch receives runoff from the entire southern and eastern sides of the facility. O'brien and Gere's 1988 RI showed low levels of RDX in the surface water taken downstream in this ditch.
	AUS-0A2P-018-SD-01			6-12 in.	TCL Volatiles (8260B)	
0A2P-019	AUS-0A2P-019-SD-0X	Drainage ditch southwest of plant road	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	This drainage ditch receives runoff from the entire southern and eastern sides of the facility. O'brien and Gere's 1988 RI showed low levels of RDX in the surface water taken downstream in this ditch.
	AUS-0A2P-019-SW-0X		Surface water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330) TCL Volatiles (8260B) Perchlorates	
0A2P-020	AUS-0A2P-020-SD-0X	Drainage ditch west of plant road on the western side of the plant west of P-1-9	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from the western side of the facility. Area is used for the storage of propellants and Explosives. Chemicals of potential concern include Metals, and Explosives.

TABLE 3-4
SAMPLE LOCATIONS FOR AREA 2P-IOP PRIMER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2P-W01	AUS-0A2P-W01-SD-0X	Drainage ditch north of northern facility road	Soil Boring	0-6 in.	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330)	Former building in this area was used for the mixing of propellants and cleaning activities may have impacted nearby soils. Chemicals of potential concern include Metals, Explosives, perchlorates, volatile solvents.
	AUS-0A2P-W01-SD-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2P-W01-SD-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2P-W01-SD-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2P-W01-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates, Alkalinity, Ammonia as N,TDS, TSS Nitrate + Nitrite, Phosphorus	

TABLE 3-4
SAMPLE LOCATIONS FOR AREA 2P-IOP PRIMER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2P-W02	AUS-0A2P-W02-SS-0X	North side of P-1-3 near building P-1-48	Soil boring	0-6 in.	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330)	The loading of primers and gas generators took place in building P-1-3. Cleaning activities may have impacted nearby soils. Primers contained primary Explosives (lead azide, etc.) containing Metals, and nitrocellulose. Gas generators contain propellant mixtures consisting of various components including Metals, Explosives, perchlorates, and volatile solvents. In addition, volatile solvents were stored in a nearby building.
	AUS-0A2P-W02-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2P-W02-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2P-W02-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2P-W02-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates, Nitrates + Nitrites, Ammonia as N	
0A2P-W03	AUS-0A2P-W03-SD-0X	South side of P-1-3 near drainage ditch	Soil boring	0-6 in.	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330)	The loading of primers and gas generators took place in building P-1-3. Cleaning activities involving volatile solvents may have impacted nearby soils. COPCs include Metals, Explosives, and volatile solvents.
	AUS-0A2P-W03-SD-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2P-W03-SD-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2P-W03-SD-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2P-W03-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates	

TABLE 3-4
SAMPLE LOCATIONS FOR AREA 2P-IOP PRIMER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2P-W04	AUS-0A2P-W04-SS-0X	North side of P-1-1 in area where sump waters were likely discharged	Soil boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	Building P-1-1 used for R&D of products listed in Table 4-3 of the Historic Search Report. This building formerly housed a sump and waters from the sump were reportedly discharged to the grounds in the area.
	AUS-0A2P-W04-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2P-W04-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2P-W04-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2P-W04-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates Nitrates + Nitrites, Ammonia as N	
0A2P-W05	AUS-0A2P-W05-SS-0X	South side of P-1-10 near entrance.	Soil boring	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	The pelleting of nitrocellulose took place in building P-1-10 as well as gas generator testing and solvent metal cleaning. Ammunition R&D activities also took place in this building. Building cleaning activities may have impacted nearby soils.
	AUS-0A2P-W05-SS-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2P-W05-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2P-W05-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2P-W05-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates Nitrates + Nitrites, Ammonia as N	

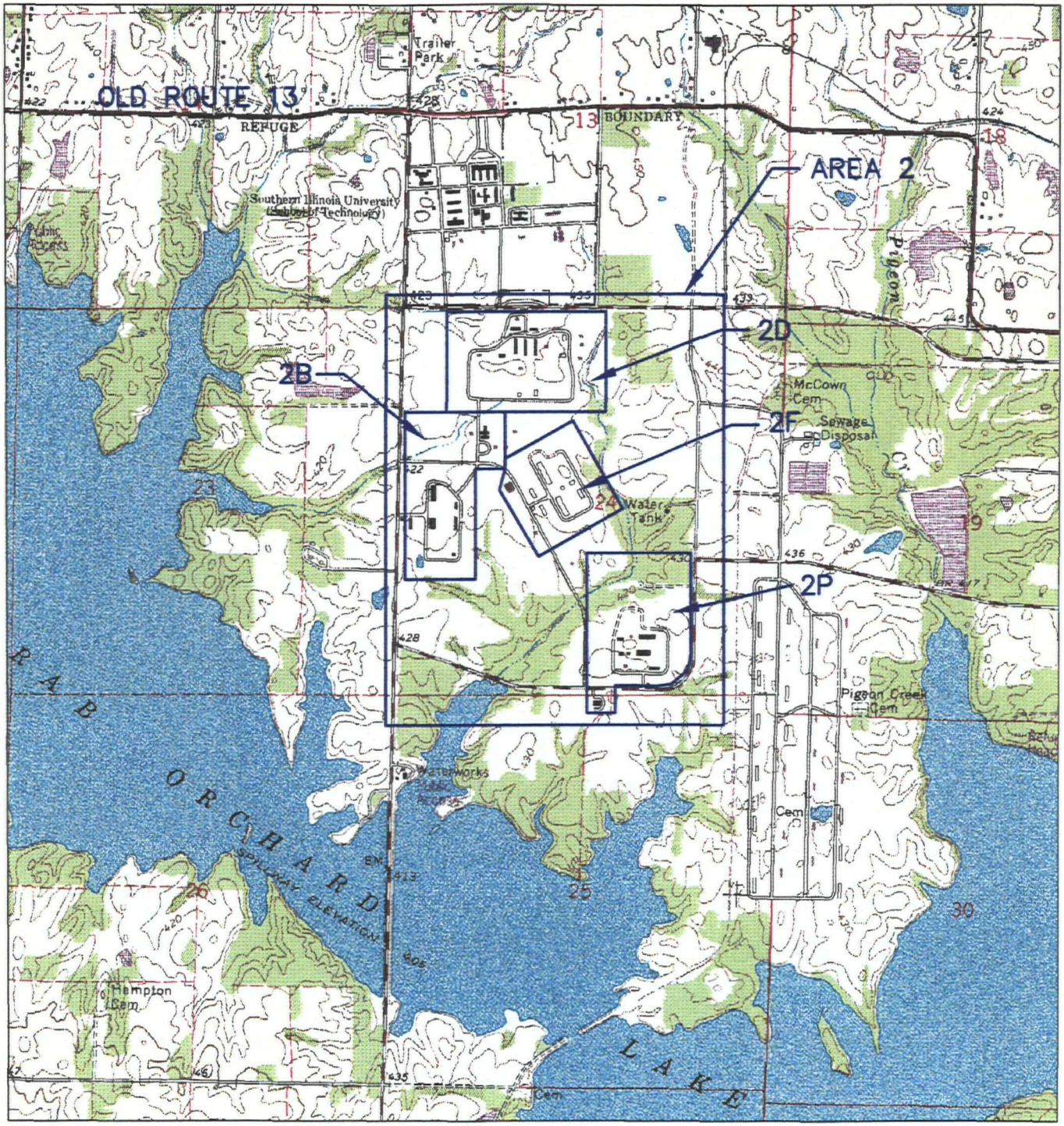
TABLE 3-4
SAMPLE LOCATIONS FOR AREA 2P-IOP PRIMER LOADING LINE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A2P-W06	AUS-0A2P-W06-SD-0X	Drainage ditch south of building P-1-1 near entranceway.	Soil boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	Building P-1-1 used for R&D of products listed in Table 4-3 of the Historic Search Report. This building formerly housed a sump and waters from the sump were reportedly discharged to the grounds in the area.
	AUS-0A2P-W06-SD-01			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A2P-W06-SD-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A2P-W06-SD-??			BWT	TCL Volatiles (8260B)	
	AUS-0A2P-W06-GW-00		Monit. Well	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates, Nitrates + Nitrites, Ammonia as N, alkalinity, TDS, TSS	

BWT = Below water table

NA = Not applicable

COPCs = Chemicals of Potential Concern



0 2000

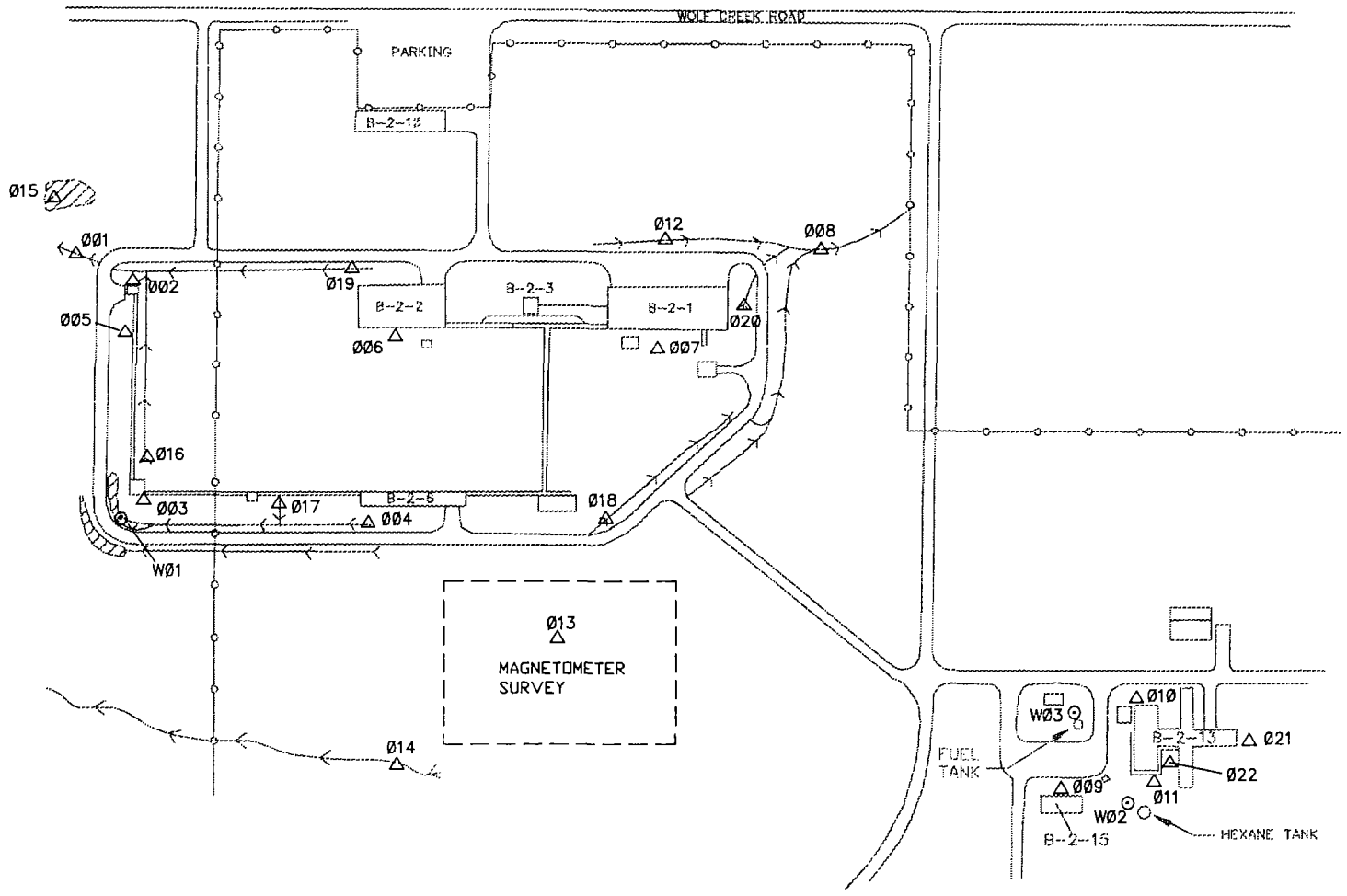
SCALE FEET

N

SOURCE: USGS DIGITAL RASTER GRAPHIC

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS		PROJECT NO. 68F0D97278.00
URS Greiner Woodward Clyde A Division of URS Corporation		
DRN. BY: djd 8/25/99 DSGN. BY: mh CHKD. BY:	Area 2 location	FIG. NO. 3–1

File: F:\45F0M9602N\CRABFIG3-1.DWG Last edited: 02/29/00 @ 4:04 p.m. @ WCC-ST.LOUIS



LEGEND

- SOIL BORING/MONITORING WELL LOCATION
- SHOVEL SAMPLE LOCATIONS
- DITCHLINE
- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

SOURCE: PRI Ø16805

APPRROXIMATE SCALE 1"=3ØØ'

FIELD SAMPLING PLAN-SITE INVESTIGATION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

URS Greiner Woodward Clyde

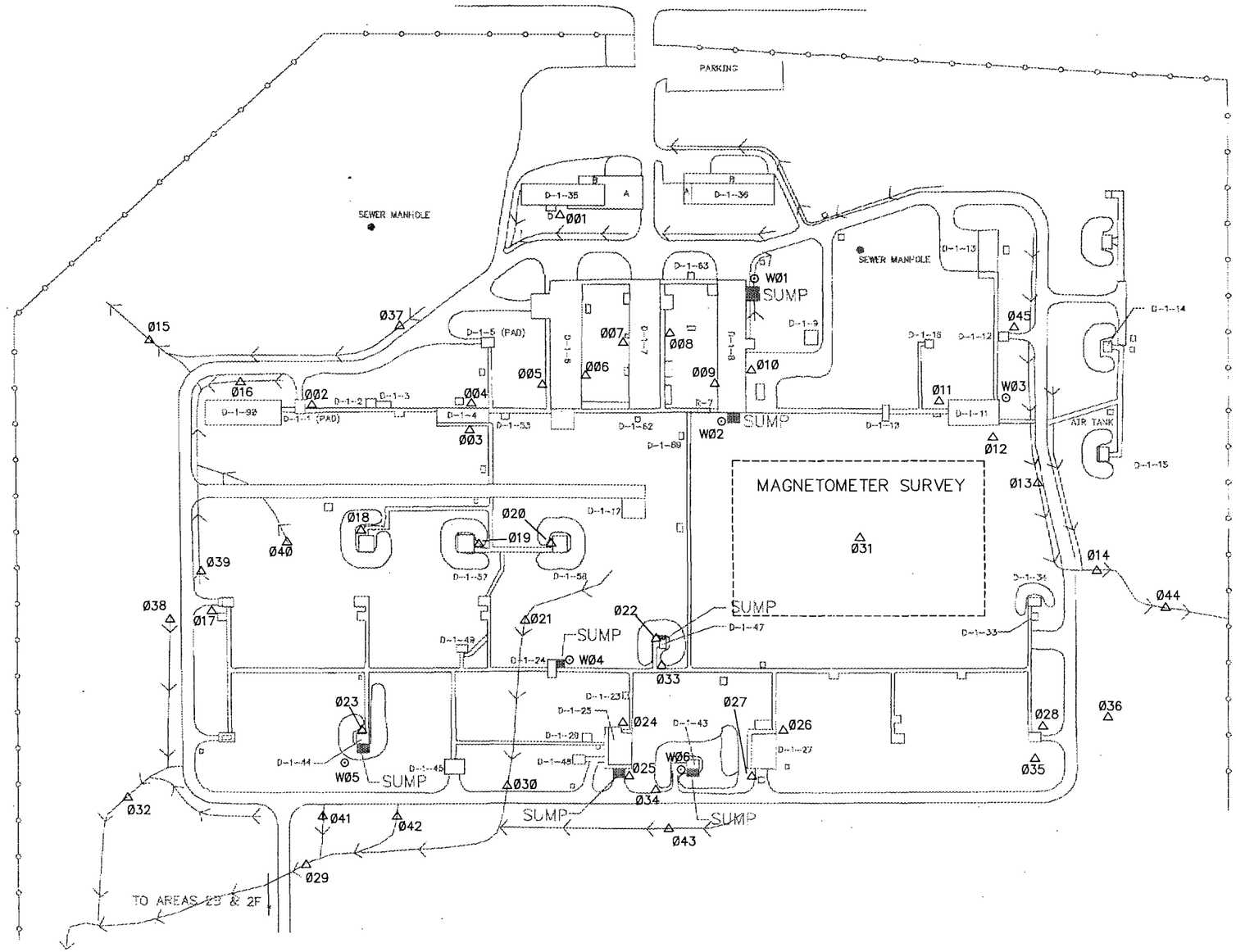
A Division of URS Corporation

DRN. BY: djd 8/15/99 DSGN. BY: mh CHKD. BY:	AUS-ØA2B Area 2B Sample Locations	FIG. NO. 3-2

File: F:\68FOD97278ØØ\COMPOA2B3-2.DWG Last edited: 02/18/00 @ 2:30 p.m. WC-ST.LOUIS, MO

LEGEND

- ⊙ SOIL BORING/MONITORING WELL LOCATION
- △ SHOVEL SAMPLE LOCATIONS
- ⟶ DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)



APPROXIMATE SCALE 1"=200'

N

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68F0D97278.00
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 9/7/99 DSGN. BY: mh CHKD. BY:	AUS–0A2D Area 2D Sample Locations
	FIG. NO. 3–3

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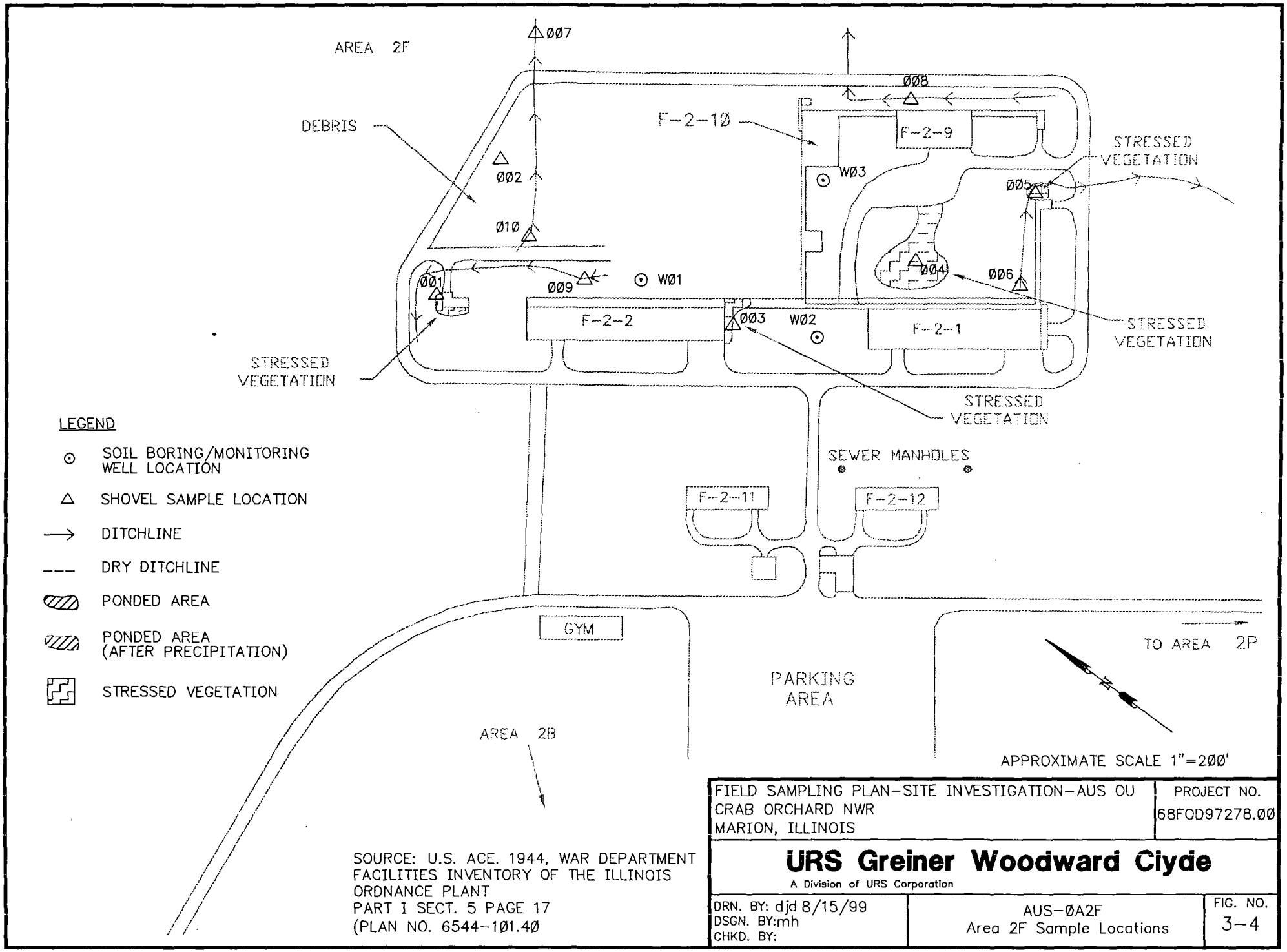


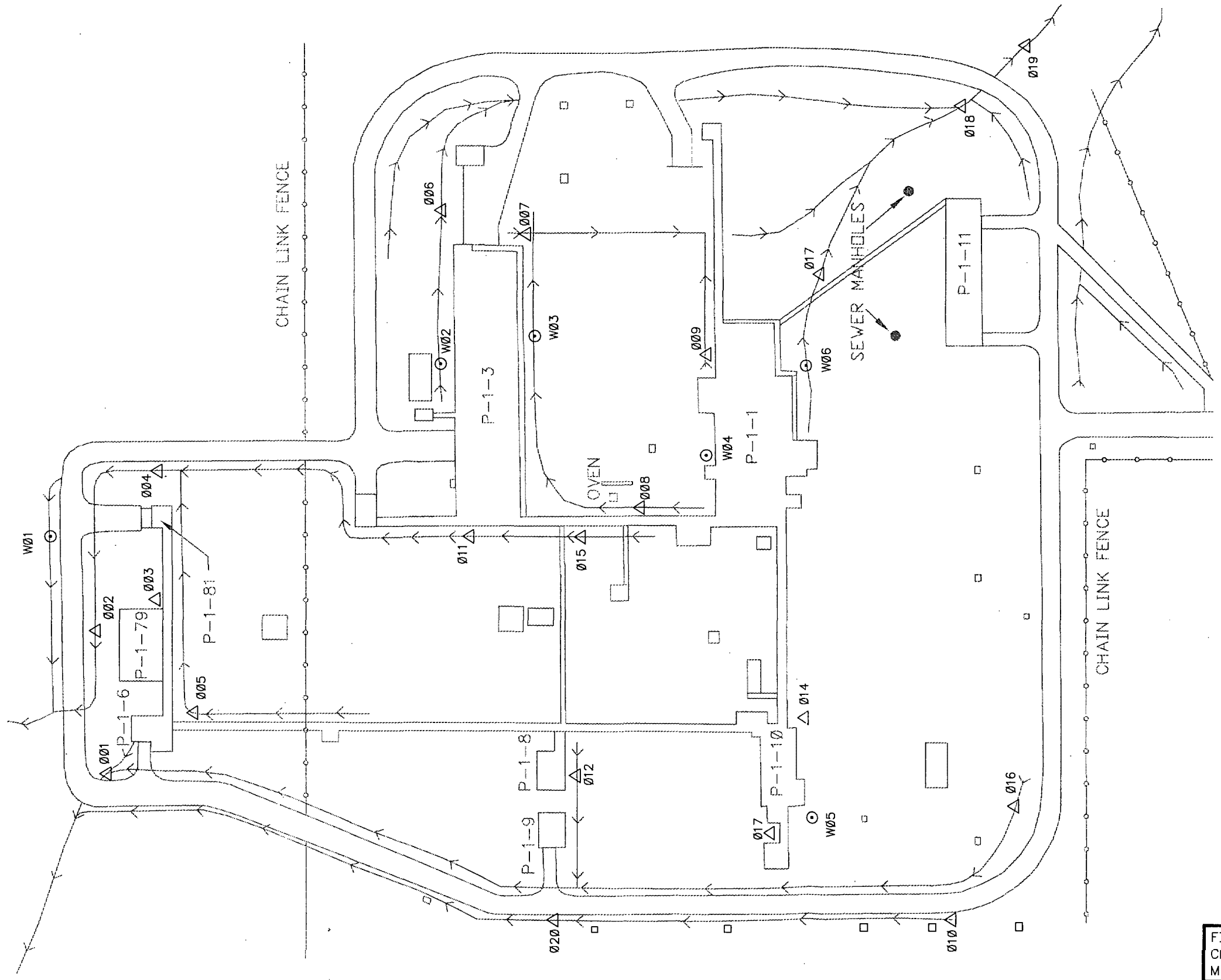
SOURCE: U.S. ACE. 1944, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT PART I SECT. 5 PAGE 17 (PLAN NO. 6544-1Ø1.4Ø

FIELD SAMPLING PLAN-SITE INVESTIGATION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 8/15/99 DSGN. BY:mh CHKD. BY:	AUS-ØA2F Area 2F Sample Locations	FIG. NO. 3-4

File: F:\68FOD97278ØØ\COWPOA2F3-4.DWG Last edited: 02/18/00 @ 2:23 p.m. WC-ST.LOUIS, MO



LEGEND

- ⊙ SOIL BORING/MONITORING WELL LOCATION
- ⊕ HAND AUGER LOCATIONS
- → DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

SOURCE: PRI – Ø16821

APPROXIMATE SCALE 1"=1ØØ'

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY:djd 8/8/99 DSGN. BY:mh CHKD. BY:	AUS–ØA2P Area 2P Sample Locations	FIG. NO. 3–5

File: F:\68FOD9727800\COWPOA2P3-5.DWG Last edited: 02/21/00 @ 08:39 a.m. WC-ST.LOUIS, MO

Area 4 was built as the IOP Shop Area. The Shop Area was the center of the IOP support operation performing the IOP facility maintenance functions necessary for the continued operation of the load lines. It housed all of the construction and mechanical trades as well as a complete automotive shop facility. The location of Area 4 is shown on Figure 4-1. For purposes of this sampling plan the Shop Area has been divided into two separate sub areas physically divided by Highway 148. They are identified below as Area 4 East and Area 4 West.

4.1 AREA 4 EAST – IOP AUTOMOTIVE AND EQUIPMENT SHOP AREA (AUS-0A4E)

Site Location and Boundaries

The site is located on the eastern side of Highway 148 approximately 1.1 miles south of Illinois Route 13. It is bounded on the west by Highway 148 and on the east and north by woodlands. To the south of AUS-0A4E is an open field. The site has two buildings remaining at the site. One is empty and a construction contractor currently leases the other. Area 4 East is shown on Figure 4-2 with sample locations. Information on each sample is contained in Table 4-1.

Site History

This site is the former IOP Automotive and Equipment Shop. The facility was designed and built for the purpose of maintaining the trucks and equipment needed to support ordnance-manufacturing operations. Since World War II the facility has been used various tenants for purposes such as truck and mining equipment maintenance and repair, storage, and manufacturing.

To the southeast of Area 4 a sanitary landfill was remediated as part of the Metals Area Operable Unit (MAOU). The landfill was referred to as the Fire Station Landfill. The contaminant of concern at the Fire Station Landfill was lead.

In the middle of the site adjacent to Highway 148 an IOP vehicle refueling station once stood. The building has been razed; however, it is suspected that the underground fuel storage tanks may have been left in place during the building demolition. A magnetometer survey is planned in the area believed to be the location of the underground storage tanks. The magnetometer survey should provide a clear indication of the presence of the fuel storage tanks if they remain at the site.

Sampling Information Specific to Area 4 East of Highway 148

A walkover survey at the site revealed several areas of stressed vegetation, industrial debris, and debris related to the maintenance of vehicles to the north of the remaining buildings. Surface water at the site is transported via storm sewers to the north and then east via ditches off the site. Samples are planned for the storm sewer outfall location as well as in the drainage ditches which carry surface water off site.

One soil boring/monitoring well is contingent on the results of the magnetometer survey results in the suspected location of the refueling station USTs. Therefore the monitoring well will be installed only if the magnetometer results indicate the presence of USTs. In addition two other

monitoring wells are planned for this site. Their installation will not be dependent on the results of magnetometer surveys or any other testing at the site.

4.2 AREA 4 WEST – IOP WEST SHOP AREA (AUS-0A4W)

Site Location and Boundaries

The site is located on the western side of Highway 148 approximately 1.1 miles south of Illinois Route 13. It is bounded on the east by Highway 148 and on the west and north by woodlands. To the south of Area 4 west is an open field. Several buildings remain at the site and are shown on Figure 4-3 with sample locations. Information on each sample is contained in Table 4-2.

Site History

Area 4 West originally housed the construction and mechanical trades buildings along with a laboratory and laundry facility. After the end of WWII several of the buildings were leased by businesses of all types. Printing companies occupied building S-1-3. A lumber company occupied building S-3-2, S-3-3, and S-3-4. Most notably, however, Supreme Plating Company (a plating operation) occupied building S-2-4 and S-2-5. It was the waste from this plating operation that ultimately became the subject of the MAOU. The remediation of the MAOU included the ditches along the roadsides in the center of Area 4 West as well as the northern drainage swale where the storm sewers discharge their waters.

Buildings S-2-1, S-2-2, and S-2-3 are no longer standing. Buildings S-2-1 and S-2-2 building pads are currently being used as compounds for vehicle storage. Building S-2-3 is now overgrown with vegetation. Sampling Information Specific to Area 4 West of Highway 148

During a walkover survey of the Area 4 West buildings several areas of stressed vegetation were observed around the S-2-5 building (Building S-2-4 was razed). A review of the site characterization for the MAOU (Site 22- O'Brien & Gere) revealed that no samples were taken in the area around building S-2-5. Since this is one of the buildings in which Supreme Plating operated, several samples are included in this Site Inspection in the stressed vegetation around this building.

In addition, aerial photo interpretations of the 1951 and 1960 aerial photos revealed evidence of disposal activities in a remote section of Area 4 to the southwest of building S-1-3.

TABLE 4-1
SAMPLE LOCATIONS FOR AREA 4 EAST - IOP AUTOMOTIVE SHOP
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A4E-001	AUS-0A4E-001-SS-0X	North of former building S-4-1.	Hand auger	0-6 in.	TAL Metals (6010/7000) PAHs (8310) SW846 Explosives + Nitroglycerin (8330)	Building used for maintenance of explosives transport vehicles and wash waters were drained from the building to a nearby field. COPCs are explosives (NG), volatile cleaning solvents, petroleum, and Metals (Pb).
	AUS-0A4E-001-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-002	AUS-0A4E-002-SS-0X	North of former building S-4-1 inside the tree line	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building used for maintenance of explosives transport vehicles. Large amounts of debris related to vehicle maintenance were observed during site walkover. COPCs are explosives (NG), volatile cleaning solvents, petroleum, and Metals (Pb).
	AUS-0A4E-002-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-003	AUS-0A4E-003-SS-0X	Southeast of former building S-4-1	Hand auger	0-6 in.	TAL Metals (6010/7000) PAHs (8310)	Building used for maintenance of explosives transport vehicles and wash waters were drained from the building to a nearby field. Stressed vegetation was observed in this area during site walkover.
	AUS-0A4E-003-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-004	AUS-0A4E-004-SS-0X	Northeast of former building S-4-1 inside the tree line	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building used for maintenance of explosives transport vehicles and wash waters were drained from the building to a nearby field. Debris was observed in this area during site walkover.
	AUS-0A4E-004-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-005	AUS-0A4E-005-SS-0X	North of former building S-4-3 inside the tree line	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Vehicle and equipment maintenance were performed in the buildings in this area. Large amounts of debris were observed in this area during site walkover.
	AUS-0A4E-005-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-006	AUS-0A4E-006-SS-0X	North of former building S-4-3 inside the tree line	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	Vehicle and equipment maintenance were performed in the buildings in this area. Large amounts of debris were observed in this area during site walkover.
	AUS-0A4E-006-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 4-1
SAMPLE LOCATIONS FOR AREA 4 EAST - IOP AUTOMOTIVE SHOP
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A4E-007	AUS-0A4E-007-SD-0X	Northeast of former building in drainage ditch west of storm water outfall location	Hand auger	0-6 in.	TAL Metals (6010/7000) PAHs (8310) TOC (9060) SW846 Explosives + Nitroglycerin (8330)	Building used for maintenance of vehicles and wash waters were drained from the building to a nearby field. Waters discharged in this area would ultimately flow into this drainage way.
	AUS-0A4E-007-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-008	AUS-0A4E-008-SD-0X	North of former building S-4-3 in drainage ditch at stormwater outfall location.	Hand auger	0-6 in.	TAL Metals (6010/7000) PAHs (8310) SW846 Explosives + Nitroglycerin (8330)	Surface water drainage in the area between buildings S-4-1, S-4-2 and S-4-3 would ultimately flow past this point. Buildings used for maintenance of vehicles and wash waters were drained from the one building to a nearby field. Storm water outfall is the likely recipient of these surface waters. COPCs are explosives (NG), volatile cleaning solvents, petroleum, and Metals (Pb).
	AUS-0A4E-008-SW-00		Surface water	NA	TAL Metals (6010/7000) PAHs (8310) SW846 Explosives + Nitroglycerin (8330) Ammonia as N, Nitrates + Nitrites	
0A4E-009	AUS-0A4E-009-SD-0X	Northeast of former building S-4-3 in drainage ditch in area of abandoned drums	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	Abandoned drums were observed in a ditch to the north and east of the former IOP automotive shop area. Drums likely resulted from vehicle maintenance activities.
	AUS-0A4E-009-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-010	AUS-0A4E-010-SD-0X	Northeast of building S-4-4 in drainage ditch.	Hand auger	0-6 in.	TAL Metals (6010/7000) PAHs (8310)	Drainage from the areas around buildings S-4-4 and S-4-5 eventually passes this point. Buildings used for storage and also for the repair and maintenance of mine equipment. COPCs include Metals (Pb), volatile solvents, and Petroleum hydrocarbons.
	AUS-0A4E-010-SD-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 4-1
SAMPLE LOCATIONS FOR AREA 4 EAST - IOP AUTOMOTIVE SHOP
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A4E-011	AUS-0A4E-011-SS-0X	East of building S-4-3 near the building	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building housed the IOP equipment maintenance garage and stressed vegetation was observed during walkover survey. COPCs include Metals, petroleum hydrocarbons, and volatile solvents.
	AUS-0A4E-011-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-012	AUS-0A4E-012-SD-0X	East of building S-4-3 in the drainage ditch just inside the tree line	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building housed the IOP equipment maintenance garage and surface waters draining east of S-4-3 would ultimately end up in this drainage way. COPCs include Metals, petroleum hydrocarbons, and volatile solvents.
	AUS-0A4E-012-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-013	AUS-0A4E-013-SD-0X	East of building S-4-3 in the drainage ditch just inside the tree line	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building housed the IOP equipment maintenance garage and surface waters draining east of S-4-3 would ultimately end up in this drainage way. COPCs include Metals, petroleum hydrocarbons, and volatile solvents.
	AUS-0A4E-013-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-014	AUS-0A4E-014-SS-0X	North of abandoned concrete foundation	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building housed a mine equipment repair facility. Volatile cleaning solvents, Metals and petroleum hydrocarbons are COPCs.
	AUS-0A4E-014-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-015	AUS-0A4E-015-SS-0X	South of abandoned concrete foundation	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building housed a mine equipment repair facility. Volatile cleaning solvents, Metals and petroleum hydrocarbons are COPCs.
	AUS-0A4E-015-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4E-016	AUS-0A4E-016-SS-0X	South of abandoned concrete foundation	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building housed a mine equipment repair facility. Volatile cleaning solvents, Metals and petroleum hydrocarbons are COPCs.
	AUS-0A4E-016-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 4-1
SAMPLE LOCATIONS FOR AREA 4 EAST - IOP AUTOMOTIVE SHOP
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A4E-W01	AUS-0A4E-W01-SS-0X	Northwest of former building S-4-1.	Soil boring	0-6 in.	TAL Metals (6010/7000) PAHs (8310) SW846 Explosives + Nitroglycerin (8330)	Building used for maintenance of explosives transport vehicles and wash waters were drained from the building to a nearby field. Vegetation changes were observed in this area during site walkover. COPCs are explosives (NG), volatile cleaning solvents, petroleum, and Metals (Pb).
	AUS-0A4E-W01-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0A4E-W01-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A4E-W01-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A4E-W01-GW-00		Monit. Well	NA	TAL Metals (6010/7000) SW846 Explosives + Nitroglycerin (8330) PAHs (8310) TCL Volatiles (8260b)	
0A4E-W02	AUS-0A4E-W02-SS-0X	East of building S-4-3 near the building	Soil boring	0-6 in.	TAL Metals (6010/7000) PAHs (8310)	Building housed the IOP equipment maintenance garage and stressed vegetation was observed during walkover survey. COPCs include Metals, petroleum hydrocarbons, and volatile solvents.
	AUS-0A4E-W02-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0A4E-W02-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A4E-W02-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A4E-W02-GW-00		Monit. Well	NA	TAL Metals (6010/7000) PAHs (8310) TCL Volatiles (8260b)	

TABLE 4-1
SAMPLE LOCATIONS FOR AREA 4 EAST - IOP AUTOMOTIVE SHOP
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A4E-W03	AUS-0A4E-W03-SS-05	South west of any USTs identified by the magnetometer survey in the area of the former vehicle refueling station.	Soil boring	4-5 ft	TCL Volatiles (8260B) PAHs (8310)	If the former vehicle refueling station USTs are located by the magnetometer survey, then this soil boring will be placed next just southwest of the USTs. If the USTs can not be located then this soil boring will be placed in the most likely area of the former USTs. This boring is to determine the potential for subsurface contamination associated with the USTs.
	AUS-0A4E-W03-SS-??			BWT	TCL Volatiles (8260B) PAHs (8310)	
	AUS-0A4E-W03-GW-00		Monit. Well	NA	TAL Metals (6010/7000) PAHs (8310) TCL Volatiles (8260b)	

BWT = Below water table
NA = Not applicable

TABLE 4-2
SAMPLE LOCATIONS FOR AREA 4 WEST - IOP WEST SHOP AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A4W-001	AUS-0A4W-001-SS-0X	Southwest of building S-1-2 in wooded area at location identified by Aerial photo interpretations	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site identified by aerial photo interpretation as the possible location of dumping activities in the 1960 aerial photos. Site will be located using GPS coordinates.
	AUS-0A4W-001-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-002	AUS-0A4W-002-SS-0X	Southwest of building S-1-2 in wooded area at location identified by Aerial photo interpretations	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site identified by aerial photo interpretation as the possible location of dumping activities in the 1951aerial photos. Site will be located using GPS coordinates.
	AUS-0A4W-002-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-003	AUS-0A4W-003-SS-0X	Northeast of building S-2-5 near building in area of stressed vegetation.	Hand auger	0-6 in.	TAL Metals (6010/7000)	Building was the original location of Supreme Plating which was the subject of the Metals Area Operable Unit Remedial Action. Definite signs of stressed vegetation were observed during site walkover.
	AUS-0A4W-003-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-004	AUS-0A4W-004-SS-0X	South of building S-2-5 adjacent to building.	Hand auger	0-6 in.	TAL Metals (6010/7000)	Building was the original location of Supreme Plating which was the subject of the Metals Area Operable Unit Remedial Action. Definite signs of stressed vegetation were observed during site walkover.
	AUS-0A4W-004-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-005	AUS-0A4W-005-SS-0X	West of building S-2-5 adjacent to building south of doorway.	Hand auger	0-6 in.	TAL Metals (6010/7000)	Building was the original location of Supreme Plating which was the subject of the Metals Area Operable Unit Remedial Action. Definite signs of stressed vegetation were observed during site walkover.
	AUS-0A4W-005-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-006	AUS-0A4W-006-SS-0X	North of building S-2-5 approximately 35 feet.	Hand auger	0-6 in.	TAL Metals (6010/7000)	Building was the original location of Supreme Plating which was the subject of the Metals Area Operable Unit Remedial Action. No investigation of the grounds between S-2-4 and S-2-5 was performed.
	AUS-0A4W-006-SS-02			1-2 ft	TCL Volatiles (8260B)	

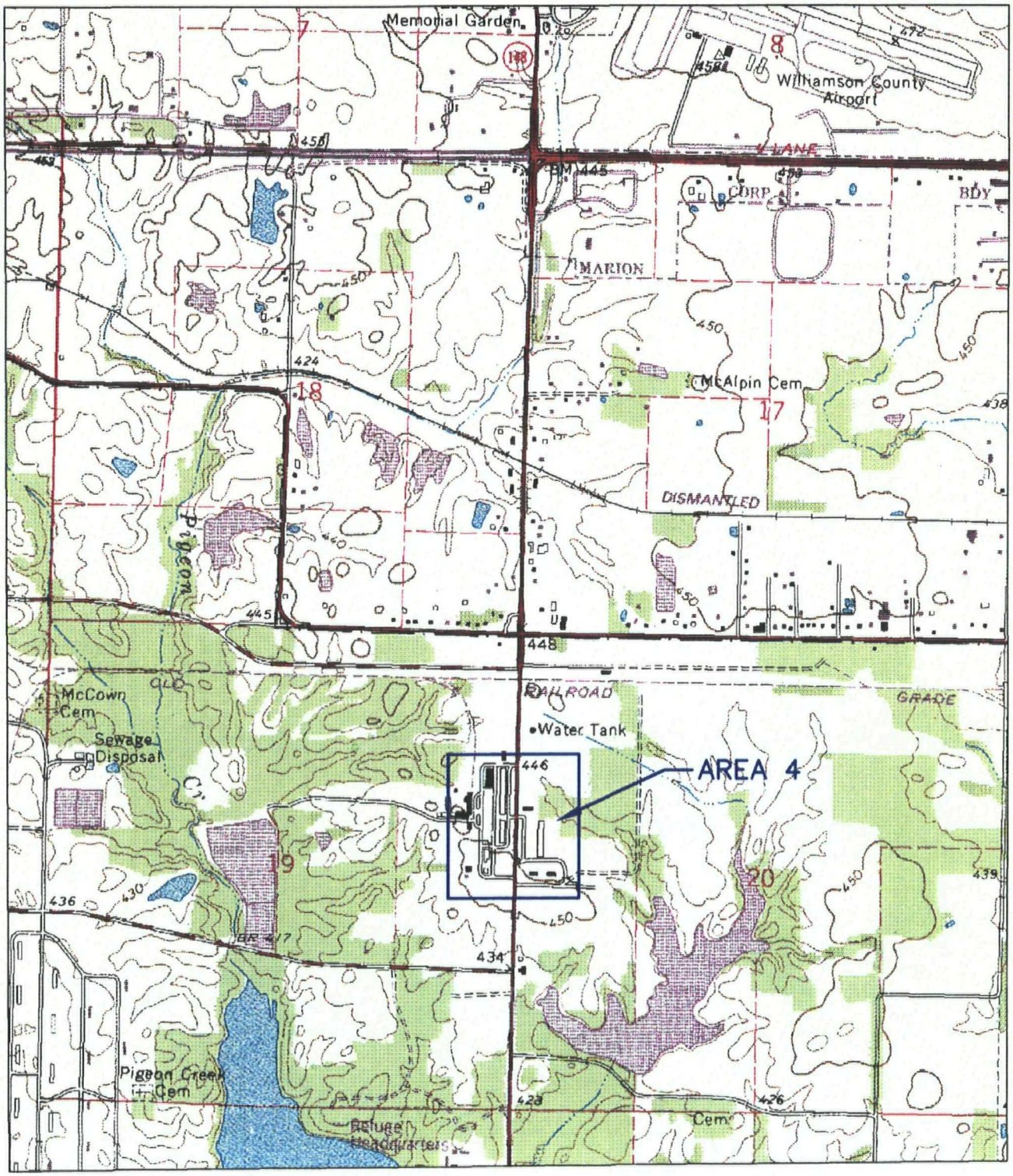
TABLE 4-2
SAMPLE LOCATIONS FOR AREA 4 WEST - IOP WEST SHOP AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A4W-007	AUS-0A4W-007-SS-0X	Northeast of former location of building S-2-4	Hand auger	0-6 in.	TAL Metals (6010/7000)	Supreme Plating which was the subject of the Metals Area Operable Unit Remedial Action operated in buildings S-2-4 and S-2-5. No investigation of the grounds between S-2-4 and S-2-3 was performed.
	AUS-0A4W-007-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-008	AUS-0A4W-008-SS-0X	Northwest of former location of building S-2-4	Hand auger	0-6 in.	TAL Metals (6010/7000)	Supreme Plating which was the subject of the Metals Area Operable Unit Remedial Action operated in buildings S-2-4 and S-2-5. No investigation of the grounds between S-2-4 and S-2-3 was performed.
	AUS-0A4W-008-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-009	AUS-0A4W-009-SD-0X	East of former location of building S-2-4 across the road in ditch.	Hand auger	0-6 in.	TAL Metals (6010/7000)	Supreme Plating which was the subject of the Metals Area Operable Unit Remedial Action operated in buildings S-2-4 and S-2-5. Analysis of one sample from this ditch had cadmium levels above cleanup levels.
	AUS-0A4W-009-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-010	AUS-0A4W-010-SD-0X	East of building S-2-5 across the road in ditch.	Hand auger	0-6 in.	TAL Metals (6010/7000)	Supreme Plating which was the subject of the Metals Area Operable Unit Remedial Action operated in buildings S-2-4 and S-2-5. Analysis of one sample from this ditch had cadmium levels above cleanup levels.
	AUS-0A4W-010-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-011	AUS-0A4W-011-SS-0X	Located in roadside drainage ditch to the northeast of building S-1-3	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) TOC (9060) SW846 Explosives (8330)	Former IOP laboratory and Diagraph Bradley/ Midwest Brush building. COPCs include Explosives, volatile solvents, Metals, and BNAs from inks.
	AUS-0A4W-011-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A4W-012	AUS-0A4W-012-SS-0X	West of building S-1-3 in an area near doorway.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Former IOP laboratory and Diagraph Bradley/ Midwest Brush building. COPCs include Explosives, volatile solvents, Metals, and BNAs from inks.
	AUS-0A4W-012-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 4-2
SAMPLE LOCATIONS FOR AREA 4 WEST - IOP WEST SHOP AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A4W-013	AUS-0A4W-013-SS-06	Northwest of building S-1-17 (use survey coords)	Hand auger	5-6 ft	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260B)	Former AST location according to aerial photographs – located next to Diesel Repair Shop – possible COPCs: fuel or waste oils

COPCs = Chemicals of Potential Concern



SOURCE: USGS DIGITAL RASTER GRAPHIC

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SCALE miles

FIELD SAMPLING PLAN-SITE INVESTIGATION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

URS Greiner Woodward Clyde

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DRN. BY: djd 8/25/99 DSGN. BY: mh CHKD. BY:	Area 4 Location	FIG. NO. 4-1

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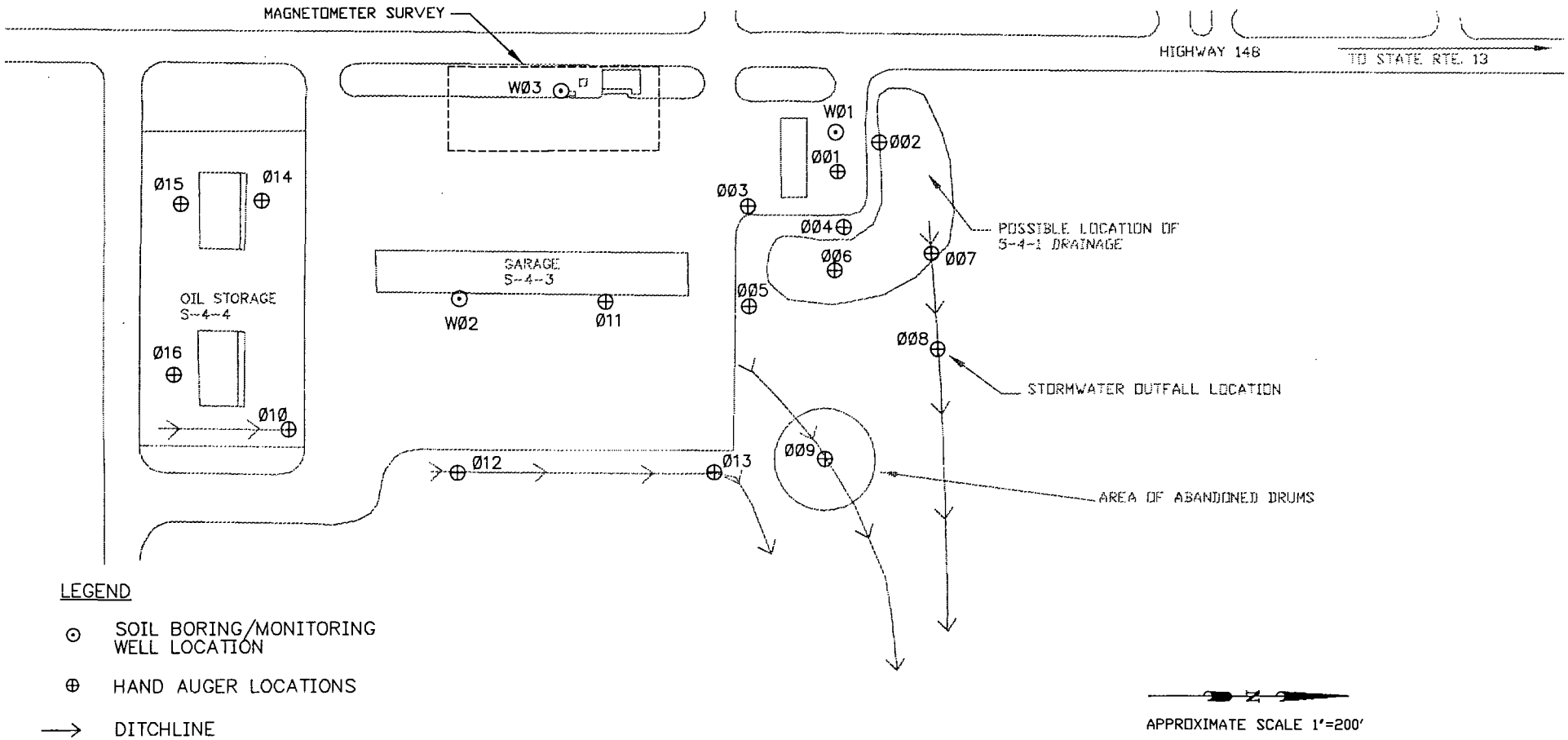

LEGEND

- ⊙ SOIL BORING/MONITORING WELL LOCATION
- ⊕ HAND AUGER LOCATIONS
- ⟶ DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

SOURCE: U.S. ACE. 1944, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT PART I SECT. 5 PAGE 2 (PLAN NO. 6544-101.06

FIELD SAMPLING PLAN-FIELD INVESTIGATION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

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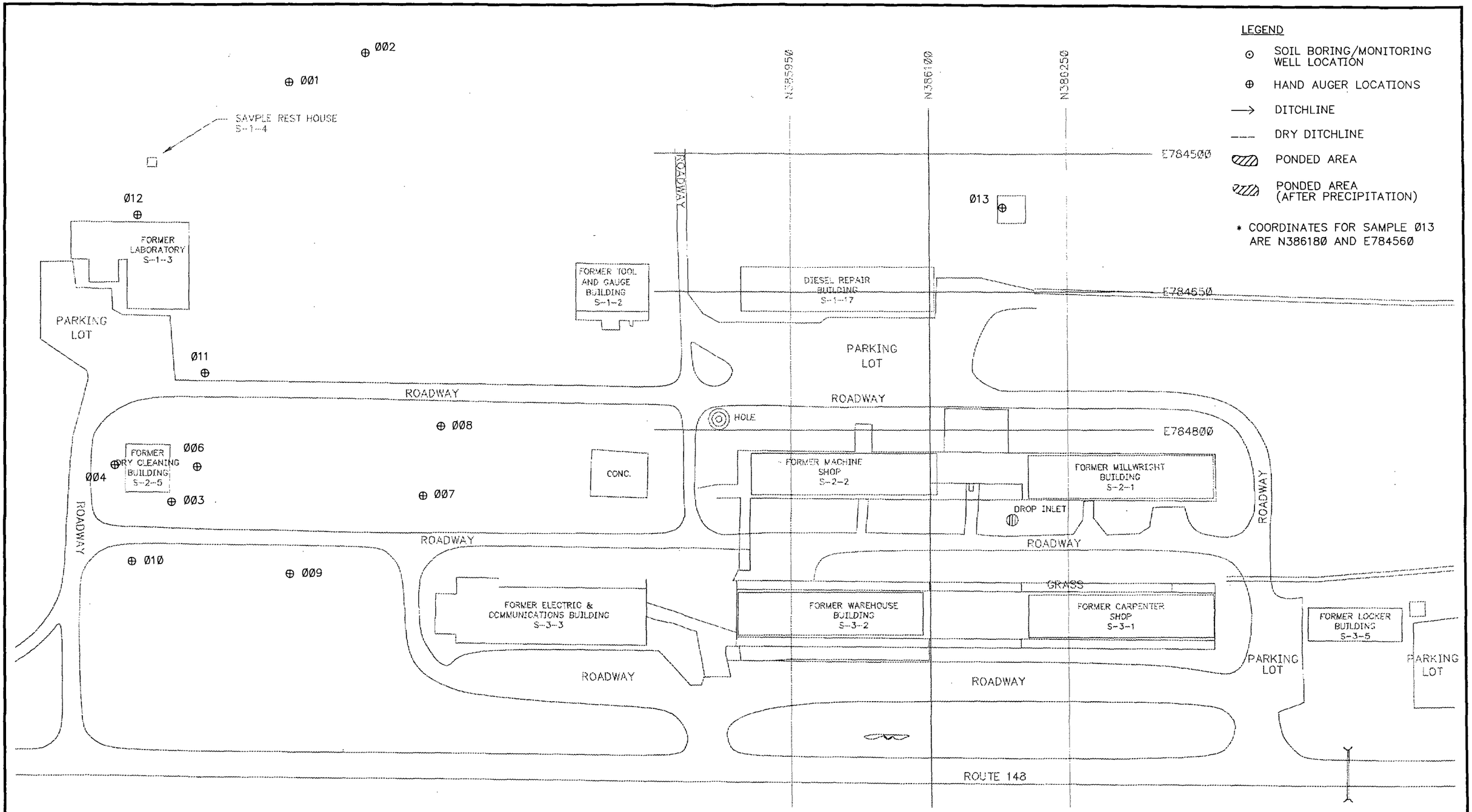
DRN. BY: djd 8/21/99 DSGN. BY: mh CHKD. BY:	AUS-ØA4E Area 4 East Sample Locations	FIG. NO. 4-2

File: F:\68FOD9727800\CRABAUS4FIG4-2.EAST.DWG Last edited: 02/21/00 @ 08:03 a.m. @ WCC-ST.LOUIS



SOURCE: U.S. ACE. 1944, WAR DEPARTMENT
FACILITIES INVENTORY OF THE ILLINOIS
ORDNANCE PLANT
PART I SECT. 5 PAGE 2
(PLAN NO. 6544-101.06

FIELD SAMPLING PLAN-FIELD INVESTIGATION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.00

URS Greiner Woodward Clyde
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DRN. BY:djd 8/21/99 DSGN. BY:mh CHKD. BY:	AUS-0A4W Area 4 West Sample Locations	FIG. NO. 4-3

File: F:\68FOD9727800\CRABAUSFIG4-3WEST.DWG Last edited: 02/24/00 @ 09:32 a.m. @ WCC-ST.LOUIS

5.1 AREA 6 – IOP AMMONIUM NITRATE HIGH EXPLOSIVE AND SMOKELESS POWDER STORAGE AREA

Site Location and Boundaries

The site is located east of Highway 148 in a remote area of the Refuge. The site is located 0.7 miles south of Old Highway 13, on Chamness Road. The site is bounded on the south, north and west by woodlands and the east by open fields. The location of Area 6 is shown on Figure 2-1.

Site History

This site is the former IOP Ammonium Nitrate High Explosive and Smokeless Powder Storage Area. The site has 84 explosive storage igloos in 7 rows and has been used for storage ever since WWII. Samples at the railroad loading docks on the north and south had exceedances of screening levels. The analytes Indeno[1,2,3-cd]pyrene and dibenz[a,h]anthracene exceeded USEPA SSLs in the sample at the south railroad loading dock. The analytes benzo[b]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-cd]pyrene, and dibenz[a,h]anthracene exceeded USEPA SSLs in the sample at the northern railroad loading dock. Barium also exceeded USEPA SSLs and Refuge background values in one sample.

In addition to the northern and southern railroad loading docks each igloo has a truck loading dock. One row of igloos sits adjacent to the former rail line and had both truck loading docks and railroad loading docks.

Sampling Information Specific to Area 6

Because of the large amounts of explosives and other materials stored in the igloos spills in the igloos and on the docks are likely. Sampling at randomly selected igloos will provide a good overall picture of the likelihood of contamination at any of the loading dock areas. Samples will be taken in the soils directly beneath the loading areas in front of the igloo doorways. Sampling in this manner will be more likely to identify loading docks affected by spills. Therefore the igloo loading docks in Area 6 were numbered from 1 to 86 (including the north and south railroad loading docks) and 26 random numbers were chosen using a random number generator (30 % sampling rate). The random numbers chosen are shown on Table 5-1. Igloos represented by those random numbers will have their loading docks sampled according to the sample outlines in Table 5-2. The loading docks to be sampled are circled on Figure 5-1.

TABLE 5-1
RANDOMLY GENERATED AREA 6 IGLOOS TO BE SAMPLED

Sample Number	Igloo Number
1	82
2	76
3	28
4	65
5	6
6	63
7	52
8	81
9	86
10	41
11	42
12	8
13	17
14	56
15	3
16	80
17	69
18	20
19	15
20	34
21	62
22	48
23	30
24	73
25	83
26	35

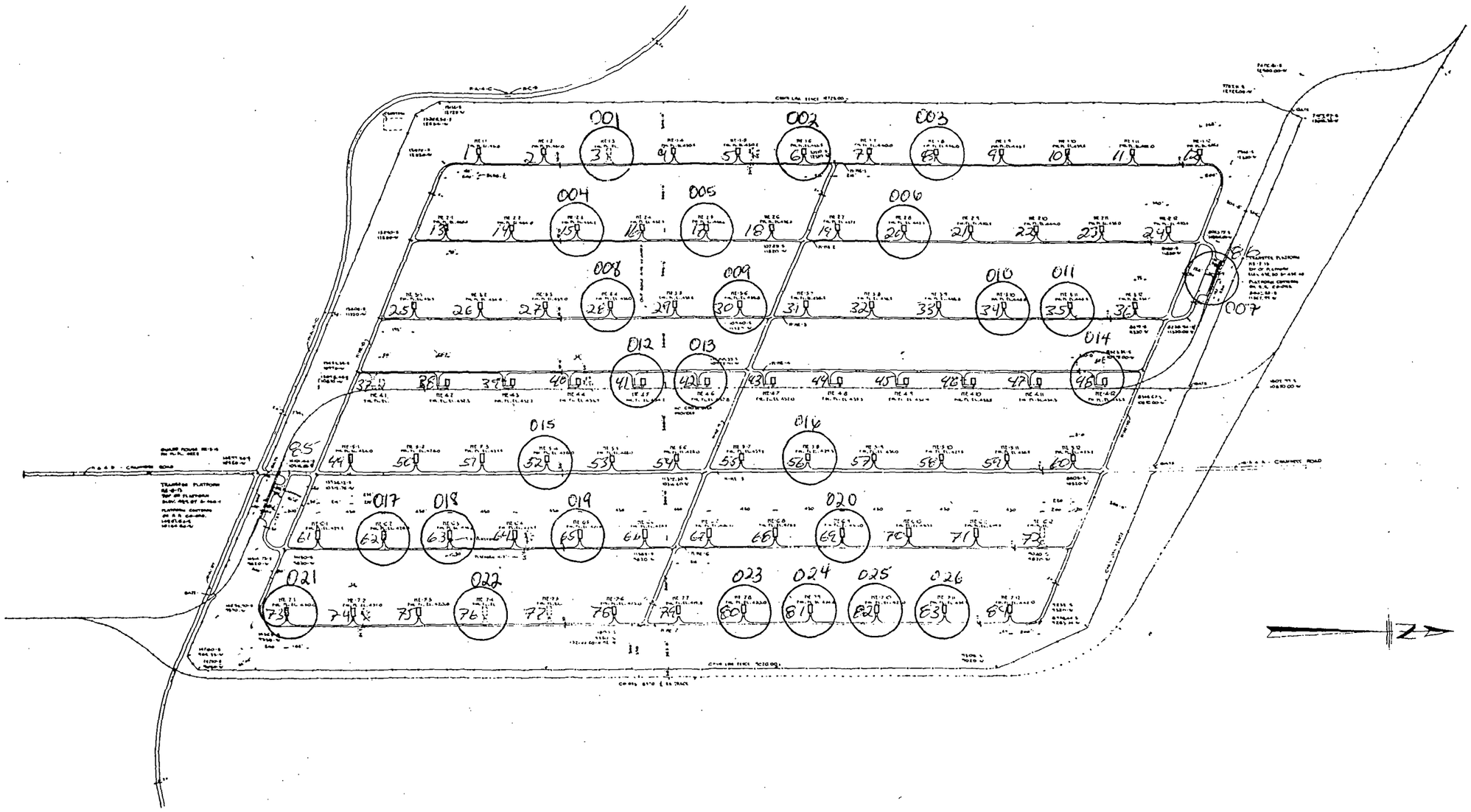
TABLE 5-2

SAMPLE ANALYSES FOR AUS 0A06 – IOP HIGH EXPLOSIVE STORAGE IGLOOS

CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A06-001 through 0A06-026	AUS-0A06-001-SS-0X through AUS-0A06-026-SS-0X	Loading dock area of the Igloo number chosen by random number generator	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	All Igloos loading docks have an equal probability of having some contamination. Thirty percent of the loading docks will be selected randomly and sampled for the listed analysis. Previous sampling at the railroad loading docks indicated the presence of BNAs and metals above SSLs. Explosives and their raw materials are normally stored in the igloos.

Note: Sample at igloo number 42 will have a TOC sample at that location.
This sample will be labeled 0A06-013.



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SCALE FEET

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.00
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 11/2/99 DSGN. BY: mh CHKD. BY:	Area 6 Sample Locations FIG. NO. 5–1

6.1 AREA 7 – IOP INERT STORAGE AREA

Site Location and Boundaries

The site is located east of Highway 148 in a remote area of the Refuge. The site is located 0.5 miles north of Ogden Road on Chamness road. The site consists of a group of 28 warehouse buildings bounded on all sides by undeveloped woodlands. The location of Area 7 is shown on Figure 6-1.

Site History

Area 7 was originally built as the IOP Inert Storage complex, which warehoused metal parts and other inert materials used in the production of artillery shells, tank mines and 500 lb. bombs and their component parts.[40] The building complex was constructed in 6 rows of buildings (5 to 7 buildings per row originally). Only 26 of the original buildings in Area 7 remain standing. The current configuration of Area 7 is shown on Figure 6-2 along with sampling locations. Information on each sample is contained in Table 6-1.

After the end of WWII several industries began leasing space in Area 7.[42] Information on the known leasing history for Area 7 is detailed in the AUS Historic Search Report Section 7. Only one business is known to have stored hazardous materials in Area 7. That business was Great Lakes T & T which stored pesticides in buildings IN-1-5 and IN-1-6. All other businesses, which would have handled hazardous materials, used the buildings for purposes other than storage. Since the buildings in Area 7 were built strictly for storage, other uses of these buildings required building occupants to modify the buildings. One of the most important modifications required in the Area 7 buildings to make them capable of housing production operations is an upgrade of the electrical service. Production operations require that three phase power be supplied to a building so that equipment and machinery can be used.[43] Only eight of the remaining 26 buildings in Area 7 have the equipment necessary for supplying three phase power. These buildings are IN-1-1, IN-1-5, IN-1-6, IN-2-1, IN-2-5, IN-2-6, IN-3-4, and IN-6-5.

It is known that buildings IN-3-5, IN-4-4, IN–5-2 and IN-5-3 were used for production activities for several years. In fact, the 1988 O'Brien & Gere RI performed sampling around these buildings because of the appearance of black residues. Sample analyses revealed low levels of BNAs and PCBs, however, no further action was recommended for this area. Subsequently these buildings were demolished and buried at the site.

It is possible that other buildings razed in Area 7 were also involved in production activities. However, the remaining building debris is buried under 2 feet of soil and the original landscape and drainage profiles have been changed as a result. Therefore identifying areas impacted from

[40] U.S. ACE, 1944, Part I Sect. 7 page 28.
[41] U.S. ACE, 1944, Part I Sect. 5 page 5.
[42] Techlaw, 1992, pages 59-63b.
[43] Large motors used in pumps, lathes, metal working equipment, etc. require three phase power be supplied to the motor. Three phase power can not be supplied using the same electrical service that was installed to supply the single phase power the IOP used for lighting. Therefore additional equipment had to be installed to support activities other than lighting.

production activities must rely on observations of the conditions at the site. During the site walkover of Area 7, none of the typical signs of environmental impacts were observed in the areas of the razed buildings. Therefore no sampling in the areas of these buildings will be performed during the site inspection.

TABLE 6-1
SAMPLE LOCATIONS FOR AREA 7 - IOP INERT STORAGE AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A07-001	AUS-0A07-001-SS-0X	Northwest corner of building IN-1-6.	Hand auger	0-6 in.	Pesticides (8081)	Building was used for the storage of pesticides as well as other unknown production activities.
	AUS-0A07-001-SS-02			1-2 ft	Pesticides (8081)	
0A07-002	AUS-0A07-002-SS-0X	North of building IN–1-6	Hand auger	0-6 in.	Pesticides (8081)	Building was used for the storage of pesticides as well as other unknown production activities.
	AUS-0A07-002-SS-02			1-2 ft	Pesticides (8081)	
0A07-003	AUS-0A07-003-SS-0X	Northeast of building IN-1-6 and northwest of building IN-1-5	Hand auger	0-6 in.	Pesticides (8081)	Building was used for the storage of pesticides as well as other unknown production activities.
	AUS-0A07-003-SS-02			1-2 ft	Pesticides (8081)	
0A07-004	AUS-0A07-004-SS-0X	North of building IN–1-5	Hand auger	0-6 in.	Pesticides (8081)	Building was used for the storage of pesticides as well as other unknown production activities.
	AUS-0A07-004-SS-02			1-2 ft	Pesticides (8081)	
0A07-005	AUS-0A07-005-SS-0X	Northeast of building IN–1-5	Hand auger	0-6 in.	Pesticides (8081)	Building was used for the storage of pesticides as well as other unknown production activities.
	AUS-0A07-005-SS-02			1-2 ft	Pesticides (8081)	
0A07-006	AUS-0A07-006-SS-0X	Northeast of building IN–1-4 near fuel oil storage tank.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Leaking aboveground fuel oil storage tank was observed during the site walkover. Petroleum hydrocarbons and Metals are chemicals of potential concern.
	AUS-0A07-006-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A07-007	AUS-0A07-007-SS-0X	Northeast of building IN–2-6 underneath the H-Frame transformer station	Hand auger	0-6 in.	PCBs (8082)	Old electrical transformers at this location are not marked as non-PCB and appear to be in poor condition.
0A07-008	AUS-0A07-008-SD-0X	East of building IN–2-6 in drainage ditch.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building used for the production of commercial fixtures involving the use of solvents, varnishes and possibly lead paints.
	AUS-0A07-008-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A07-009	AUS-0A07-009-SS-0X	South of building IN–2-6 near discharge pipe.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Discharge pipe is a floor drain for a flammable materials storage vault. It likely was used to discharge cleaning fluids from the vault. COPCs include lead paints, varnishes, and volatile solvents.
	AUS-0A07-009-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 6-1
SAMPLE LOCATIONS FOR AREA 7 - IOP INERT STORAGE AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A07-010	AUS-0A07-010-SS-0X	South of building IN–2-6 near exhaust fan.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Exhaust fan used to exhaust a paint booth used to paint commercial fixtures. Solvents, lead and paint additives are possible pollutants.
	AUS-0A07-010-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A07-011	AUS-0A07-011-SD-0X	Drainage ditch to the south of building IN-2-1	Hand auger	0-6 in.	TCL BNAs (8270c) TAL Metals (6010/7000)	Building used for printing operations and solvent use is likely. COPCs include Volatiles, Metals, and BNAs used in inks.
	AUS-0A07-011-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A07-012	AUS-0A07-012-SS-0X	South of building IN–2-5 second overhead door from the east end.	Hand auger	0-6 in.	TCL BNAs (8270c)	Gluing operations were performed in the building near this area involving both glues and solvent cleaners.
	AUS-0A07-012-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A07-013	AUS-0A07-013-SS-0X	West of building IN-3-4 near the sump pit.	Hand auger	0-6 in.	TCL BNAs (8270c) PCBs (8082)	Building was used for used oil recycling and drum cleaning operations. Contamination in the area of the sump is likely. PCBs, and petroleum hydrocarbons are contaminants of concern.
	AUS-0A07-013-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A07-014	AUS-0A07-014-SD-0X	Drainage ditch to the south east of building IN-2-1	Hand auger	0-6 in.	TCL BNAs (8270c) PCBs (8082)	Building used for printing operations and solvent use is likely.
	AUS-0A07-014-SD-02			6-12 in.	TCL Volatiles (8260B)	
0A07-015	AUS-0A07-015-SD-0X	Drainage ditch to the south of building IN-4-1	Hand auger	0-6 in.	PCBs (8082)	Drainage ditch collects surface water runoff from the southeastern portion of the facility. PCBs and Xylenes were found in other areas of the site.
	AUS-0A07-015-SD-02			6-12 in.	TCL Volatiles (8260B)	
0A07-016	AUS-0A07-016-SS-0X	East of building IN-4-6 in area of stressed vegetation alongside building	Hand auger	0-6 in.	Pesticides (8081) TCL BNAs (8270c) PCBs (8082)	Building does not have a complete tenant history, however stressed vegetation was observed during the site walkover. PCBs and Xylenes found in drainage sediment in a ditch to the east and are therefore COPCs along with pesticides.
	AUS-0A07-016-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 6-1
SAMPLE LOCATIONS FOR AREA 7 - IOP INERT STORAGE AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A07-017	AUS-0A07-017-SD-0X	Southeast of building IN-4-5 in drainage ditch	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) PCBs (8082) TOC (9060)	Drainage ditch collects surface runoff from the area between buildings IN-4-5 and IN-4-6 and stressed vegetation was observed in this area. PCBs and Xylenes found in drainage sediment in a ditch to the east and are therefore COPCs along with pesticides.
	AUS-0A07-017-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A07-018	AUS-0A07-018-SS-0X	East of building IN-4-5 in area of stressed vegetation alongside building	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building was used for fiberglass operations and mining equipment restoration and stressed vegetation was observed during the site walkover. COPCs include Metals, paints, and volatile solvents
	AUS-0A07-018-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A07-019	AUS-0A07-019-SS-0X	North of building IN–5-6 near aboveground storage tanks.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Leaking aboveground fuel storage tanks were observed during the site walkover and petroleum hydrocarbons and Metals are contaminants of concern.
	AUS-0A07-019-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A07-020	AUS-0A07-020-SS-0X	South of building IN-6-5	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building was used for fiberglass operations, mining equipment restoration, and other production uses. Chemicals of potential concern include volatile solvents, Metals, and paints.
	AUS-0A07-020-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A07-021	AUS-0A07-021-SS-0X	East of building IN-6-5 in area of stressed vegetation alongside building	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building was used for fiberglass operations and mining equipment restoration and stressed vegetation was observed during the site walkover. COPCs include volatile solvents, Metals, and paints.
	AUS-0A07-021-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A07-022	AUS-0A07-022-SD-0X	Southern end of north-south drainage ditch.	Hand auger	0-6 in.	PCBs (8082)	Previous sampling in this portion of the drainage ditch found both PCBs and xylenes. No definitive source of these compounds was identified.
	AUS-0A07-022-SD-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 6-1
SAMPLE LOCATIONS FOR AREA 7 - IOP INERT STORAGE AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

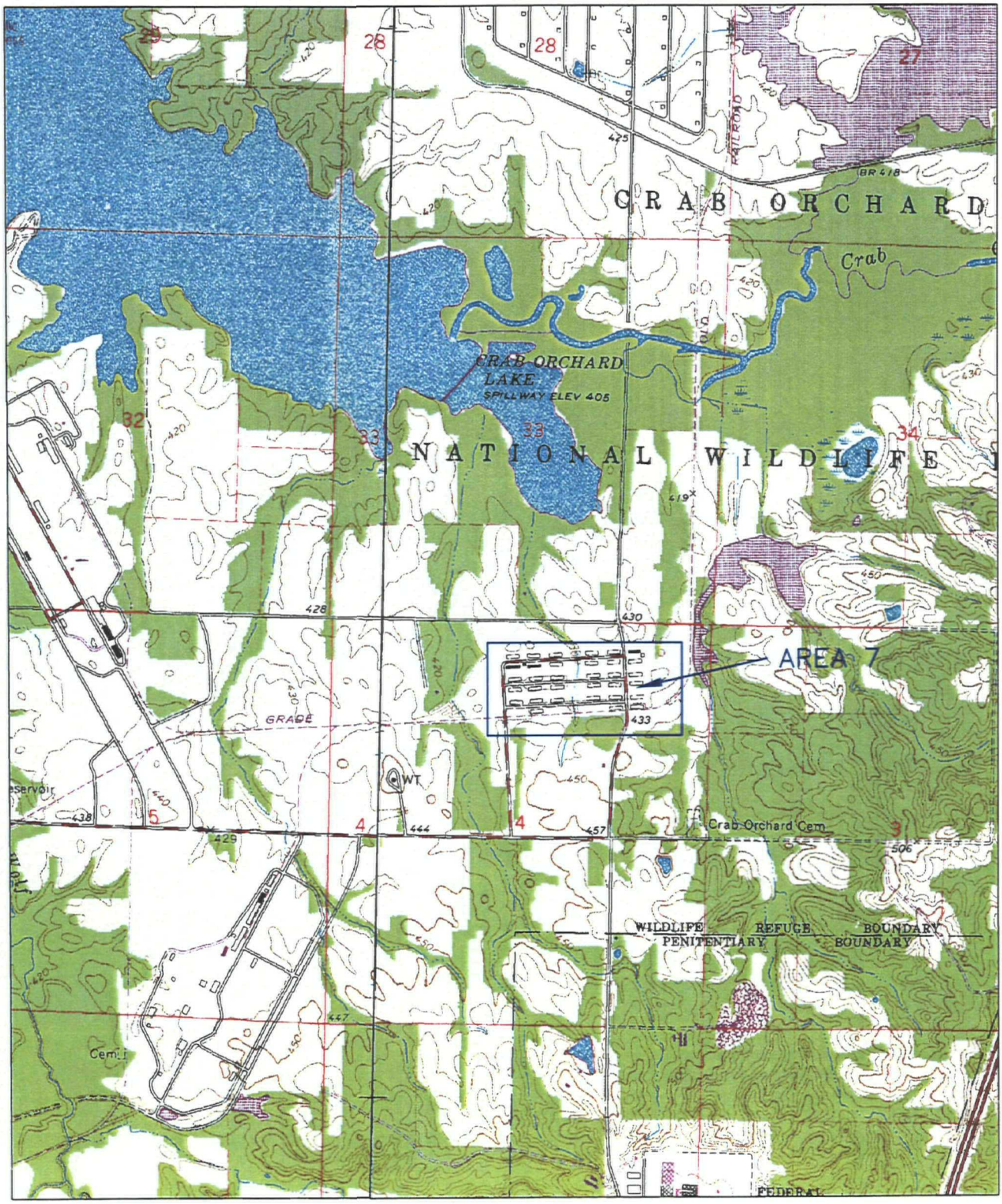
LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A07-023	AUS-0A07-023-SS-0X	South of the walkway between buildings IN-4-2 and IN-4-3 near stressed vegetation.	Hand auger	0-6 in.	TAL Metals (6010/7000) PCBs (8082)	Stressed vegetation was observed in this area along with numerous electrical insulators which were discarded on the ground in this area. PCBs, Metals, and volatile solvents are COPCs
	AUS-0A07-023-SS-02			1-2 ft	TCL Volatiles (8260B)	
0A07-024	AUS-0A07-024-SD-0X	Central section of north-south drainage ditch.	Hand auger	0-6 in.	PCBs (8082)	Previous sampling in this portion of the drainage ditch found both PCBs and xylenes. No definitive source of these compounds was identified.
	AUS-0A07-024-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A07-025	AUS-0A07-025-SD-0X	Northern section of north-south drainage ditch.	Hand auger	0-6 in.	PCBs (8082)	Sampling in upstream areas of the drainage ditch found both PCBs and xylenes. No definitive source of these compounds were identified.
	AUS-0A07-025-SD-02			1-2 ft	TCL Volatiles (8260B)	
0A07-026	AUS-0A07-026-SS-0X	East of building IN-1-2 in area of stressed vegetation alongside building	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) PCBs (8082) TOC (9060)	Building history is incomplete and stressed vegetation was observed during the site walkover.
	AUS-0A07-026-SS-02			6-12 in.	TCL Volatiles (8260B)	
0A07-027	AUS-0A07-027-SS-0X	North of building IN-1-1 in ground beneath stained concrete	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building was used for printing operations and stained concrete was observed on northern loading dock during site walkover. COPCs include Volatiles, Metals, and BNAs used in inks.
	AUS-0A07-027-SS-02			6-12 in.	TCL Volatiles (8260B)	
0A07-028	AUS-0A07-028-SS-0X	Northeast of building IN-1-1 near the loading dock	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Building was used for printing operations and the use of solvents is likely. COPCs include Volatiles, Metals, and BNAs used in inks.
	AUS-0A07-028-SS-02			6-12 in.	TCL Volatiles (8260B)	

TABLE 6-1
SAMPLE LOCATIONS FOR AREA 7 - IOP INERT STORAGE AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A07-029	AUS-0A07-029-SS-0X	Area to the southeast of Area 7 at GIS coordinates:	Test pit samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site identified by aerial photo interpretation as resembling land disposal cells.
	AUS-0A07-029-SS-02			6-12 in.	TCL Volatiles (8260B)	
	AUS-0A07-029-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A07-029-SS-??			Below trench	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	
	AUS-0A07-029-GW-00		Test pit water	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330)	
0A07-030	AUS-0A07-030-SS-0X	Area to the southeast of Area 7 at GIS coordinates:	Test pit samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site identified by aerial photo interpretation as resembling land disposal cells.
	AUS-0A07-030-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0A07-030-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A07-030-SS-??			Below trench	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	
	AUS-0A07-030-GW-00		Test pit water	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330)	

N/A = Not applicable

COPCs = Chemicals of Potential Concern



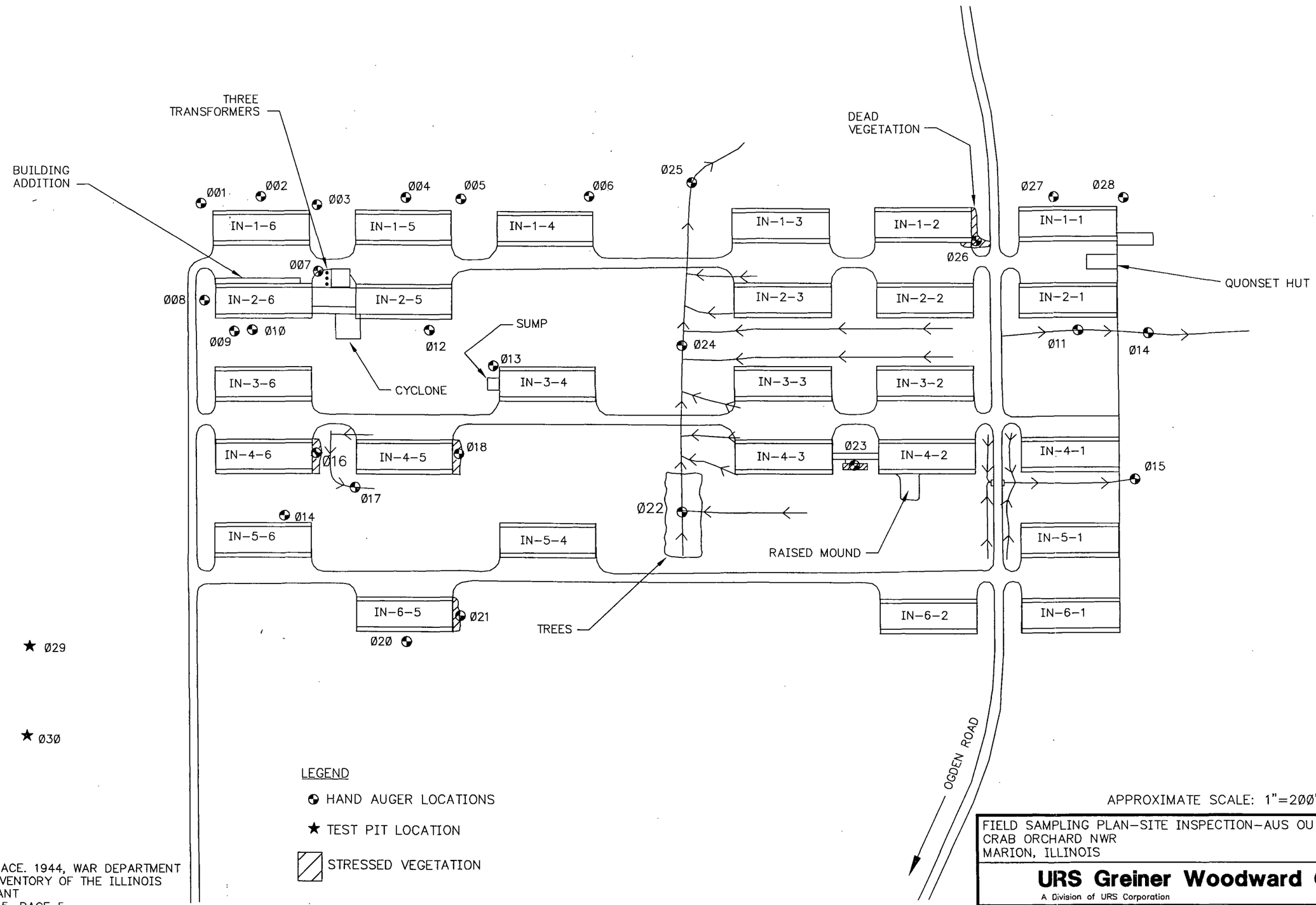
SOURCE: USGS DIGITAL RASTER GRAPHIC

N

.5 0 .5
SCALE miles

FIELD SAMPLING PLAN-SITE INSPECTION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68F0D97278.00
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 8/25/99 DSGN. BY: mh CHKD. BY:	Area 7 Location FIG. NO. 6-1

File: F:\45F0M9602N\CRABRASTER6-1.DWG Last edited: 01/10/00 @ 9:07 a.m. @ WCC-ST.LOUIS



LEGEND

- HAND AUGER LOCATIONS
- TEST PIT LOCATION
- STRESSED VEGETATION

SOURCE: U.S. ACE. 1944, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT PART I SECT. 5, PAGE 5 (PLAN NO. 6544-1Ø1.11)

APPROXIMATE SCALE: 1"=2ØØ'

FIELD SAMPLING PLAN-SITE INSPECTION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 9/7/99 DSGN. BY: mh CHKD. BY:	Area 7 Sample Locations	FIG. NO. 6-2

File: F:\68FOD9727800\CRABFIG2-2.DWG Last edited: 02/21/00 @ 08:05 a.m. © WCC-ST.LOUIS

7.1 AREA 8 SOUTH – IOP LOAD LINE III (AUS-0A8S)

Site Location and Boundaries

The location of Area 8 is shown on Figure 7-1. It is located east of Highway 148 and south of Ogden Road. To get to the site travel east on Ogden road from Highway 148 for 1.1 miles and turn south onto unnamed road. Follow the road for 0.7 miles and then turn right onto another road. This road ends at AUS-0A8S. The site is bounded on the south, east and west by woodlands and on the north by industrial buildings (MISCA OU Site #14). Area 8 South is shown on Figure 7-2 with sample locations. Information on each sample is contained in Table 7-1.

Site History

This site was formerly a bomb loading line for the IOP where TNT was screened, melted, and loaded. After World War II, several different industrial tenants leased the site for various production operations. Products manufactured at the site after World War II include fiberglass canoes, propellants, pyrotechnics, and ground nitrocellulose. After a fire at the site in 1981, the entire site was razed and buried. No industrial activity has taken place at Area 8 South since that time.

Sampling Information Specific to Area 8

A visual inspection of the site revealed several mounded areas in the former location of the production buildings. Two drums were identified at the site to the northwest of the former IOP TNT Cooling building. In addition, a sump pit was observed to the west of the former TNT Melting building which also was the site of the American Fiber Lite production operations.

Aerial photo interpretations at the site indicated ground scarring at one location to the southeast of the northern change house. No supplementary information has been found indicating a cause for the ground scarring, however, it was observed in aerial photography from 1943 to 1993. Three other features identified by aerial photo interpretations were southwest of the eastern TNT Cooling building. One was a trench like feature more than 190 feet long and 8 feet wide. The other two were identified as pits.

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-001	AUS-0A8S-001-SD-0X	Drainage ditch west of plant road	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	This drainage ditch receives runoff from the entire western portion of the facility in the area of the main post war industrial building. COPCs include Metals (pyrotechnics), BNAs (fiberglass and pyrotechnics), Explosives (TNT), Volatiles (all manufacturing), perchlorates (pyrotechnics), dioxin (AFL fire). Analytical results from this ditch will be an indication of contaminants moving offsite in surface waters.
	AUS-0A8S-001-SW-00		Surface Water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B) Perchlorates	
A8S-002	AUS-0A8S-002-SD-0X	Drainage ditch northwest of plant road	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin TOC (9060)	This drainage ditch receives runoff from the middle and north western portions of the facility. COPCs include Metals (pyrotechnics), BNAs (fiberglass and pyrotechnics), Explosives (TNT), Volatiles (all manufacturing), perchlorates (pyrotechnics), dioxin (AFL fire). Analytical results from this ditch will be an indication of contaminants moving offsite in surface waters.
	AUS-0A8S-002-SW-00		Surface Water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B) Perchlorates	
A8S-003	AUS-0A8S-003-SD-0X	Drainage ditch on northwest side of plant just to the east of the plant road	Hand Auger	0-6 in.	SW846 Explosives (8330) Ammonia as N Nitrates + Nitrites	This drainage ditch receives runoff from the area around the former IOP TNT and AN storage magazines. No post war industrial activity is known in this area.
A8S-004	AUS-0A8S-004-SD-0X	Marshy area west of the former IOP cooling building.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Water ponds in this area. TNT, pyrotechnic and fiberglass operations were performed nearby. COPCs include Explosives (TNT), Metals (pyro.), BNAs (fiberglass), and dioxin (AFL fire).

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-005	AUS-0A8S-005-DRUM	Area north of former IOP Cooling building where abandoned drums were found. Sample taken in the drum.	Hand Auger	N/A	TCL BNAs (8270c) Dioxin	Three Abandoned drums were observed in this area. The partial contents of the drums are unknown. They appear to be hardened and may be related to the fiberglass manufacturing facility. Drum contents will be sampled along with the soils underneath. Dioxin, Volatiles, and BNAs are COPCs.
	AUS-0A8S-005-SS-0X			0-6 in.	TCL BNAs (8270c) Dioxin	
	AUS-0A8S-005-SS-02			1-2 ft	TCL Volatiles (8260B)	
A8S-006	AUS-0A8S-006-SD-0X	Drainage ditch on northwest side of plant east of the plant road	Hand Auger	0-6 in.	Dioxin TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives runoff from the area around the former IOP TNT Screening and Melt-Pour buildings as well as the area where construction debris and abandoned drums were found. Chemicals from fiberglass manufacturing and TNT are COPCs.
A8S-007	AUS-0A8S-007-SD-0X	Ditch on northwest side of plant east of the plant road and north of sample 006	Hand Auger	0-6 in.	Ammonia as N, Nitrates + Nitrites SW846 Explosives (8330)	Ditch receives runoff from the area around the former IOP TNT Screening building as well as the area where construction debris was found. COPCs include TNT, Ammonia Nitrate, and volatile cleaning solvents.
	AUS-0A8S-007-SD-02			1-2 ft	TCL Volatiles (8260B)	
A8S-008	AUS-0A8S-008-SS-0X	Area of the former IOP TNT Cooling building	Hand Auger	0-6 in.	TCL BNAs (8270c) SW846 Explosives (8330)	Building used for the cooling of TNT during WWII and for fiberglass manufacturing in the late 1970s. Soil used to cover this former building may have been surficial soils from the nearby area and were potentially impacted by industrial operations. COPCs include dioxin (AFL fire), TNT, and fiberglass component chemicals.
	AUS-0A8S-008-SS-02			1-2 ft	TCL Volatiles (8260B) Dioxin	
	AUS-0A8S-008-SS-05			4-5 ft	SW846 Explosives (8330) TCL Volatiles (8260B) Dioxin	
A8S-009	AUS-0A8S-009-SS-0X	Area between cooling buildings where construction debris was observed	Hand Auger	0-6 in.	TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	TNT melting and fiberglass production were the main activities performed near this point. Demolition debris was exposed in this area. The soil in this area may not have been buried during facility demolition.
	AUS-0A8S-009-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-010	AUS-0A8S-010-SS-0X	Area of the former IOP TNT Screening building	Hand Auger	0-6 in.	SW846 Explosives (8330)	TNT was screened in a former building here and cleaning activities may have impacted the surrounding soils. Explosives and volatile solvents are the COPCs.
	AUS-0A8S-010-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0A8S-010-SS-05			4-5 ft	TCL Volatiles (8260B) SW846 Explosives (8330)	
A8S-011	AUS-0A8S-011-SD-0X	Drainage ditch between the former IOP TNT Screening and Melt-Pour buildings	Hand Auger	0-6 in.	Ammonia as N Nitrate + Nitrites SW846 Explosives (8330)	This drainage ditch receives runoff from the area around the former IOP TNT Screening and Melt-Pour buildings. COPCs include TNT, and ammonium nitrate.
A8S-012	AUS-0A8S-012-SD-0X	Drainage ditch south of the former IOP TNT Melt-Pour building	Hand Auger	0-6 in.	TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives runoff from the area south of the former IOP TNT Melt-Pour building. BNAs and TNT are COPCs.
A8S-013	AUS-0A8S-013-SS-0X	Southwest side of the former IOP TNT Melt Pour building	Hand Auger	0-6 in.	Ammonia as N SW846 Explosives (8330)	This building was used for the melting and pouring of TNT during WWII. Production and cleaning activities may have impacted nearby soils. COPCs include TNT, volatile solvents and ammonium nitrate.
	AUS-0A8S-013-SS-02			1-2 ft	TCL Volatiles (8260B)	
A8S-014	AUS-0A8S-014-SS-0X	North side of the former IOP TNT Melt Pour building	Hand Auger	0-6 in.	SW846 Explosives (8330)	This building was used for the melting and pouring of TNT during WWII. Production and cleaning activities may have impacted nearby soils. COPCs include TNT, volatile solvents and ammonium nitrate.
	AUS-0A8S-014-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0A8S-014-SS-05			4-5 ft	SW846 Explosives (8330) TCL Volatiles (8260B) Ammonia as N	
A8S-015	AUS-0A8S-015-SD-0X	East side of the former IOP TNT Melt Pour building in drainage way.	Hand Auger	0-6 in.	SW846 Explosives (8330)	This building was used for the melting and pouring of TNT during WWII. Production and cleaning activities may have impacted nearby soils. TNT is chemical of potential concern.
	AUS-0A8S-015-SD-03			2-3 ft	SW846 Explosives (8330)	

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-016	AUS-0A8S-016-SS-0X	Area of the former IOP TNT Cooling building	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Soil used to cover this former building may have been surficial soils from the nearby area and were potentially impacted by industrial operations. Building used by AFL, IOP and CTI. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs.
	AUS-0A8S-016-SS-02			1-2 ft	TCL Volatiles (8260B)	
				3-4 ft	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	
A8S-017	AUS-0A8S-017-SW-00	Ditch southeast of former IOP TNT Cooling building on southeast side of plant road.	Surface Water	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B) Perchlorates	Operations in the IOP TNT Cooling building may have impacted the soils in this ditch. Building used by AFL, IOP and CTI. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs. Perchlorates associated with CTI's production activities.
	AUS-0A8S-017-SD-0X		Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) TOC (9060) SW846 Explosives (8330)	
A8S-018	AUS-0A8S-018-SS-0X	Area southwest of former IOP TNT Melting building near visible debris	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	Soils in this area may have been impacted from the TNT, pyrotechnic, or reinforced plastic production operations taking place in the buildings nearby. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs. Dioxin associated with the AFL fire.
	AUS-0A8S-018-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0A8S-018-SS-05			4-5 ft	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-019	AUS-0A8S-019-SS-0X	East of former IOP TNT Melting building	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	Soils in this area may have been impacted from the TNT, pyrotechnic, or reinforced plastic production operations taking place in the buildings nearby. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs. Dioxin associated with the AFL fire.
	AUS-0A8S-019-SS-02			1-2 ft	TCL Volatiles (8260B)	
A8S-020	AUS-0A8S-020-SS-0X	North of the former IOP Load Pack and Ship building in drainage ditch	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Soils in this drainage ditch may have been impacted from the TNT, pyrotechnic, or reinforced plastic production operations taking place in the buildings nearby. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs.
A8S-021	AUS-0A8S-021-SS-0X	West of the former IOP Load Pack and Ship building	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Soils in this area may have been impacted from the TNT, pyrotechnic, or reinforced plastic production operations taking place in the buildings nearby. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs.
	AUS-0A8S-021-SS-02			1-2 ft	TCL Volatiles (8260B)	
A8S-022	AUS-0A8S-022-SW-00	East of the former IOP Load Pack and Ship building in the drainage ditch	Surface Water	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B) Perchlorates	Soils in this drainage ditch may have been impacted from the TNT, pyrotechnic, or reinforced plastic production operations taking place in the buildings nearby. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs.
	AUS-0A8S-022-SD-0X		Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-023	AUS-0A8S-023-SD-00	Pond furthest to the south at the facility.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	Monitor if the industrial operations which occurred in the southern portions of this facility affected the surface waters in the area. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs. Dioxin is associated with the AFL fire and perchlorates were used by CTI.
	AUS-0A8S-023-SW-0X		SW	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B) Perchlorates	
A8S-024	AUS-0A8S-024-SD-0X	Small pond just north of large southernmost pond.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	Monitor if the industrial operations which occurred in the southern portions of this facility affected the surface waters in the area. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs.
	AUS-0A8S-024-SW-00		SW	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B) Perchlorates	
A8S-025	AUS-0A8S-025-SS-0X	North of the former IOP TNT Melt building:	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	This spot identified by aerial photo interpretation as potentially impacted by American Fiberlite operations.
	AUS-0A8S-025-SS-02			1-2 ft	TCL Volatiles (8260B)	
A8S-026	AUS-0A8S-026-SS-0X	North of the former IOP TNT Melt building:	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	This spot identified by aerial photo interpretation as potentially impacted by American Fiberlite operations.
	AUS-0A8S-026-SS-02			1-2 ft	TCL Volatiles (8260B)	
A8S-027	AUS-0A8S-027-SS-0X	North of the former IOP TNT Melt building:	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	This spot identified by aerial photo interpretation as potentially impacted by American Fiberlite operations.
	AUS-0A8S-027-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-028	AUS-0A8S-028-SD-0X	East of the former IOP TNT Melt building across the road in the ditch.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Soils in this drainage ditch may have been impacted from the TNT, pyrotechnic, or reinforced plastic production operations taking place in the building to the northwest of this sample location. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs.
A8S-029	AUS-0A8S-029-SS-0X	East of the former load line in a field southeast of change house	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This spot identified by aerial photo interpretation as potentially impacted by operations at the load line. It appears as a light toned ground scar and exists from 1943 to 1980.
	AUS-0A8S-029-SS-02			1-2 ft	TCL Volatiles (8260B)	
A8S-030	AUS-0A8S-030-SL-0X	Sewer line northwest of former change house location.	Sewer	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Change house sewer lines may have contamination resulting from workers showering after their shifts. Area 8 change house utilized by IOP, and CTI.
A8S-W01	AUS-0A8S-W01-SS-0X	Near drainage ditch southeast of former IOP Melt Pour building	Soil Boring	0-6 in.	SW846 Explosives (8330)	Design drawings show a sump was located at the TNT Melt Pour building near this ditch. Process waters from the sump would have been discharged to the nearest ditches. TNT, and Perchlorate samples are taken east of the buildings where perchlorates were used.
	AUS-0A8S-W01-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A8S-W01-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A8S-W01-GW-00		Monit. Well	N/A	Ammonia as N Nitrates + Nitrites TDS, TSS, alkalinity TCL Volatiles (8260b) SW846 Explosives (8330) Perchlorates	

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-W02	AUS-0A8S-W02-SS-0X	Area of stained soil to the northeast of former IOP TNT Melting building.	Soil Boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Soil staining was observed in this area during the site walkover. Buildings nearby all used by AFL, IOP and CTI. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs. Perchlorates associated with CTI's production activities.
	AUS-0A8S-W02-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A8S-W02-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A8S-W02-GW-00		Monit. Well	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330) Perchlorates	
A8S-W03	AUS-0A8S-W03-SS-0X	Area around the sump pit located north of the former IOP TNT Melting building	Soil Boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	Sump may have been used to collect process waste from TNT, pyrotechnic, or reinforced plastic production operations. Sump waters were likely discharged to the ground in the area of the sump. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs. Perchlorates associated with CTI's production activities. Dioxin associated with the AFL fire.
	AUS-0A8S-W03-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A8S-W03-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A8S-W03-GW-00		Monit. Well	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330) Perchlorates	

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-W04	AUS-0A8S-W04-SS-0X	Fenced area with contaminated area signs known as the black powder disposal area.	Soil Boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330) Dioxin	Fenced area has contaminated area signs and is believed to be a disposal area for black powder. Walkover survey observations indicate that some burning may have occurred in this area. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs. Perchlorates samples represent the southern boundary of CTIs perchlorate use.
	AUS-0A8S-W04-SS-05			4-5 ft	TCL Volatiles (8260B) SW846 Explosives + Nitroglycerin (8330)	
	AUS-0A8S-W04-SS-??			BWT	TCL Volatiles (8260B) SW 846 Explosives + Nitroglycerin (8330)	
	AUS-0A8S-W04-GW-00		Monit. Well	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives + Nitroglycerin (8330) Perchlorates	

TABLE 7-1
SAMPLE LOCATIONS FOR AUS AREA 8 SOUTH – IOP LOAD LINE III
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

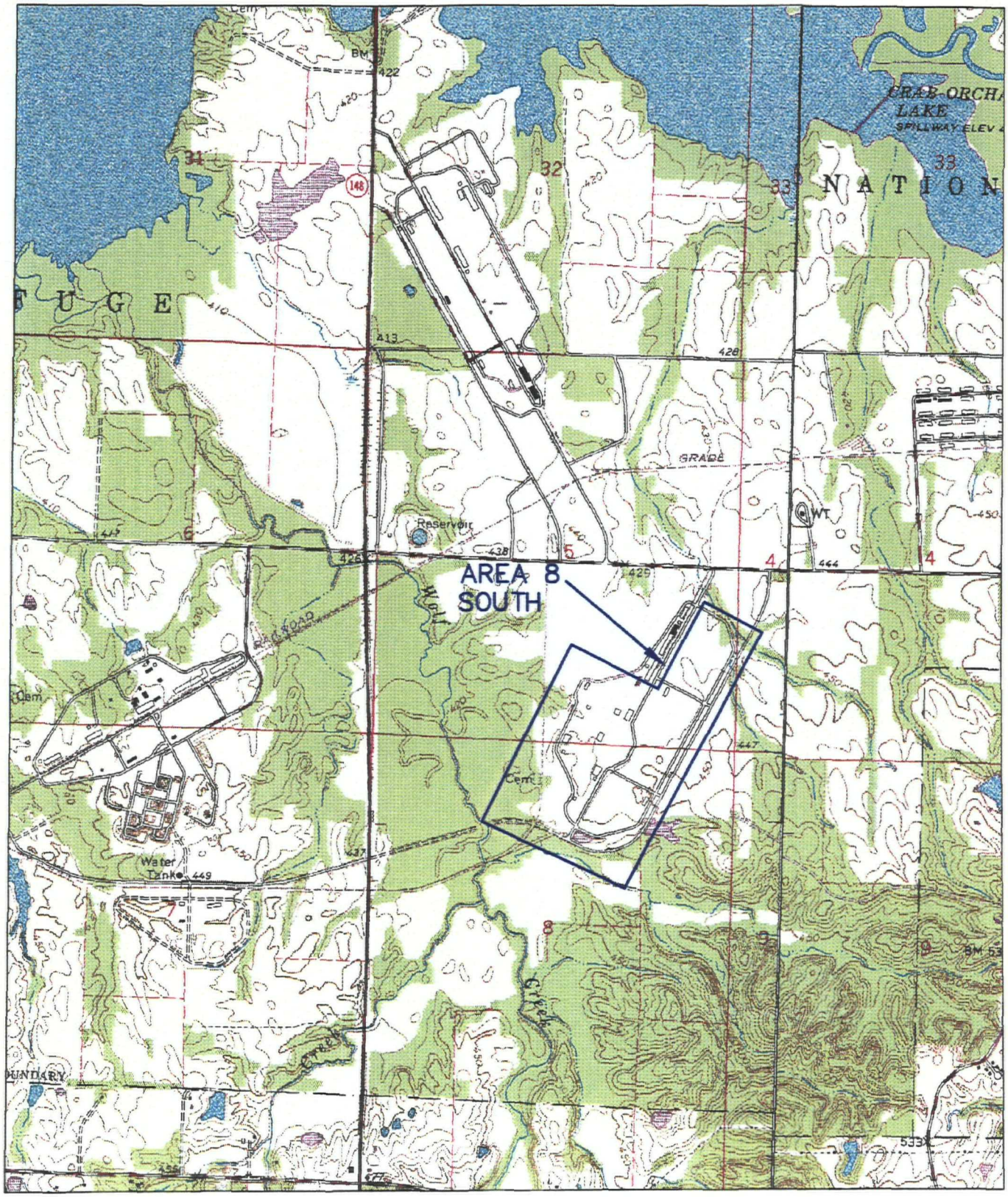
LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A8S-W05	AUS-0A8S-W05-SS-0X	North of the former IOP Load Pack and Ship building	Soil Boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Soils in this area may have been impacted from the TNT, pyrotechnic, or reinforced plastic production operations taking place in the buildings nearby. Metals, BNAs, TNT, and volatile cleaning solvents are all COPCs.
	AUS-0A8S-W05-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A8S-W05-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A8S-W05-GW-00		Monit. Well	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330)	
A8S-W06	Magnetometer Survey	Southwest of former Building 60	Magnet-ometer	Surface	NA	A magnetometer survey of this area will be done during the staking of borings to identify if the USTs are still present on site. If they are still present, then this boring will be located next to former No. 2 Fuel Oil USTS – there were four USTs and it is not known if these were removed or left in place – if they do not appear to still be in place, then the boring will be placed in the vicinity of these former USTs to detect the possibility of any remaining contamination – possible COPCs: organics and TAL Metals (from possible fuel oil contamination), SW846 Explosives (only in groundwater from upgradient areas)
	AUS-0A8S-W06-SS-12		Soil Boring	10-12 ft	TCL Volatiles (8260B) PAHs (8310) TAL Metals(6010/7000)	
	AUS-0A8S-W06-SS-18			16-18 ft	TCL Volatiles (8260B) PAHs (8310) TAL Metals(6010/7000)	
	AUS-0A8S-W06-SS-24			22-24 ft	TCL Volatiles (8260B) PAHs (8310) TAL Metals(6010/7000)	
	AUS-0A8S-W06-GW-00		Monit. Well	NA	TCL Volatiles (8260B) PAHs (8310) TAL Metals(6010/7000)	

BWT = Below water table

N/A = Not applicable

COPCs = Chemicals of Potential Concern

Shaded samples will be collected by the UXO subcontractor.



SOURCE: USGS DIGITAL RASTER GRAPHIC

N

0 2000

SCALE FEET

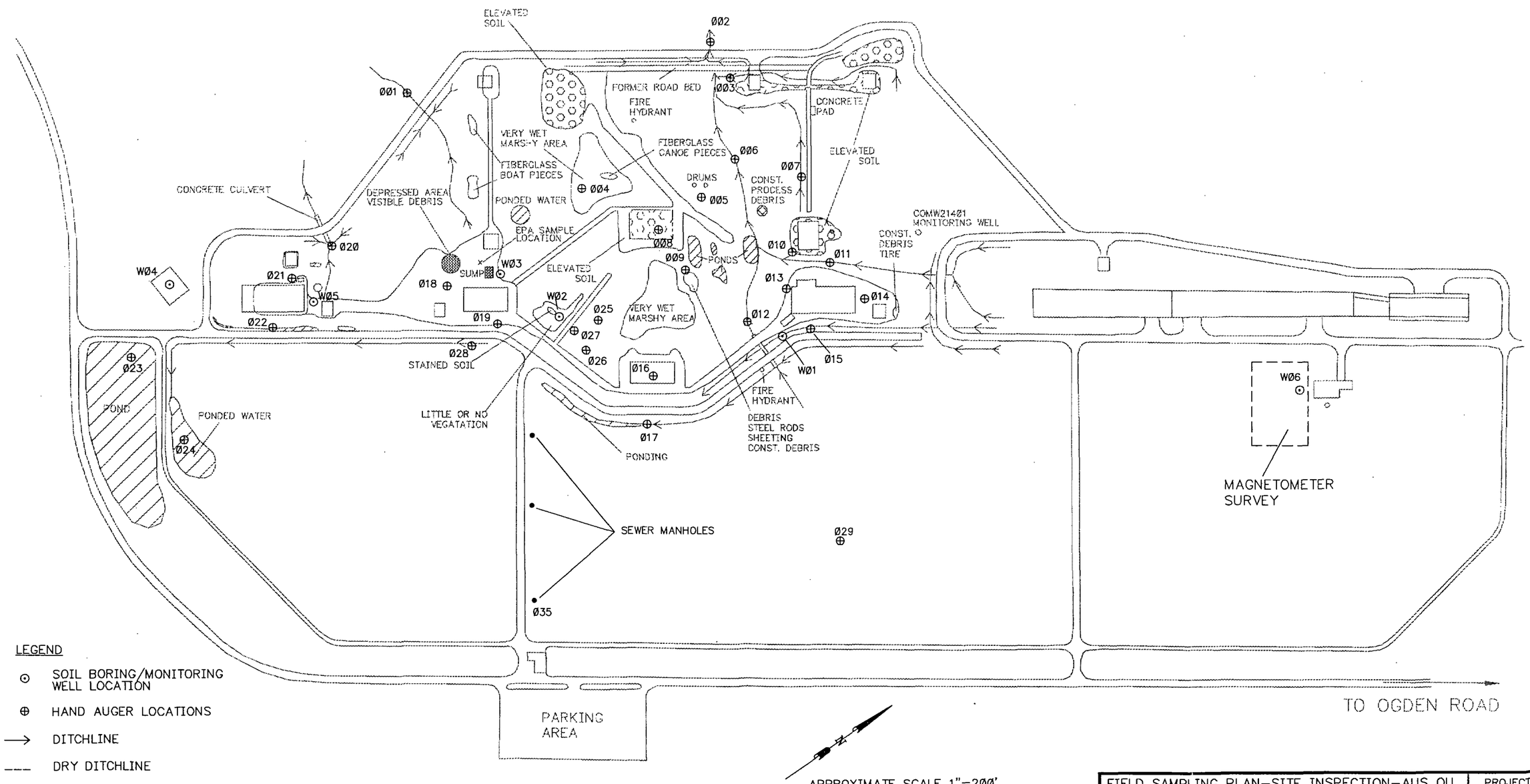
FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68F0D97278.00

URS Greiner Woodward Clyde

A Division of URS Corporation

DRN. BY: djd 8/25/99 DSGN. BY: mh CHKD. BY:	Area 8 South Location	FIG. NO. 7–1

File: F:\45F0M9602N\CRABRASTER7-1A.DWG Last edited: 02/29/00 @ 4:03 p.m. @ WCC-ST.LOUIS



LEGEND

- ⊙ SOIL BORING/MONITORING WELL LOCATION
- ⊕ HAND AUGER LOCATIONS
- ⟶ DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)
- ELEVATED SOIL

APPROXIMATE SCALE 1"=200'

SOURCE: U.S. ACE. 1944, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT
PART I SECT. 5 PAGE 9
(PLAN NO. 6544-101.15
SITE WALKOVER CONDUCTED ON

FIELD SAMPLING PLAN-SITE INSPECTION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68F0D97278.00

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 8/15/99 DSGN. BY: mh CHKD. BY:	AUS-0A8S Area 8 South Sample Locations	FIG. NO. 7-2

File: F:\68F0D9727800\COWPOA08FIG7-2.DWG Last edited: 02/29/00 @ 08:40 a.m. @ WCC-ST.LOUIS

8.1 AREA 9 – IOP LOAD LINE I (AUS-0A09)

Site Location and Boundaries

The location of Area 9 is shown on Figure 8-1. It is located east of Highway 148 and south of Crab Orchard Lake. To get to the site travel south on Highway 148 over the Crab Orchard Lake Causeway for 0.5 miles and turn east at the signs for the Primex facility. The guard shack and gate mark the boundary of AUS Area 9. The site is bounded on all sides by woodlands. Area 9 is shown on Figure 8-2 with sample locations. Information on each sample is contained in Table 8-1.

Site History

This site was formerly a artillery and bomb loading line for the IOP where TNT was screened, melted, and loaded. After World War II, several different industrial tenants leased the site for various production operations. Products manufactured at the site after World War II include capacitors, wrapping paper, gloves, boats, and industrial finishes. Industrial tenants in Area 9 include Sangamo Electric Co., Technical Tape Corp., Good Luck Glove Co., Mark Twain Marine Industries, Pyramid Industrial Finishes, and Olin Corp. Olin Corp. (now Primex) is currently the sole tenant in Area 9.

In 1982 the US FWS identified PCB and lead contamination in the portion of Area 9 known as the Sangamo Dump. Area 9 was then investigated as sites 32 and 33 by O'Brien & Gere in their 1988 Remedial Investigation (See Section 15 Results of Previous Investigations). It was subsequently designated as part of the PCB Areas Operable Unit (PCB OU) and a Record of Decision on a remedial action was issued on August 1, 1990.[44] In 1996 and 1997, a large area in and near Area 9 was remediated as a part of the PCB OU.[45] The excavation boundaries for this remedial action are shown on Figure 8-2 to the extent they are known.[46] In addition, there is an on-going RI/FS in the same area, for chlorinated volatile organic contamination (See Section 15). Because of the extensive nature of the remediation in Area 9, only the portions of Area 9 which were not remediated as part of the PCB OU will be investigated during the Site Inspection.

Sampling Information Specific to Area 9

One soil boring / monitoring well will be installed in Area 9 near building I-1-19. This building was used as a mix house for pyrotechnic and ammunition mixes and contains sumps which are believed to have collected fluids from the mixing operations. More sumps are located south of building I-1-23. Three surface soil samples are planned for the area near these samples. Another sample will be taken from the sewer manholes that connected the original change houses to the main sewer line in Area 9. The remaining samples will be collected around the main industrial buildings in Area 9. These samples are surface soil samples and are positioned to collect information about areas which likely received floor sweepings and wastewater discharges.

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[44] U.S. EPA, 1990, Declaration for the Record of Decision, Crab Orchard National Wildlife Refuge, PCB Areas Operable Unit.

[45] International Technology Corporation, 1997, Acceptance Report for Closure of PCB Areas Operable Unit Landfill, Crab Orchard National Wildlife Refuge, Marion, IL.

[46] The excavation boundary was provided to URSGWC as an electronic file from FWS.

TABLE 8-1
SAMPLE LOCATIONS FOR AUS AREA 9 – IOP LOAD LINE I
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A09-001	AUS-0A09-001-SS-0X	East side of building I-1-19.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	Building I-1-19 is a mix house and contained sumps. Pyrotechnic and ammunition mixes were mixed in this building. Cleaning of buildings at the refuge involved the discharge of fluids to the grounds around the building. Metals, perchlorates, and BNAs are typical raw materials for pyrotechnics, and Explosives are involved in ammunition mixes. Volatile solvents used for cleaning activities.
	AUS-0A09-001-SS-02			1-2 ft	TCL Volatiles (8260B)	
A09-002	AUS-0A09-002-SS-0X	North east of building I-1-19 near building exit.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates, TOC (9060)	Building I-1-19 is a mix house and contained sumps. Pyrotechnic and ammunition mixes were mixed in this building. Cleaning of buildings at the refuge involved the discharge of fluids to the grounds around the building. Metals, perchlorates, and BNAs are typical raw materials for pyrotechnics, and Explosives are involved in ammunition mixes. Volatile solvents used for cleaning activities.
	AUS-0A09-002-SS-02			1-2 ft	TCL Volatiles (8260B)	
A09-003	AUS-0A09-003-SS-0X	South end of building I-1-20 on northwest side of plant just to the east of the plant road, near building	Hand Auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	A mix house was located in this area in building I-1-19 that appears to have become part of I-1-20. The products mixed in this building include fuses, delay and tracer mixes. These items contain Metals, Volatiles, and Explosives.
	AUS-0A09-003-SS-02			1-2 ft	TCL Volatiles (8260B)	
A09-004	AUS-0A09-004-SL-0X	Sewer lines for the former change houses which have been demolished.	Hand Auger	0-6 in.	SW846 Explosives (8330)	Sewer lines are reportedly a typical source of TNT contamination from IOP workers. Manholes will be used to collect sediment until enough sediment is gathered to analyze.

TABLE 8-1
SAMPLE LOCATIONS FOR AUS AREA 9 – IOP LOAD LINE I
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A09-005	AUS-0A09-005-SS-0X	East of building I-1-20 toward the southern end of the building.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Pyrotechnic and ammunition mixes have traditionally been handled in this building. Metals and BNAs are typical raw materials for pyrotechnics, and Explosives and Volatiles (vinyl chloride) are involved in ammunition mixes.
	AUS-0A09-005-SS-02			1-2 ft	TCL Volatiles (8260B)	
A09-006	AUS-0A09-006-SD-0X	East of building I-1-20 on the northern end of the building near an exit door.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Pyrotechnic and ammunition mixes have traditionally been handled in this building. Metals and BNAs are typical raw materials for pyrotechnics, and Explosives are involved in ammunition mixes.
	AUS-0A09-006-SD-02			1-2 ft	TCL Volatiles (8260B)	
A09-007	AUS-0A09-007-SD-0X	West of building I-1-23 Around the building exit in center of building.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building I-1-23 formerly housed pyrotechnic and ammunition mix loading facilities and wastewater was reportedly dumped to the ground. PCB OU remediation took place to the north of this area. Explosives and Volatiles (vinyl chloride) are COPCs in ammunition mixes. Metals and BNAs are typical raw materials for pyrotechnics,
	AUS-0A09-007-SD-02			1-2 ft	TCL Volatiles (8260B)	
A09-008	AUS-0A09-008-SS-0X	West side of building I-1-23 at the southern end of the building north of sumps.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) TOC (9060) SW846 Explosives (8330)	Sumps were reportedly located at the southern end of building I-1-23. Sump cleaning involved the dumping of waters from the sump to the grounds near the sumps. COPCs include Explosives, Volatiles, Metals, and BNAs
	AUS-0A09-008-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0A09-008-SS-05			4-5 ft	SW846 Explosives (8330) TCL Volatiles (8260B)	
A09-009	AUS-0A09-009-SS-0X	West side of building I-1-23 at the southern end of the building south of sumps.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Sumps were reportedly located at the southern end of building I-1-23. Sump cleaning involved the dumping of waters from the sump to the grounds near the sumps. COPCs include Explosives, Volatiles, Metals, and BNAs
	AUS-0A09-009-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 8-1
SAMPLE LOCATIONS FOR AUS AREA 9 – IOP LOAD LINE I
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A09-010	AUS-0A09-010-SS-0X	Near the exit door to building I-1-33.	Hand Auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Building I-1-33 was reportedly used as a mix house for a short period. No information exists on the type of mixes produced in this building, however it is assumed that either pyrotechnic or ammunition mixes were produced here. COPCs include Explosives, Volatiles, Metals, and BNAs
	AUS-0A09-010-SS-02			1-2 ft	TCL Volatiles (8260B)	
A09-011	AUS-0A09-011-SS-0X	East of building I-1-12 on the north end of the building.	Hand Auger	0-6 in.	TAL Metals (6010/7000 SW846 Explosives (8330)	Building I-1-12 has been used for ammunition operations. Cleaning operations are believed to have affected grounds outside the buildings. COPCs include Explosives, Volatiles and Metals.
	AUS-0A09-011-SS-02			1-2 ft	TCL Volatiles (8260B)	
A09-012	AUS-0A09-012-SD-0X	East of building I-1-12 toward the middle of the building.	Hand Auger	0-6 in.	TAL Metals (6010/7000 SW846 Explosives (8330)	Building I-1-12 has been used for ammunition operations. Cleaning operations are believed to have affected grounds outside the buildings. COPCs include Explosives, Volatiles and Metals.
	AUS-0A09-012-SD-0X			1-2 ft	TCL Volatiles (8260B)	
A09-013	AUS-0A09-013-SS-0X	East of building I-1-12 toward southern end of the building.	Hand Auger	0-6 in.	TAL Metals (6010/7000 SW846 Explosives (8330)	Building I-1-12 has been used for ammunition operations. Cleaning operations are believed to have affected grounds outside the buildings. COPCs include Explosives, Volatiles and Metals.
	AUS-0A09-013-SS-02			1-2 ft	TCL Volatiles (8260B)	
A09-014	AUS-0A09-014-SS-0X	West side of building I-1-12 toward northern end of the building	Hand Auger	0-6 in.	TAL Metals (6010/7000 SW846 Explosives (8330)	Building I-1-12 has been used for ammunition operations. Cleaning operations are believed to have affected grounds outside the buildings. COPCs include Explosives, Volatiles and Metals.
	AUS-0A09-014-SS-02			1-2 ft	TCL Volatiles (8260B)	
A09-015	AUS-0A09-015-SS-0X	West side of building I-1-12 toward the southern endd of the building.	Hand Auger	0-6 in.	TAL Metals (6010/7000 SW846 Explosives (8330)	Building I-1-12 has been used for ammunition operations. Cleaning operations are believed to have affected grounds outside the buildings. COPCs include Explosives, Volatiles and Metals.
	AUS-0A09-015-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 8-1

SAMPLE LOCATIONS FOR AUS AREA 9 – IOP LOAD LINE I

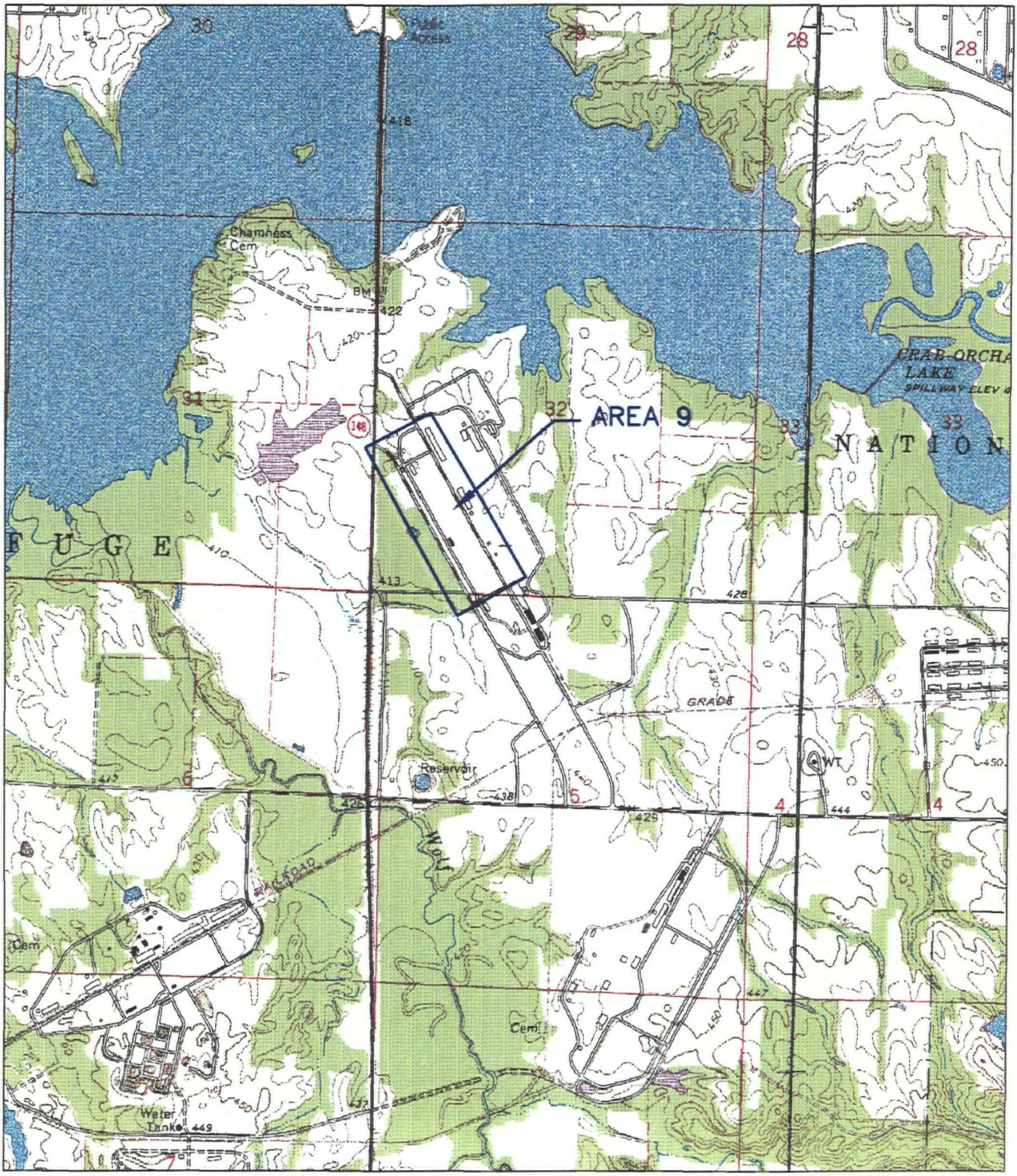
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A09-016	AUS-0A09-016-SD-0X	West side of building I-1-49.	Hand Auger	0-6 in.	TAL Metals (6010/7000 SW846 Explosives (8330)	This is the reported location of wastewater discharge to the ground. Wastewater contained RDX and aluminum and possibly solvents.
	AUS-0A09-016-SD-02			1-2 ft	TCL Volatiles (8260B)	
A09-W01	AUS-0A09-W01-SS-0X	South west of building I-1-19 near discharge location	Soil Boring	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Perchlorates	Building I-1-19 is a mix house and contained sumps. Pyrotechnic and ammunition mixes were mixed in this building. Cleaning of buildings at the refuge involved the discharge of fluids to the grounds around the building. Metals, perchlorates, and BNAs are typical raw materials for pyrotechnics, and Explosives are involved in ammunition mixes. Volatile solvents used for cleaning activities.
	AUS-0A09-W01-SS-05			4-5 ft	TCL Volatiles (8260B) SW846 Explosives (8330)	
	AUS-0A09-W01-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0A09-W01-GW-00		Monit. Well	N/A	Ammonia as N Nitrates + Nitrites TCL Volatiles (8260b) SW846 Explosives (8330) Perchlorates TAL Metals (6010/7000) TCL BNAs (8270c)	

BWT = Below water table

N/A = Not applicable

COPCs = Chemicals of Potential Concern



SOURCE: USGS DIGITAL RASTER GRAPHIC

N

0 2000
SCALE FEET

FIELD SAMPLING PLAN-SITE INVESTIGATION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.00
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 8/25/99 DSGN. BY: mh CHKD. BY:	Area 9 West Location FIG. NO. 8-1

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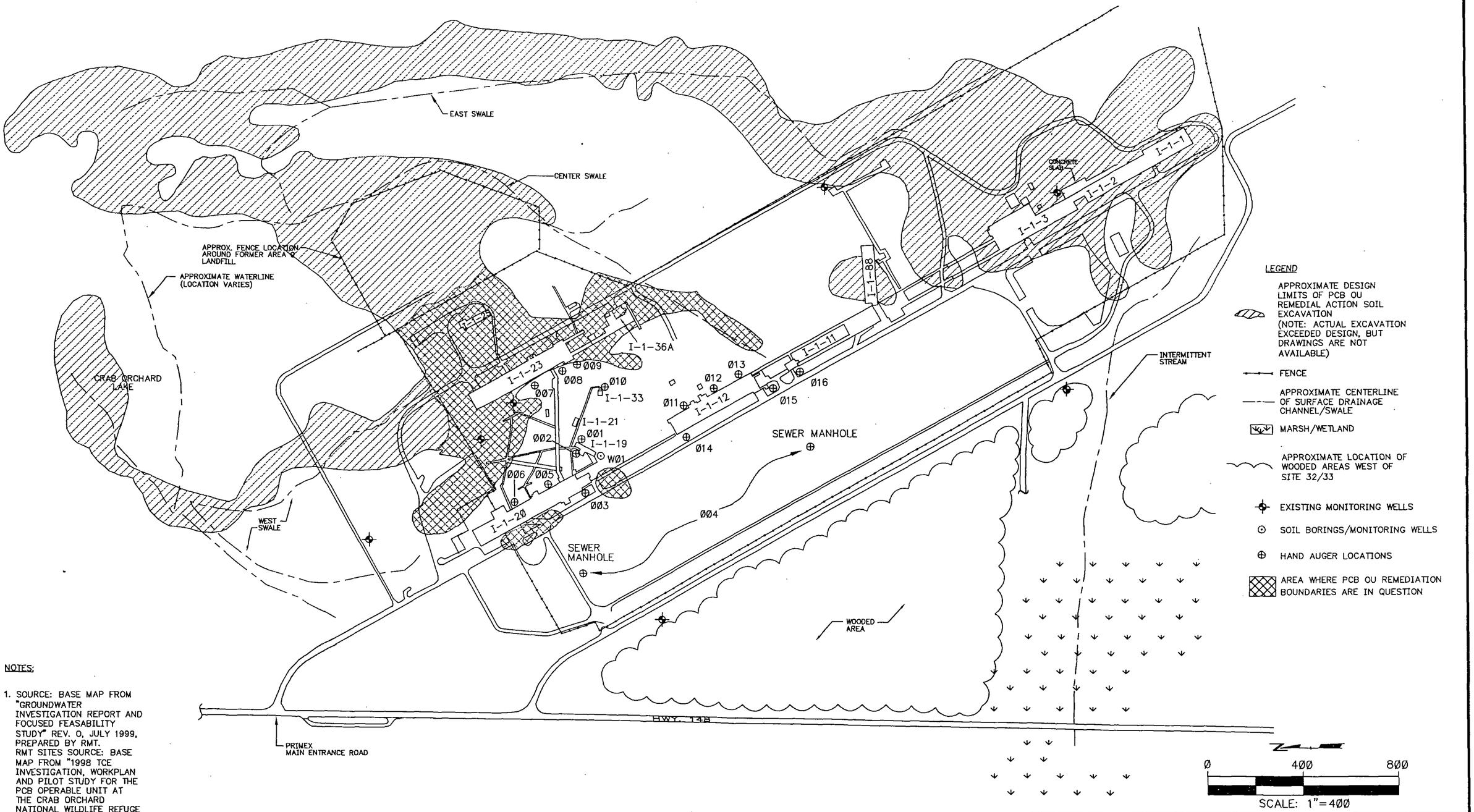


NOTES:

1. SOURCE: BASE MAP FROM "GROUNDWATER INVESTIGATION REPORT AND FOCUSED FEASABILITY STUDY" REV. 0, JULY 1999, PREPARED BY RMT. RMT SITES SOURCE: BASE MAP FROM "1998 TCE INVESTIGATION, WORKPLAN AND PILOT STUDY FOR THE PCB OPERABLE UNIT AT THE CRAB ORCHARD NATIONAL WILDLIFE REFUGE SUPERFUND SITE, MARION, ILLINOIS" REV. 1, MAY 1998, PREPARED BY FLUOR DANIEL GTI.
2. APPROXIMATE EXTENT OF MARSH/WETLANDS ESTIMATED FROM SITE TOPOGRAPHIC MAP.
3. LOCATION OF ALL WOODED AREAS NOT SHOWN.

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68F0D9727800

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 8/21/99 DSGN. BY: JA CHKD. BY:	AUS–0A09 Area 9 Sample Locations	FIG. NO. 8–2

File: F:\68F0D9727800\CRABFIG8–2A.DWG Last edited: 02/25/00 @ 09:09 a.m. @ WCC–ST.LOUIS

9.1 AREA 10 – IOP FUSE AND BOOSTER STORAGE MAGAZINES (AUS-0A10)

Site Location and Boundaries

The location of Area 10 is shown on Figure 2-1. The site is located west of Highway 148 and just to the north of Ogden Road. To get to the site travel west on Ogden road from Highway 148 for 1.0 miles. Turn north onto an unnamed road ant this road leads to Area 10. The site is bound on all sides by woodlands. Area 10 is shown on Figure 9-1 with sample locations. Information on each sample is contained in Table 9-1.

Site History

This site was formerly a group of storage magazines for the explosive components of anti-tank mines, bombs and artillery being produced at the load lines. From 1967 to 1970 the site was used for the incineration of ignitable wastes from the production operations of an ordnance manufacturer. The burning of the wastes was done in large pits called burning pits. In 1970, open burning was banned on the Refuge and the pits were covered. Since that time the site has been used by local law enforcement personnel for small arms practice.

Sampling Information Specific to Area 9

Two test pits are planned in the area where the burn pits were located. Several samples will be collected from both of these pits. Two other area where site conditions during the site walkover indicated possible contamination will also be sampled.

TABLE 9-1
SAMPLE LOCATIONS FOR AREA 10 - IOP FUSE AND BOOSTER STORAGE MAGAZINES
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A10-001	AUS-0A10-001-SS-0X	North of former building FBM 2-2.	Test pit samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site previously used as a burning ground/burning pit for ignitable wastes.
	AUS-0A10-001-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0A10-001-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A10-001-SS-??			Below trench	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	
	AUS-0A10-001-GW-00		Test pit water	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) TCL volatiles (8260b) SW846 Explosives (8330) Perchlorates	

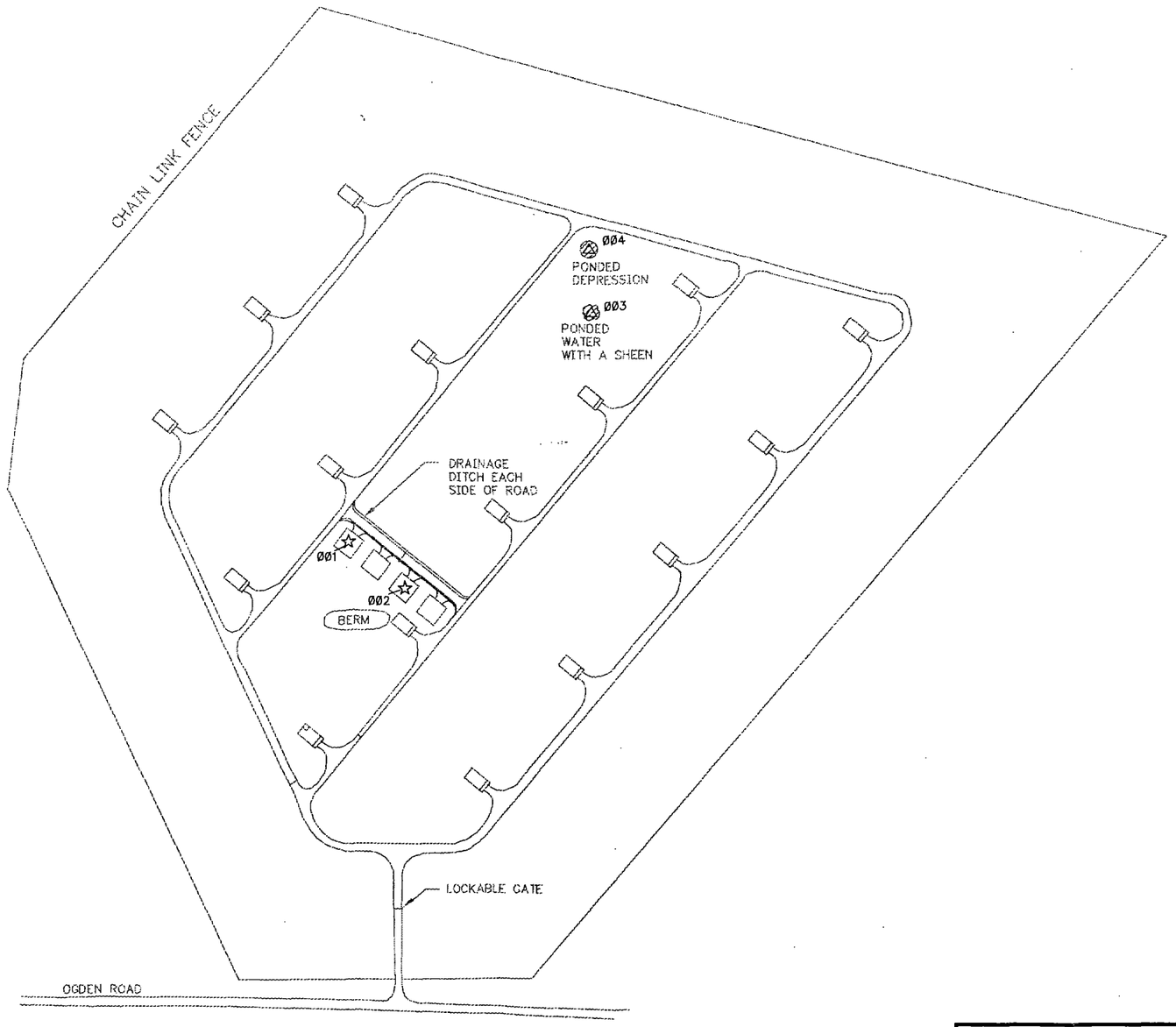
TABLE 9-1
SAMPLE LOCATIONS FOR AREA 10 - IOP FUSE AND BOOSTER STORAGE MAGAZINES
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A10-002	AUS-0A10-002-SS-0X	East of former building FBM 2-2.	Test pit samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site previously used as a burning ground/burning pit for ignitable wastes.
	AUS-0A10-002-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0A10-001-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0A10-002-SS-??			Below trench	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) Dioxin	
	AUS-0A10-002-GW-00		Test pit water	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330) Perchlorates	
0A10-003	AUS-0A10-003-SD-0X	West of former building FBM 2-5 in ponded area	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Ponded area shows an obvious sheen indicating that contamination is possible.
	AUS-0A10-003-SW-02		Surface water	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	

TABLE 9-1
SAMPLE LOCATIONS FOR AREA 10 - IOP FUSE AND BOOSTER STORAGE MAGAZINES
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A10-004	AUS-0A10-004-SD-0X	North of former building FBM 2-5 in ponded depression	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Depression was not normal for the surrounding terrain suggesting the depression was man-made.
	AUS-0A10-004-SW-02		Surface water	N/A	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	

N/A = Not applicable



LEGEND

- ☆ TEST PIT LOCATIONS
- △ SHOVEL SAMPLE LOCATIONS
- ⟶ DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

APPROXIMATE SCALE 1"=3ØØ'

SOURCES: U.S. ACE. 1944, WAR DEPARTMENT FACILITIES INVENTORY OF THE ILLINOIS ORDNANCE PLANT.
PART 1 SECT. 5 PAGE 14
(PLAN NO. 6544-1Ø1.28)

OLIN BURNING GROUND LAYOUT
SOURCE: PRI-ØØ521

AUS HISTORIC SEARCH REPORT CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 8/18/99 DSGN. BY: ja CHKD. BY:	AUS-ØA1Ø Area 1Ø Sample locations
	FIG. NO. 9-1

File: F:\68FOD9727800\CRABFIG9-1.DWG Last edited: 02/10/00 @ 4:14 p.m. WC-ST.LOUIS, MO

Area 11 and 12 Location and Boundaries

The roadway that leads south into Areas 11 and 12 intersects Ogden Road approximately 0.3 miles west of Route 148. The boundaries of Areas 11 and 12 are presented on Figure 10-1. The general groundwater flow direction in Areas 11 and 12 is to the north, towards Crab Orchard Lake. Figures 10-2 and 10-3 present groundwater contours in these areas. Groundwater elevation information was collected from two separate groundwater sampling events, one in October 1991 (Figure 10-2) and another in July 1993 (Figure 10-3).

Area 11 History

Area 11 consists of the IOP Group II Melt Loading Line, group of buildings. It originally consisted of 31 buildings located just south of Ogden Road to the west side of Highway 148 (see Figure 10-1). Load Line II was designed and built for the loading of 105 or 155mm shells. Figure 10-2 is a site layout map for Area 11. Several corporations have had operations within Area 11 including:

- The Sherwin Williams Defense Corporation (SWDC) operated the Group II Melt Loading Line (Load Line II) in Area 11 during World War II, from August 1942 through September 1945. Sherwin Williams loaded shells, bombs and mines on Load Line II. They occupied all of the buildings along Load Line II in conjunction with operating the area for IOP.

- Hoosier Cardinal Corporation and the Ordill Machine Works operated in Area 11 from approximately August 1948 through 1954. Hoosier Cardinal Corporation manufactured and finished decorative metal and plastic parts. Ordill Machine Works did tool and dye workings. It is not known what buildings they occupied.

- From January 1956 through April 1964, Olin conducted operations in Area 11. Olin occupied all of the former IOP buildings and expanded the plant into the vacant property located between Areas 11 and 12. For the purposes of this report, this expanded area will be considered part of Area 11. Olin produced various types of commercial explosives in Area 11.

- Commercial Solvents Corporation (CSC) occupied Area 11 from April 1964 through 1982. CSC (and its successors, including U.S. Powder who initially operated the plant for CSC) also produced explosives in Area 11. CSC occupied the same buildings that Olin had previously occupied. Explosives were manufactured in Area 11 until June 1971, when decontamination procedures began. By 1986, there were no tenants in Area 11.[47]

Area 12 History

Area 12 consists of the IOP Ammonium Nitrate Plant. It originally consisted of 12 buildings located just south of Ogden Road to the west side of Highway 148 – south of Area 11 (see Figure 10-1). The Ammonium Nitrate Plant was designed and built for the production of explosive-

[47] CRO 185 – According to Techlaw, Inc., 1992, Final Draft Report - Site Operations/Ownership History – Crab Orchard National Wildlife Refuge; Prepared for U.S. Army Corps of Engineers, Page 75.

grade ammonium nitrate. Figure 10-2 is a site layout map for Area 12. Several corporations have had operations within Area 12 including:

- SWDC used Area 12 for explosive-grade ammonium nitrate production during World War II from August 1942 through May 1943.
- Silas Mason produced fertilizer-grade ammonium nitrate in this area from 1947 through 1950.
- Universal Match Corporation (UMC) tested photo flash signals in this area for approximately six months during 1955.[48]
- Olin leased this area from January 1956 through April 1964. According to John Miller, a former Olin employee, it was used mostly for storage and burning.[49] According to Mr. Robert Meyers[50] (a former Olin truck driver) and Mr. Harry Stiles[51] (former FWS project manager for entire Refuge), Area 12 was also used to make explosives for a brief time.
- CSC occupied Area 12 from April 1964 through 1982. CSC (and its successors) used Area 12 for cyclonite (RDX) production and for storage, according to the U.S. Powder Map. Additionally, according to the U.S. Powder Map the burning grounds were also still present on the western side of the property. CSC occupied the same buildings that Olin had previously occupied and they built several new buildings (Figure 10-2).

Decontamination of Area 12 began after 1971.[52] By 1986, there were no tenants in Area 12.[53]

Sampling Information Specific to Areas 11 and 12

Sampling in Areas 11 and 12 may be slightly different from other AUS sites, due to the different types of explosives manufacturing that were done in these two areas. For example, perchlorates were analyzed for in several sample locations from these two areas because they are often found in association with explosives production. Since detailed information about explosives production was not available for these areas, it is not known if perchlorates were used; however, it is possible. As a result, perchlorate samples were collected from various sample locations throughout the sites.

In several of the deeper soil borings, the soil samples that were collected from below the water table and the groundwater samples collected from that soil boring, may have been analyzed for

[48] ACO 39 and ACL 670 - According to Techlaw, Inc., 1992, Final Draft Report - Site Operations/Ownership History – Crab Orchard National Wildlife Refuge; Prepared for U.S. Army Corps of Engineers, Pages 6, 25.
[49] Testimony of Mr. John Miller taken on April 9, 1998, Page 31.
[50] Testimony of Mr. Robert Meyers taken on April 10, 1998, Page 20.
[51] Testimony of Mr. Harry Stiles taken on November 18, 1997, Page 67.
[52] CRO185 – According to Techlaw, Inc., 1992, Final Draft Report - Site Operations/Ownership History – Crab Orchard National Wildlife Refuge; Prepared for U.S. Army Corps of Engineers, Page 76.
[53] CRO185 – According to Techlaw, Inc., 1992, Final Draft Report - Site Operations/Ownership History – Crab Orchard National Wildlife Refuge; Prepared for U.S. Army Corps of Engineers, Page 75.

additional compounds that were not analyzed for in the soils above the water table. The reasoning for this is because these borings may be located downgradient of other areas of concern (i.e. any soil boring/monitoring well location that is located downgradient of AUS-A11N – the Nitroglycerin Area – would also be analyzed for nitroglycerin in the groundwater sample and in any soil samples collected below the water table). Samples that will be collected from below the water table, will be collected from near the top of the saturated zone of soil as determined in the field.

It should be noted that samples located around buildings in Areas 11 and 12 were usually placed in areas that were likely to receive wash water from the buildings or near truck loading docks. During the time period when explosives were manufactured in Areas 11 and 12 (approximately 1942 through 1971), common practice was to wash spilled materials out of the buildings with water. The wash water would exit the building via doorways and floor drains (if they were present in the building), and flow out into either sumps or the surrounding ditches. For this reason samples will be collected next to all suspected sumps; there are numerous ditch samples to be collected throughout these two areas; and several samples to be collected near former doorways and truck docks.

Many samples were collected along the former IOP Group II Melt Loading Line, to be analyzed for explosives and/or metals. Explosives were analyzed for along various portions of this load line (mostly northwest of Building 66), since bombs, shells and mines were loaded with explosives during World War II in this area. Metals were analyzed for in this area because Hoosier Cardinal Corp./Ordill Machine Company occupied various unknown buildings along this load line, prior to Olin's presence in the area. It should also be noted that metals were analyzed for in areas where Olin and or CSC manufactured or used ammonium nitrate. Based on the Olin patent information reviewed during the historical records search, chromates may have been used in ammonium nitrate production. Since CSC bought Olin's ammonium nitrate production process, they may have also been using chromates in this process.

There were several railroad lines and shop areas in Areas 11 and 12. Samples collected from these areas were likely analyzed for VOCs and/or BNAs, depending on the kind of contamination expected in each of these areas.

In locations where both surface water and sediment samples are to be collected, surface water samples should always be collected prior to sediment samples. The reason for this, is so that the surface water samples do not contain any additional sediment which could be stirred up during sediment sampling.

There are numerous mounds of soil located in Areas 11 and 12. The ordnance subcontractor will sample all of these mounds. Some of these mounds appear to be covering buried buildings. Historical records indicate that the buried buildings were covered with 2 to 3 feet of fill material. These mounds will have samples collected from the fill that covers the building materials (a depth of approximately 1-2 feet), and samples collected from the material beneath the fill (either at auger refusal or a depth of 4-5 feet – whichever comes first). **The thickness of the fill material will be noted in the field notes during sampling.**

Those mounds that do not appear to be covering buried buildings will also be sampled by the ordnance subcontractor. Soil samples will be collected from within the mound of material, from approximately 25% below the top of the mound. For instance, if a ten-foot tall mound is sampled, the sample would be collected from a depth of approximately 2-3 feet below the top of the mound.

The historic records search also identified numerous buildings in Areas 11 and 12 that have been flashed due to explosive hazards. It is not known if chlorinated solvents were used in these buildings or not; however, due to the potential for dioxin contamination resulting from burning chlorinated solvents, a few representative samples collected from buried building locations (sample below the fill material), will be analyzed for dioxin.

Along with all of the mounds, the ordnance subcontractor will also sample all of the soil sample locations next to the mix houses, next to the laboratories, and within the burning grounds.

10.1 AUS-A11A – AREA 11 ACID AND AMMONIUM NITRATE PRODUCTION AREA

Site Location and Boundaries

The site is located between the Area 11 Pilot Propellant Plant/Cap Production Area (AUS-A11P) to the west, the Area 11 Support Area (AUS-A11S) to the east, and the Area 11 High Explosives Area (AUS-A11H) to the south; as seen on Figure 10-2. The boundary lines were drawn so that all of the buildings that were used in ammonium nitrate and acid production, would be included in this area. The boundaries also included the entire Acid Magazine Pond, and the dynoil mixing area (Buildings 50 and 53). Figure 10-4 shows most of the Acid and Ammonium Nitrate Production Area, however some portions of the area that are not going to be sampled were not included on the figure, so that a larger scale map could be used.

Sample locations at AUS-A11A are shown on Figure 10-4. Sample analysis information for each sample location is contained in Table 10-1.

Site History

The Area 11 Acid and Ammonium Nitrate Production Area has been occupied by all of the above-mentioned occupants of Area 11 (this area may or may not have been occupied by Hoosier Cardinal/Ordill Machine Company, since it is not known for certain what buildings these companies occupied).

This area was used during IOP operations as a part of the Melt Loading Line – mostly for TNT and ammonium nitrate storage and screening. Both Olin and CSC used this area as an acid and ammonium nitrate production facility. This production facility was in operation from late 1957 through April 1969, when it was eliminated. The processes used in this area are not known, however it is possible that Olin used chromates in their production of ammonium nitrate. There are numerous ditches and ponded areas in this area that will be investigated in addition to the areas around the buildings.

The Acid Magazine Pond (Site COP-1 which is located in the northern portion of AUS-A11A) was previously investigated and elevated levels of explosives, semivolatiles, metals, total recoverable petroleum hydrocarbons (TRPH), and sulfates were detected in the Acid Magazine Pond and/or the ditches located west of the pond. This pond appears to have received drainage from AUS-A11A.

Sampling Information Specific to Area AUS-A11A

The easternmost half of this area was the acid production area for both Olin and CSC. The westernmost half of this area was used for ammonium nitrate production by Olin and CSC and was also used for dynoil production by Olin. Hand augers samples and surface water samples are planned for most of site AUS-A11A.

There will be two monitoring wells installed in this area. These wells will be remotely drilled because this area appears to be downgradient of the Nitroglycerin Area (AUS-A11N). Both of these wells will be sampled. One of the wells is located next to the Dynoil Mix House (Building 53) where there is a high potential for spilled materials (dynamite and diesel oil). The other well

is located next to the Chemical Area Maintenance Shop (Building 47) where there is also a high potential for spilled materials such as solvents, oils, etc. During the historic records search, it was discovered that a monitoring well was previously installed in this area just northwest of the Acid Magazine Pond (formerly known as site COP-1). This monitoring well is not shown on Figure 10-4. This well will also be sampled during the field investigation, if it is still present on site.

10.2 AUS-A11H – AREA 11 HIGH EXPLOSIVES AREA

Site Location and Boundaries

The site is located east of the Area 11 Pilot Propellant Plant/Cap Production Area (AUS-A11P), and south of the Area 11 Acid and Ammonium Nitrate Production Area (AUS-A11A) and the Area 11 Support Area (AUS-A11S), as seen on Figure 10-2. The boundary lines were drawn so that all of the buildings that may have been used for the production of high explosives, would be included in this area. The eastern boundary was drawn just west of the road that runs between the West and Center Holding Ponds, because based on current site drainage it appears that the West Holding Pond was associated with the High Explosives Area and the East and Center Holding Ponds were associated with the Nitroglycerin Area. The northern boundary runs just south of the Service Area Rd., except in the area of the former Dope House (Building 7), where Buildings 7 and 67 and their associated buildings are included in the High Explosives Area instead of in the Acid and Ammonium Nitrate Production Area. The southern boundary generally runs along the Smokeless Powder Road and the western boundary is just west of the ammonium nitrate fuel oil (ANOIL) manufacturing area (near Building 23).

Sample locations at AUS-A11H are shown on Figure 10-5. Sample analysis information for each sample location is contained in Table 10-2.

Site History

The majority of the Area 11 High Explosives Area was built by Olin and was occupied by both Olin and CSC. This area has been used for the production and packaging of high explosives. Contaminants identified in this area by CSC include the following: dynamite, RDX, pentaerythritol tetranitrate (PETN), nitroglycerin, nitrocellulose, TNT and ANOIL. Several buildings were also used by SWDC for IOP operations at the Melt Loading Line. These buildings were Building 7, 8, 24, 67 and 69 and the most likely explosive contaminant in these buildings would be TNT. There are numerous ditches and ponded areas in this area that will be investigated in addition to the areas around the buildings.

USEPA collected samples from the former evaporation basin that was located in this area in 1998, however the locations and depths of their samples are not known. A few metals results were slightly elevated.

Sampling Information Specific to Area AUS-A11H

Hand auger samples, shovel samples and surface water samples are planned for most of this area. Several samples will be collected by the ordnance subcontractor. These samples are as follows: samples located next to or near former mix houses, samples located next to or near former laboratories, samples located in the former West Holding Pond and samples collected from mounds.

There is one monitoring well that will be installed in this area next to the ANOIL Manufacturing Building (Building 23), where there is a high potential for spilled materials (ammonium nitrate and fuel oil). This soil boring will be drilled remotely, since it may be downgradient of the Nitroglycerin Area (AUS-A11N).

There are three test pits that will be excavated in Area AUS-A11H. Two of the test pits are placed next to possible former sumps. One of the sumps was located next to the former Melt Loading Building (Building 7). This sump received wash waters from the former IOP TNT melt-loading operations. The other possible sump was located next to the Dynamite Parts Cleaning Building (Building 24-3). It is not known what contaminants this possible sump might have received, however, solvents are likely. The third test pit will be excavated through a former trench location that was identified by aerial photographs just south of the Melt Loading Building (Building 7), on the south side of the Service Area Road. The use of this trench is not known. Test pits are being excavated in these areas instead of borings, since these three sample locations are not very far downgradient of the Nitroglycerin Area (AUS-A11N). Both soil and groundwater (if encountered) samples will be collected from each of these test pits.

10.3 AUS-A11N – AREA 11 NITROGLYCERIN AREA

Site Location and Boundaries

The site is located north and east of the Area 11 High Explosives Area (AUS-A11P), and south of the Area 11 Support Area (AUS-A11S), as seen on Figure 10-2. The boundary lines were drawn so that all of the buildings that may have been used for the production of nitroglycerin, would be included in this area. The western boundary was drawn just west of the road that runs between the West and Center Holding Ponds, because based on current site drainage it appears that the East and Center Holding Ponds were associated with the Nitroglycerin Area and the West Holding Pond was associated with the High Explosives Area. The northern boundary runs just north of the Dynamite Area Rd. The southern boundary is located just north of the Powder Storage Ponds in Area 12 and the eastern boundary follows along the plant fenceline.

Sample locations at AUS-A11N are shown on Figure 10-6 and Figure 10-7. Sample analysis information for each sample location is contained in Table 10-3.

Site History

The Area 11 Nitroglycerin Area was built by Olin and was occupied by both Olin and CSC. This area has been used for the production of nitroglycerin using the Biazzi process. The only explosive contaminant identified in this area by CSC was nitroglycerin. There are numerous ditches and ponded areas in this area that will be investigated in addition to the areas around the buildings.

A previous investigation was done in AUS-A11N, in the East Holding Pond (Site COP-2). Metals and nitrates were the only elevated compounds detected in this area. Note that nitroglycerin has not been previously analyzed for at this site because during the previous investigations, the investigators did not know that this was a former nitroglycerin manufacturing area.

Sampling Information Specific to AUS-A11N

Hand auger samples and surface water samples are planned for most of this area. The ordnance subcontractor will be responsible for collecting the majority of the samples from this area because of the hazards associated with nitroglycerin.

There are no deep borings or monitoring wells planned in this area due to the potential explosive hazards associated with drilling in an area where nitroglycerin may be encountered. Nitroglycerin is a dense non-aqueous phase liquid (DNAPL) and is subject to pooling in favorable geologic conditions. Since this is the most likely area of nitroglycerin contamination, the possibility of encountering one of these pooled areas is much greater in this area than in other areas that are farther downgradient. There will be no monitoring wells installed in this area due to the high potential for explosive hazards in this area resulting from the possible presence of nitroglycerin in the subsurface. There were previously two monitoring wells located in this area

near the East Holding Pond (formerly known as site COP-2), however, they were not identified during the site reconnaissance. They will be sampled if they are located during the field investigation. These wells were placed in this area without the knowledge that this was a former nitroglycerin production area.

There were eight possible burning trenches located in AUS-A11N that were identified in historical aerial photographs. There is currently no evidence of these trenches on site. Two were identified in the location of former Building 10, and six were identified in an open area located just east of former Building 9. Two test pits will be excavated in AUS-A11N, in the open area located just west of Building 9 (Figure 10-7), through two of the former trench locations. The former use of these trenches is not known. Test pits are being excavated in these areas instead of borings, based on the proximity of these trenches to the buildings where nitroglycerin was produced and because it is believed that test pits will give us a better idea of what these trenches were used for than soil borings would. Both soil and groundwater (if encountered) samples will be collected from each of these test pits. Note that the two trenches identified in the former Building 10 location will not be investigated since this is one of the most likely areas of nitroglycerin contamination. Thus, the potential explosive hazards in this area is expected to be very high.

There were two railroad tank cars (RRTCs) located just west of the former Nitrator (Building 9). One of these two RRTCs had an access port and it has been previously sampled. The other RRTC will be sampled during this investigation. The tank will be cored into remotely, if it is determined to be safe to do so, and then a liquid or sludge sample will be collected from this tank.

It has been reported that the ditches and holding pond in this area may have been flashed; however, the potential for contamination still exists therefore extreme care should be taken during intrusive activities in this area.

10.4 AUS-A11P – AREA 11 PILOT PROPELLANT PLANT/CAP PRODUCTION AREA

Site Location and Boundaries

The site is located west of the Area 11 Acid and Ammonium Nitrate Production Area (AUS-A11A) and west of the Area 11 High Explosives Area (AUS-A11H), as seen on Figure 10-2. The boundary lines were drawn so that all of the buildings that may have been used by the Pilot Propellant Plant or used for Big Inch Cap production, would be included in this area. The boundaries were drawn just east of former Building 48 and south of the Service Area Rd. Figure 10-8 shows most of the Pilot Propellant Plant/Cap Production Area, however some portions of the area that are not going to be sampled were not included on the figure, so that a larger scale map could be used.

Sample locations at AUS-A11P are shown on Figure 10-8. Sample analysis information for each sample location is contained in Table 10-4.

Site History

The Area 11 Pilot Propellant Plant/Cap Production Area has been occupied by all of the above-mentioned occupants of Area 11 (this area may or may not have been occupied by Hoosier Cardinal/Ordill Machine Company, since it is not known what buildings these companies occupied).

This area was used by SWDC during IOP operations as a part of the Melt Loading Line, for some TNT pouring operations and drilling and boostering operations. Olin used this area as a Pilot Propellant Plant that was used for research and development of propellants. Olin also manufactured gas generators and tested some explosives in this area. CSC used this area for Big Inch Cap Production that involved the use of RDX, lead azide and/or lead styphnate and possibly mercury fulminate. Testing of Big Inch Caps was also done in this area and there were numerous storage facilities also. This area was in operation during most of the time that Olin and CSC had possession of the property. There are numerous ditches and ponded areas in this area that will be investigated in addition to the areas around the buildings.

There was one previous UXO investigation in this area, however it did not involve the chemical analysis of samples.

Sample Information Specific to AUS-A11P

Hand auger samples, shovel samples and surface water samples are planned for most of this area. The ordnance subcontractor will be responsible for collecting many of the samples from this area, because of the hazards associated with CAP Production and possibly testing (i.e. lead azide, lead styphnate and/or mercury fulminate contamination).

One monitoring well will be installed in this area, just south of Building 85 (former Pilot Propellant Plant). This boring will be drilled remotely, since it appears to be located downgradient of the Nitroglycerin Area (AUS-A11N). This boring will determine the potential

for contamination associated with the IOP Drilling and Boostering Building and with the former Pilot Propellant Plant that was run by Olin.

The potential for lead azide, lead styphnate and/or mercury fulminate contamination still exists in portions of this area (mostly the western portion), therefore, extreme care should be taken during intrusive activities in this area.

10.5 AUS-A11S – AREA 11 SUPPORT AREA

Site Location and Boundaries

The site is located east of the Area 11 Acid and Ammonium Nitrate Production Area (AUS-A11A) and north of the Area 11 Nitroglycerin Area (AUS-A11N) as seen in Figure 10-2. The boundary lines were drawn so that all of the general support buildings for Areas 11 and 12, were included in this area. It should be noted that there are numerous support buildings located in other areas (such as storage buildings, control houses, etc.), however, they are used to support the specific operations in that area, so they were not included in the Area 11 Support Area. Figures 10-9 (North Support Area) and 10-10 (South Support Area) show buildings in the Support Area. The Support Area was split into two figures so that a larger scale map could be used.

Sample locations at AUS-A11S are shown on Figure 10-9 and Figure 10-10. Sample analysis information for each sample location is contained in Table 10-5.

Site History

The Area 11 Support Area has been occupied by all of the above-mentioned occupants of Area 11. It is likely that several of the buildings in this area were also occupied by Hoosier Cardinal/Ordill Machine Company; however it is not known for certain which buildings that the companies may have occupied.

This area was used during IOP operations as a part of the Melt Loading Line, mostly for storage and for cleaning and painting operations (Buildings 56 and 66). The IOP Boiler House along with four associated underground storage tanks (USTs) was also located in this area. It has been reported that the USTs were removed from near the boiler house,there is no evidence of their presence at the site. However, no documentation has been found to confirm that the USTs were actually removed. The building has been razed; however, it is possible that the underground fuel storage tanks may have been left in place during the building demolition. An attempt will be made to locate these USTs during the field investigation, if they still exist. Both Olin and CSC used this area as a support area for their explosives manufacturing operations in Areas 11 and 12. This portion of the facility was in use for the duration of Olin and CSC's tenure at the site – from January 1956 through the mid-1970s when decontamination procedures began at the site. The following buildings were located in this area: Carpenter, Maintenance and Machine Shop (Building 55), Welding Shop (Building 57), Oil Stores (Building 68), Administration Buildings (various buildings), Laboratories (Buildings 75-1 and 80), Garage/Wash Room (Building 56), Boiler House (Building 60), Scrap Yard (Location 58) and other miscellaneous buildings. There are numerous ditches and ponded areas in this area that will be investigated in addition to the areas around the buildings.

The USEPA previously collected samples from near the cleaning and painting building and near the boiler house; both semivolatiles and metals were detected at elevated levels in samples from these locations. The depth and locations of these samples is not known.

Sample Information Specific to AUS-A11S

Hand auger samples and surface water samples are planned for most of this area. The ordnance subcontractor will be responsible for collecting several of the samples from this area, including those located in soil mounds and those located next to laboratories. URS will be responsible for collecting the majority of the samples in this area.

A magnetometer survey is planned in the area believed to be the location of the underground storage tanks. The magnetometer survey should provide a clear indication of the presence of the fuel storage tanks if they remain at the site.

Four monitoring wells will be installed in this area. All of the soil borings will be drilled remotely, since they are likely located downgradient of the Nitroglycerin Area (AUS-A11N). One of these monitoring wells will be placed in the area of the former fuel oil USTs whether they are identified during the magnetometer survey or not, to determine the possibility of residual fuel oil contamination. Another monitoring well will be located next to a potential "sump" that is located just east of the former Salvage Yard (Figure 10-9). This "sump" was identified during the site reconnaissance, however, it was not identified by either Olin or CSC and its former use is not known. There were no former buildings identified in this area. A third monitoring well will be placed on the north side of the former Cleaning and Painting Building (Building 66), next to former Building 68 - Paint Shield Cleaning Building (IOP) and Oil Stores (Olin and CSC). The fourth monitoring well will be placed on the south side of the former Cleaning and Painting Building (Building 66). Both the third and the fourth monitoring wells were placed in these areas to identify the potential for paint, solvent and possibly oil contamination.

10.6 AUS-0A12 – AREA 12 FORMER AMMONIUM NITRATE PLANT

Site Location and Boundaries

Area 12 is located just south of the Area 11 High Explosives Area (AUS-A11H). The boundary lines (Figures 10-11) were drawn to include the former ammonium nitrate plant (triangular area bound by the plant fenceline); the powder storage ponds (located just north of the former ammonium nitrate plant); and "the area west of Area 12" which was reportedly several small burn areas (located west of the former ammonium nitrate plant). The burn areas identified as the "area west of Area 12" were not located during the site reconnaissance; however, another area was located in the vicinity, near the shore of an un-named lake, which may have contained a former disposal and/or burning trench. This area is shown in Figure 10-12.

Sample locations at AUS-0A12 are shown on Figure 10-11 and Figure 10-12. Sample analysis information for each sample location is contained in Table 10-6.

Site History

As mentioned above, SWDC, Silas Mason, UMC, Olin and CSC all occupied Area 12. SWDC operated the explosive-grade ammonium nitrate plant for the IOP. Silas Mason then operated the ammonium nitrate plant to produce fertilizer-grade ammonium nitrate. UMC was reported to have used the area to test photo flash signals. Olin used the area for storage, burning and to manufacture explosives. Olin originally manufactured ammonium nitrate in this area until the ammonium nitrate facility in Area 11 was completed. CSC used this area for storage, burning and RDX production. There are numerous ditches and ponded areas in Area 12 that will be investigated in addition to the areas around the buildings.

There were eight storage ponds present in Area 12 also and these were used for storage of double-base propellants, smokeless powder, and possibly other explosive materials. A previous investigation was done at the powder storage ponds (Site COP-3), and a few metals were detected at elevated levels. However, all soil samples were collected from depths of at least four feet and no surficial soil samples were collected. As a result, surface soils in this area will be targeted for sampling during this investigation.

The area south of the burning ground was also previously investigated (Site COP-4). Volatiles, semivolatiles, metals, explosives, TRPH, nitrates and sulfates were all detected at elevated levels in this area. Removal actions are currently being done at COP-4. These areas are being avoided during this investigation.

Sample Information Specific to AUS-0A12

Hand auger samples and surface water samples are planned for most of this area. The ordnance subcontractor will be responsible for collecting several of the samples from this area, including those located in soil mounds and those located in or near potential burning grounds. URS will be responsible for collecting the majority of the samples in this area.

There were reportedly two partially buried tanks located in the northwest portion of the Powder Storage Pond area. It is not known if these tanks are still present on site or not, nor if the contents of either of the tanks are accessible. A magnetometer survey is planned in the area believed to be the location of the partially buried tanks. If the tank locations are identified and if it is possible, the tank will be cored into remotely and then a liquid or sludge sample will be collected from this tank. The contents of these tanks are not known.

Two monitoring wells are planed to be installed in the area near the Powder Storage Ponds. These borings will be drilled remotely, since they appear to be located downgradient of the RDX production area in Area 12 and the ordnance subcontractor does not feel that it is safe to drill near the RDX production area. Both of the borings appear to be located downgradient of the powder storage ponds and one of the borings will be located in the area of the partially buried tanks to detect any potential subsurface contamination associated with these tanks. *Note: There are possibly three existing monitoring wells located in the area of the Powder Storage ponds. If these three wells are still present on site, then monitoring wells will not be installed in these two soil borings and the boring that is not located next to the partially buried tanks, will not be drilled as discussed in Table 10-6.*

Seven monitoring wells were installed in Area 12 during previous investigations. Three were located in the area of the Powder Storage Ponds (formerly known as site COP-3) as discussed above, and four were located on the western half of Area 12 (formerly known as site COP-4). All seven of these monitoring wells will be analyzed for the parameters listed in Table 10-6, if these wells are still present on site.

One drum sample will be collected from this site. A sample will be collected from the solid material that is still present in the drum. This drum is partially deteriorated, therefore, access to its contents will not require opening the drum as it is already open to the atmosphere.

There are twelve test pits that will be excavated in Area 12, (Figure 10-11). Six of the test pits will be excavated through former trenches that were identified in historical aerial photographs. The use of these trenches is not known, however it is likely that some of these trenches were used for burning explosives and other materials. Two additional test pits will be dug in potential former burning trench locations. These potential trenches were not identified on aerial photographs, however the locations are within the burning grounds identified by Olin and CSC. Test pits are being excavated in these eight locations instead of borings, because of potential explosive hazards and because it is believed that test pits will give us a better idea of what these trenches may have been used for than soil borings would.

Two more test pits will be excavated in areas of potential volatile organic contamination as identified by previous investigations. A third test pit will be excavated outside the RDX Mixer House (Building 76-2) and a fourth will be excavated outside the RDX Separation Building (Building 76). Test pits will be done instead of borings in these four locations, due to the potential for buried explosive materials in Area 12. Both soil and groundwater (if encountered) samples will be collected from each of these test pits.

TABLE 10-1
SAMPLE LOCATIONS FOR AREA 11 – AMMONIUM NITRATE/ACID PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11A-001	AUS-A11A-001-SD-0X	Ponded area south of Chemical Area Rd.	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Located in ditch south of Chemical Area Rd., west of former Building 53 (Dynoil Mix House) – ditch may have received spillage from mixing/loading operations - possible COPCs: dynamite and diesel oil and TNT (from former Bldg. II-1-16 – TNT Service Magazine)
	AUS-A11A-001-SW-00		Surface water	N/A	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives, TDS	
A11A-002	AUS-A11A-002-SS-0X	Southwest of former Building 50	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located southwest of former Building 50 (in field, just off east corner of concrete parking area) – Bldg. 50 (unknown use) may have been used in assoc. with Bldg. 53 (Dynoil Mix House) – appears to have a truck loading dock also – possible COPCs: dynamite and diesel oil
	AUS-A11A-002-SS-02			1-2 ft	TCL Volatiles	
A11A-003	AUS-A11A-003-SD-0X	Ponded area east of former Building 50	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in ponded area just east of former Building 50 (unknown use), which may have received runoff from Bldg. 50 – Bldg. 50 may have been used in assoc. with Bldg. 53 (Dynoil Mix House) – possible COPCs: dynamite and diesel oil
	AUS-A11A-003-SW-00		Surface water	N/A	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, TDS	
A11A-004	AUS-A11A-004-SL-0X	South of former Building 50	Sewer Sed.	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	IOP sewer manhole located south of former Building 50 (unknown use) – manhole dates back to IOP – Bldg. 50 was not an IOP building although it is possible that it was connected to sewer – possible COPCs: SW846 Explosives, TAL Metals, organics – TCL Volatiles are not expected to still be present
A11A-005	AUS-A11A-005-SD-0X	North of Service Area Rd. and west of former Building 67	Hand auger	0-6 in.	TCL Volatiles + Hexane, TCL BNAs, Perchlorates, TAL Metals, SW846 Explosives + Nitroglycerin	Located in northernmost of two northeast flowing ditches that flow into "Solid Propellant Creek" – ditches are located between 90 and 130 feet north of Service Area Rd., southwest of former Building 67 (former Melt Loading Building) – this ditch may have received drainage from Bldg. 48 (former IOP Cooling Bldg. and Olin Jet Starter Cartridge Assembly Bldg.) – possible COPCs: NG, AN, TAL Metals, perchlorates, cutting oils, hexane, TNT

TABLE 10-1
SAMPLE LOCATIONS FOR AREA 11 – AMMONIUM NITRATE/ACID PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11A-006	AUS-A11A-006-SD-0X	North of Service Area Rd. and west of former Building 67	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	Located in "Solid Propellant Creek", just north of a culvert that goes underneath an old railroad bed – may receive drainage from Bldgs. 67 (former IOP Melt House and former Olin/CSC storage) and 48 (former Cooling Building and Jet Starter Cartridge Assembly) – possible COPCs: NG, AN, TAL Metals, perchlorates, cutting oils, TCL BNAs, hexane, TNT
	AUS-A11A-006-SW-00		Surface water	N/A	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Ammonia as N, Perchlorates, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate)	
A11A-007	AUS-A11A-007-SD-0X	North of Service Area Rd. and west of former Building 67	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	Located in a ponded area that leads into "Solid Propellant Creek" (which flows northward), just southeast of a culvert that goes underneath an old railroad bed – there is a slight sheen on the water in this area – may receive drainage from Bldgs. 67 (former IOP Melt House and former Olin/CSC storage) and 48 (former Cooling Building and Jet Starter Cartridge Assembly) – possible COPCs: NG, AN, TAL Metals, perchlorates, cutting oils, TCL BNAs, hexane, TNT
	AUS-A11A-007-SW-00		Surface water	N/A	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, SW846 Explosives +Nitroglycerin, Ammonia as N, Perchlorates, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate)	
A11A-008	AUS-A11A-008-SD-0X	South of Chemical Area Rd. and east of former Building 53	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in "Solid Propellant Creek" which is named this because there is solid propellant located along the length of the creek – the creek has a black substance on the surface of the water along the edges of the creek – location is approximately 200 feet south of Chemical Area Rd. (in area of black substance) – possible COPCs: organics, TAL Metals, AN, and perchlorates (from propellants); TNT and AN (from Building 67 - former Melt Loading Building)
	AUS-A11A-008-SW-00		Surface water	N/A	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	

TABLE 10-1
SAMPLE LOCATIONS FOR AREA 11 – AMMONIUM NITRATE/ACID PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11A-009	AUS-A11A-009-SD-0X	South of Chemical Area Rd. and northeast of former Building 53	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives, Perchlorates	Located at confluence of northward flowing "Solid Propellant Creek" and a ditch which runs along the south side of the Chemical Area Rd. from Dynoil Mix House – just south of culvert that goes under Chemical Area Rd. – possible COPCs: organics, TAL Metals, AN, and perchlorates (from propellants); TNT and AN (from Building 67 - former Melt Loading Building); and diesel oil and dynamite (from Bldg. 53 – Dynoil Mix House)
	AUS-A11A-009-SD-02			1-2 ft	TCL Volatiles	
A11A-010	AUS-A11A-010-SD-0X	North of Chemical Area Rd. and west of Building 46-1	Hand auger	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located in ditch on north side of culvert that runs under Chemical Area Rd – ditch runs northward along east side of broken asphalt road that goes to ammonium nitrate (A.N.) production area – receives drainage from near Bldg 46-1 which was a former AN Storage building and NG Dry House
	AUS-A11A-010-SW-00		Surface water	N/A	TAL Metals, SW846 Explosives + Nitroglycerin, Nitrate+Nitrite, Ammonia as N, TDS	
A11A-011	AUS-A11A-011-SD-0X	Midway between Chemical Area Rd. and former Building 42	Hand auger	0-6 in.	TAL Metals	Located at south end of ditch that runs northward along east side of broken asphalt road that goes to ammonium nitrate production area (approx. 250 ft south-southeast of Chemical Area Rd.)–possible COPCs: chromates from AN
A11A-012	AUS-A11A-012-SS-0X	West of former Building 42	Hand auger	1-2 ft	TAL Metals	Located on a 5 ft high soil mound that is located approx. 380 feet south of Chemical Area Rd on northwest side of broken asphalt road that leads to A.N. production area – possible COPCs: chromates from AN
A11A-013	AUS-A11A-013-SL-0X	Northwest of former Building 42	Sewer Sed.	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Sediment in bottom of drain (three foot square metal grating) located approximately 400 feet south of Chemical Area Rd. just on southeast side of broken asphalt road that leads to A.N. production area – possible COPCs: chromates from AN, organics, TNT from former Bldg. 67
A11A-014	AUS-A11A-014-SD-0X	Former Building 42	Hand auger	0-6 in.	TAL Metals	Located in ponded area that is former location of Building 42 (A.N. Graining Building) – possible COPCs: chromates from AN production
	AUS-A11A-014-SW-00		Surface water	N/A	TAL Metals, Ammonia as N, Nitrate+Nitrite, TDS	

TABLE 10-1
SAMPLE LOCATIONS FOR AREA 11 – AMMONIUM NITRATE/ACID PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11A-015	AUS-A11A-015-SS-0X	Southwest of former Building 41	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located just southwest of former Building 41 (A.N. Cooling and Bagging Building) and west of former Building 41-2 (A.N. Loading dock and TNT Booster Service Magazine) approx. 250 feet north of Service Area Rd. and 30 feet east of broken asphalt road – possible COPCs: chromates from AN, TNT
A11A-016	AUS-A11A-016-SD-0X	West of former Building 67	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in northernmost of two southwest flowing ditches that flow into "Solid Propellant Creek" – ditches between 90 and 130 feet north of Service Area Rd., southwest of former Building 67 (former Melt Loading Building) – possible COPCs: chromates from AN, TNT
A11A-017	AUS-A11A-017-SD-0X	West of former Building 67	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in southernmost of two southwest flowing ditches that flow into "Solid Propellant Creek" – ditches between 90 and 130 feet north of Service Area Rd., southwest of former Bldg 67 (former Melt Loading Building) – possible COPCs: chromates from AN, TNT, TCL BNAs from railroad
A11A-018	AUS-A11A-018-SS-0X	Between former Buildings 40, 40-1 and 43	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located between former Bldgs 40, 40-1 & 43 (Prill Tower and Wet End, A.N. Recovery Bldg & A.N. Lab) – approx. 250 ft north of Service Area Rd and 150 ft east of broken asphalt road going to A.N. production area – possible COPCs: chromates from AN, TNT, organics from lab
	AUS-A11A-018-SS-02			1-2 ft	TCL Volatiles	
A11A-019	AUS-A11A-019-SS-0X	North of former Building 46-1	Hand auger	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located on west side of soil mound, approximately 50 feet south of Chemical Area Rd. – mound just northeast of former location of former Building 46-1 (former TNT Service Bldg. and AN Storage/Nitroglycerin Dry House) – possible COPCs: TNT, NG, and chromates from AN
A11A-020	AUS-A11A-020-SS-02	Northeast of former Building 46-1	Hand auger	1-2 ft	TAL Metals, SW846 Explosives + Nitroglycerin	Located on mound just northeast of former location of Building 46-1 (former TNT Service Building and AN Storage/Nitroglycerin Dry House) – potentially buried debris from Building 46-1 – possible COPCs: chomates from AN, TNT, NG
	AUS-A11A-020-SS-05			4-5 ft or refusal	TAL Metals, SW846 Explosives + Nitroglycerin	

TABLE 10-1
SAMPLE LOCATIONS FOR AREA 11 – AMMONIUM NITRATE/ACID PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11A-021	AUS-A11A-021-SD-0X	South of former Building 46-1	Hand auger	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located in southeast-northwest trending ditchline that starts near former Building 46-1 (former TNT Service Building and AN Storage/Nitroglycerin Dry House) and drains into north flowing creek located on southeast side of broken asphalt road that leads to A.N. production area – possible COPCs: chomates from AN, TNT, NG
A11A-022	AUS-A11A-022-SD-0X	Ponded area west of former Building 47	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in ponded area, just northwest of former Building 47 (Chemical Area Maintenance Shop) – previously drainage ditch which exhibited ground scarring in historical aerial photographs – possible COPCs: organics (from oils used in maintenance), TAL Metals, SW846 Explosives, AN
	AUS-A11A-022-SW-00		Surface water	N/A	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, TDS, Nitrate + Nitrite, Ammonia as N	
A11A-023	AUS-A11A-023-SD-0X	Ponded area east of former ramp which connected former Buildings 46-1 and 46	Sewer Sed.	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, TOC	Ponded area that has a sewer grate under water (just north of Building 47 - Chemical Area Maintenance Shop) ponded area is a part of a ditch that extends to the east from the ponded area and extends to the northwest from the ponded area (flow direction of the ditch is not known, but it is assumed to be to the west/northwest) – sample sewer sediment if possible – possible COPCs: organics (from oils used in maintenance), TAL Metals, SW846 Explosives, AN, acids (nitric and sulfuric)
	AUS-A11A-023-SW-00		Surface water	N/A	TCL BNAs, TAL Metals, SW846 Explosives, Nitrate+Nitrite, Sulfates, Ammonia as N, TDS, Alkalinity	
A11A-024	AUS-A11A-024-SD-0X	Ponded area west of former Building 46	Hand auger	0-6 in.	TCL BNAs, SW846 Explosives, TAL Metals	Located in ponded area located south-southwest of former Building 47 (Chemical Area Maintenance Shop) – this ponded area is connected via ditchline to second smaller ponded area (larger pond to be sampled) – possible COPCs: chromates from AN and TNT (from former Bldg. 46 - TNT Screening Bldg. and AN Storage House), organics (from Bldg. 47 – Maintenance Shop)
	AUS-A11A-024-SW-00		Surface water	N/A	TCL BNAs, SW846 Explosives, TAL Metals, TDS, Ammonia as N, Nitrate+Nitrite	
A11A-025	AUS-A11A-025-SS-0X	North of former Building 46	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located north of former Building 46 (TNT and A.N. Screening Building and A.N. Storage) – there was one press located in this building so there is potential for contamination assoc. with cutting oils – sample located in area identified as possible liquid release on aerial photos – possible COPCs: chromates from AN, TNT, organics from cutting oils
	AUS-A11A-025-SS-02			1-2 ft	TCL Volatiles	

TABLE 10-1
SAMPLE LOCATIONS FOR AREA 11 – AMMONIUM NITRATE/ACID PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11A-026	AUS-A11A-026-SD-0X	Ponded area north of former ramp which connected former Buildings 46-1 and 32	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located in a ponded area just south of Chemical Area Rd. between former Buildings 46-1 (former TNT Service Building and Nitroglycerin Dry House) and 32 (A.N. and TNT? Service Building and Acid Office & Shop) – ponded area is connected via drainpipes to the Acid Magazine Pond on the north and to another ponded area to the south-southeast – possible COPCs: TNT, chromates from AN, NG, acids (nitric & sulfuric), organics (from shop)
	AUS-A11A-026-SW-00		Surface water	N/A	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives +Nitroglycerin, Ammonia as N, Nitrate+Nitrite, Sulfates, TDS, Alkalinity	
A11A-027	AUS-A11A-027-SS-0X	North of former Building 32	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located just northwest of a soil mound that appears to be in the same location as former Building 32 (A.N. and TNT? Service Building and Acid Office & Shop) – possible COPCs: organics (from shop), AN, TNT
				1-2 ft	TCL Volatiles	
A11A-028	AUS-A11A-028-SD-0X	Ponded area south of former ramp which connected former Buildings 46-1 and 32	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located in a ponded area that is located south of the former ramp (soil mound) that connected former Buildings 46-1 (former TNT Service Building and Nitroglycerin Dry House) and 32 (A.N. & TNT? Service Building and Acid Office & Shop) – this ponded area is connected to another smaller ponded area to the north and it is connected to a ditch at the southern corner of the ponded area – possible COPCs: NG, TNT, chromates from AN, organics (from shop)
	AUS-A11A-028-SW-00		Surface water	N/A	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives +Nitroglycerin, Ammonia as N, Nitrate+Nitrite, TDS, Sulfates, Alkalinity	
A11A-029	AUS-A11A-029-SL-0X	Southwest of Building 37-1	Sewer Sed.	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	IOP sewer manhole located southwest of Building 37-1 (Ammonia Hortensphere) – possible COPCs: SW846 Explosives (from IOP), TAL Metals and organics (from Hoosier Cardinal)
A11A-030	AUS-A11A-030-SS-0X	North of former Building 31	Hand auger	0-6 in.	TAL Metals	Low-lying area with some ponding – located just north of former Building 31 (Cooling Tower and Control Building) – possible COPCs: chromates from AN
A11A-031	AUS-A11A-031-SD-0X	North of Chemical Area Rd. and south of Acid Magazine Pond	Hand auger	0-6 in.	TAL Metals	Located in a ditch which runs northeast-southwest along the north side of the Chemical Area Rd – it appears as if it may be connected to the Acid Magazine Pond – possible COPCs: TAL Metals (from Hoosier Cardinal drainage)

TABLE 10-1
SAMPLE LOCATIONS FOR AREA 11 – AMMONIUM NITRATE/ACID PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11A-032	AUS-A11A-032-SD-0X	North of Chemical Area Rd. and south of Acid Magazine Pond	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located in ditch which runs along the west side of the Acid Magazine Pond, just upgradient (south) of drainage pipe which appears to be connected to the Acid Magazine Pond – it is possible that this drainage pipe can be opened and closed – sediment at drainage pipe was already sampled by ESE for TAL Metals, SW846 Explosives and TNT – possible COPCs: chromates from AN; TNT and NG(from Bldg. 46-1); acids (nitric and sulfuric); ammonia; organics (TPH), elevated TAL Metals and SW846 Explosives were all detected in sediment in this drainageway (see Figure 15-7 of HSR)
	AUS-A11A-032-SW-00		Surface water	N/A	TAL Metals, SW846 Explosives, TDS, Nitrate+Nitrite, Ammonia as N, Sulfates, Alkalinity	
A11A-033	AUS-A11A-033-SD-0X	In Acid Magazine Pond	Hand auger	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Located in southern end of Acid Magazine Pond which appears to receive drainage from Acid and Ammonium Nitrate Production Area – possible COPCs: NG and TNT (from Bldg. 46-1), chromates from AN, organics (TCL BNAs and TPH) and SW846 Explosives were detected in Acid Pond, TAL Metals were detected at elevated levels in the sediment from the Acid Pond (including chromium and mercury – see Figure 15-7 of HSR)
	AUS-A11A-033-SW-00		Surface water	N/A	TCL Volatiles, TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
A11A-034	AUS-A11A-034-SD-0X	In Acid Magazine Pond	Hand auger	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Located in northern end of Acid Magazine Pond which appears to receive drainage from Acid and Ammonium Nitrate Production Area – possible COPCs: NG and TNT (from Bldg. 46-1), chromates from AN, organics (TCL BNAs and TPH) and SW846 Explosives were detected in Acid Pond, TAL Metals were detected at elevated levels in the sediment from the Acid Pond (including chromium and mercury – see Figure 15-7 of HSR)

TABLE 10-1
SAMPLE LOCATIONS FOR AREA 11 – AMMONIUM NITRATE/ACID PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11A-035	AUS-A11A-035-SD-0X	Ponded area west of former Building 47	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in ponded area, just northwest of former Building 47 (Chemical Area Maintenance Shop) – previously drainage ditch which exhibited ground scarring in aerials – possible COPCs: organics (from oils used in maintenance), TAL Metals, SW846 Explosives, chromates from AN
A11A-036	AUS-A11A-036-SD-0X	West of former Building 46	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located west of former Building 46 (TNT and A.N. Screening Building and A.N. Storage) - possible former drum storage area acc. to historical aerial photographs – there was also one press located in this building so there is potential for contamination assoc. with cutting oils – possible COPCs: organics (from cutting oils), chromates from AN, TNT
	AUS-A11A-036-SD-02			1-2 ft	TCL Volatiles	
A11A-037	AUS-A11A-037-SD-0X	South of former Building 46	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located south of former Building 46 (TNT and A.N. Screening Building and A.N. Storage) - possible former drum storage area acc. to historical aerial photographs – there was also one press located in this building so there is potential for contamination assoc. with cutting oils – possible COPCs: organics (from cutting oils), chromates from AN, TNT
	AUS-A11A-037-SD-02			1-2 ft	TCL Volatiles	
MW-COP1-3	AUS-A11A-MW-COP1-3-GW-00	North of Acid Magazine Pond	Ground water	N/A	TCL Volatiles, TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals, Perchlorates, TDS, Nitrate+Nitrite, Sulfates, Ammonia as N	*Sample existing monitoring well if it is still present on site. (Well location is identified on Figure 10-2 of this FSP.)*

TABLE 10-1
SAMPLE LOCATIONS FOR AREA 11 – AMMONIUM NITRATE/ACID PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11A-W01	AUS-A11A-W01-SS-0X	West of former Building 53	Soil Boring	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Located just west of former Building 53 – Dynoil Mix House (in field, approximately 240 feet west of broken asphalt road and 65 feet south of Chemical Area Rd.) – this location appears to be truck loading area according to historical aerial photographs – area may also have received spillage from mixing operations or from wash waters – possible COPCs: dynamite and diesel oil
	AUS-A11A-W01-SS-02			1-2 ft	TCL Volatiles	
	AUS-A11A-W01-SS-05			4-5 ft	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives	
	AUS-A11A-W01-SS-??			BWT	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives+ Nitroglycerin	
	AUS-A11A-W01-GW-00		Monit. Well	N/A	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives+Nitroglycerin, Nitrate+Nitrite, TDS, Sulfates, Ammonia as N	
A11A-W02	AUS-A11A-W02-SS-0X	East of former Building 47	Soil Boring	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located just southeast of former Building 47 (Chemical Area Maintenance Shop) – contamination is possible at this location due to spillage/washing from maintenance operations in this shop – possible COPCs: organics (from oils used in maintenance), TAL Metals, SW846 Explosives, AN, PETN and NG (both below water table only because this area is believed to be downgradient of A11H and A11N)
	AUS-A11A-W02-SS-02			1-2 ft	TCL Volatiles	
	AUS-A11A-W02-SS-05			4-5 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-A11A-W02-SS-??			BWT	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + PETN + Nitroglycerin	
	AUS-A11A-W02-GW-00		Monit. Well	N/A	TCL Volatiles, TCL BNAs, SW846Explosives +Nitroglycerin +PETN, TAL Metals, Perchlorates, TDS, TSS, Ammonia as N, Nitrate+Nitrite, Sulfate, Alkalinity, Phosphorus (orthophos.)	

BWT = Below Water Table
N/A = Not Applicable
COPCs = Chemicals of Potential Concern
Shaded samples will be collected by the UXO subcontractor.

FSP = Field Sampling Plan
HSR = Historic Search Report

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-001	AUS-A11H-001-SS-0X	West of former temporary ANOIL building	Hand auger	0-6 in.	PAHs, TAL Metals	Located just west-northwest of the former temporary ANOIL building – approx. 230 ft south of Dynamite Area Rd. and 40 ft west of edge of berm – located in area which appears scarred on historical aerial photographs – possible COPCs: AN, organics and TAL Metals (from fuel oil)
	AUS-A11H-001-SS-02			1-2 ft	TCL Volatiles	
A11H-002	AUS-A11H-002-SD-0X	North of former temporary ANOIL building	Hand auger	0-6 in.	PAHs, TAL Metals	Ponded area located in former roadway to former temporary ANOIL building, on south side of Dynamite Area Rd. – north of berm – possible COPCs: AN, organics and TAL Metals (from fuel oil)
A11H-003	AUS-A11H-003-SD-0X	Northwest of former Building 23	Hand auger	0-6 in.	PAHs, TAL Metals	Located in north-flowing ditch that appears to drain the area surrounding former Building 23 (ANOIL Manufacturing Building) – possible COPCs: AN, organics and TAL Metals (from fuel oil)
	AUS-A11H-003-SD-02			1-2 ft	TCL Volatiles	
A11H-004	AUS-A11H-004-SS-0X	West of former Building 23	Hand auger	0-6 in.	PAHs, TAL Metals	Located on southwest side of former Building 23 (ANOIL Manufacturing Building) – north of former Building 23A (Heated House or ANOIL Mix Building) – trailers were loaded in this area – possible COPCs: AN, organics and TAL Metals (from fuel oil)
	AUS-A11H-004-SS-02			1-2 ft	TCL Volatiles	
A11H-005	AUS-A11H-005-SD-0X	Southeast of former Building 23	Hand auger	0-6 in.	PAHs, TAL Metals	Located in east flowing ditch that appears to receive drainage from the area surrounding former Buildings 23 (ANOIL Manufacturing Building) and 23A (Heated House or ANOIL Mix Building) – possible COPCs: AN, organics and TAL Metals (from fuel oil)
	AUS-A11H-005-SD-02			1-2 ft	TCL Volatiles	
A11H-006	AUS-A11H-006-SS-0X	South of former Building 22	Shovel sample	0-6 in.	SW846 Explosives, TAL Metals	Located south of former Building 22 (former Case House No. 3 and Torpex Operation) – sample is located in a depressed area – possible COPCs: RDX, TNT and aluminum (from Torpex operation)
A11H-007	AUS-A11H-007-SD-0X	South of former Building 18	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located at the confluence of a north-flowing and a west-flowing ditch located south of Building 18 (Pack House, MXU 4A Mix House and Powder Stripping House), on the opposite side of the roadway – may have received some drainage from Bldg. 22 (Torpex Operation) – possible COPCs: RDX, TNT and aluminum (from Torpex operation)

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-008	AUS-A11H-008-SD-0X	West of former Building 18	Hand auger or trowel	0-6 in	TCL BNAs, TAL Metals, SW846 Explosives + PETN + Nitroglycerin	Located in north flowing ditch near culvert which may receive drainage from former Building 18 (Pack House, MXU 4A Mix House and Powder Stripping House) – ditch is located west of Building 18 on opposite side of roadway – possible COPCs: RDX, TNT and aluminum (from Torpex operation upstream); and possibly organics (solvents), NG, nitrocellulose and nitrocotton (possibly in smokeless powders used in MXU 4A Mix Hse. – Bldg. 18); dynamite and PETN (identified by CSC in Bldg. 18)
	AUS-A11H-008-SD-01			6-12 in.	TCL Volatiles	
A11H-009	AUS-A11H-009-SD-0X	Northeast of former Building 18	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + PETN	Located in ponded area of west flowing ditch that is located in the northeast corner of the Building 18 (Pack House, MXU 4A Mix House and Powder Stripping House) area – possible COPCs: possibly organics (solvents), NG, nitrocellulose and nitrocotton (possibly in smokeless powders used in MXU 4A Mix Hse. – Bldg. 18); dynamite and PETN (identified by CSC in Bldg. 18)
	AUS-A11H-009-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + PETN, Nitrate+Nitrite	
A11H-010	AUS-A11H-010-SD-0X	West of former Building 21	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin	West of former Building 21 (Case House No. 2 and Superprime and Slurry Operations), in ponded area – possible COPCs: dynamite, NG, RDX, and TNT (all identified by CSC in Bldg. 21) and possibly nitrocellulose (from slurry operations), other unknowns from (Superprime & Slurry)
	AUS-A11H-010-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, SW846 Explosives + Nitroglycerin, TDS	
A11H-011	AUS-A11H-011-SD-0X	Northeast of former Building 21	Shovel sample	0-6 in	SW846 Explosives + Nitroglycerin	Located in ponded area which runs along north side of former Building 21 (Case House No. 2 and Superprime and Slurry Operations) area, near culvert which may have received drainage from Building 15 (Cil-Vibra Pack House) area – possible COPCs: dynamite, NG, RDX, and TNT (all identified by CSC in Bldgs. 15 and 21) and possibly nitrocellulose (from slurry operations),

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-012	AUS-A11H-012-SD-0X	South of former Building 29	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + PETN + Nitroglycerin	Located in ponded area, west of Building 21 (Case House No. 2 and Superprime and Slurry Operations) on opposite side of roadway – appears to receive drainage from the areas of former Buildings 18, 21 and 22 – possible COPCs: dynamite, NG, RDX, and TNT (all identified by CSC in Bldg. 21); possibly nitrocellulose (from slurry operations); and dynamite and PETN (identified by CSC in Bldg. 18); RDX, TNT and aluminum and NG (from Torpex operation upstream – Bldg. 22)
	AUS-A11H-012-SW-00		Surface water	NA	TCL BNAs, TAL Metals, SW846 Explosives + PETN + NG, Perchlorates, Ammonia as N, Nitrate + Nitrite	
A11H-013	AUS-A11H-013-SS-0X	West of former Building 29	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin +PETN	Located west of former Building 29 (Loading Dock) – across roadway from water valves – COPCs: unknown
A11H-014	AUS-A11H-014-SD-0X	Northeast of former Building 29	Shovel sample	0-6 in.	SW846 Explosives + Nitroglycerin + PETN	Located in north-flowing ditch which appears to receive drainage from areas of former Buildings 18, 21,22 and 29 – northwest of former Building 13 (Hall Pack House – Dynamite) – on opposite side of roadway – possible COPCs: Dynamite, NG, TNT, RDX, PETN (identified by CSC in the above-mentioned buildings)
A11H-015	AUS-A11H-015-SS-0X	Northwest of former Building 13	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located in area of brownish red staining inside of area of former Building 13 (Hall Pack House – Dynamite)– northwest of former Building 13 (mounded area) – possible COPCs: TNT (reddish staining); NG, dynamite, RDX, and TNT (identified by CSC in Building 13)
A11H-016	AUS-A11H-016-SS-02	Former Building 13	Hand auger	1-2 ft	TAL Metals, SW846 Explosives + Nitroglycerin	Located on mound that is former Building 13 (Hall Pack House – Dynamite) location – possible COPCs: NG, dynamite, RDX, and TNT (identified by CSC in Building 13), possibly dioxin (from flashing bldg. because there is possibility that chlorinated solvents may have been used in this building)
	AUS-A11H-016-SS-05			4-5 ft or refusal	TAL Metals, SW846 Explosives + Nitroglycerin, Dioxin	
A11H-017	AUS-A11H-017-SD-0X	Northeast of former Building 13	Shovel sample	0-6 in.	SW846 Explosives + Nitroglycerin	Located in the area of former Building 13 (Hall Pack House – Dynamite), in north-flowing ditch near culvert which drains water from area of former Building 13 to north – ditch appears to receive drainage from areas of former Buildings 13 & 15 (Cil Vibra Pack House) – possible COPCs: NG, dynamite, RDX, and TNT (identified by CSC in Buildings 13 and 15)

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-018	AUS-A11H-018-SD-0X	Northwest of former Building 69	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	Ponded area just north of culvert that runs under road that's located west of former Building 69 (Change House & Laboratory) – sample located east of road – possible COPCs: everything used in Area 11 (may have been used in laboratory)
	AUS-A11H-018-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
A11H-019	AUS-A11H-019-SD-0X	West of former Building 24	Shovel sample	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Located in northwest-flowing ditch that is located north of Dynamite Area Rd. and west of the road which is located just west of former Building 69 (Change House & Laboratory) – this ditch may receive drainage from area surrounding former Building 23 (ANOIL Manufacturing Building) – possible COPCs: AN, TAL Metals and fuel oil (from ANOIL), possibly SW846 Explosives (from laboratory)
A11H-020	AUS-A11H-020-SD-0X	Northwest of former Building 24	Hand auger or trowel	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Located in ditch north of Dynamite Area Rd. and south of former Building 69 (Change House & Laboratory), east of roadway, near culvert which appears to receive drainage from former Building 24 (Dynamite Maintenance Shop and R&D Lab) – possible COPCs: all compounds used in Area 11 (from laoboratories)
	AUS-A11H-020-SD-01			6-12 in.	TCL Volatiles	
A11H-021	AUS-A11H-021-SS-05	East of former Buildings 7 and 67	Test pit samples	4-5 ft (within trench)	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Dioxin	Located in pit/trench location which was identified in 1965 aerial photograph – the use of this pit/trench is unknown – If there is no evidence of a former trench identified in the test pit, then the dioxin sample will not be collected and the "beneath the trench" sample will become a "below the water table" sample – possible COPCs: PAHs and Dioxin (from burning), TAL Metals and SW846 Explosives (residues from burning), organics (may have been burned also, or used to ignite materials)
	AUS-A11H-021-SS-??			Beneath trench	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-A11H-021-GW-00		Test pit water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Ammonia asN, Alkalinity, Nitrate+Nitrite,	

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-022	AUS-A11H-022-SD-0X	Northeast of former Building 24	Hand auger or trowel	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Located in northeast-flowing ditch on south side of Dynamite Area Rd. (just east of former Building 24 - Dynamite Maintenance Shop and R&D Lab) which appears to receive drainage from former Building 24 – possible COPCs: all compounds used in Area 11 (from laboratory)
	AUS-A11H-022-SD-01			6-12 in.	TCL Volatiles	
A11H-023	AUS-A11H-023-SD-0X	East of former Building 69	Hand auger or trowel	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Located in dry ditch which runs along north side of Dynamite Area Rd. and appears to receive drainage from former Building 69 (Change House and Lab) – possible COPCs: all compounds used in Area 11 (from laboratory)
	AUS-A11H-023-SD-01			6-12 in.	TCL Volatiles	
A11H-024	AUS-A11H-024-SD-0X	West of former Building 20	Shovel sample	0-6 in.	SW846 Explosives + Nitroglycerin	Located in dry, west-flowing ditch which appears to receive drainage from Building 20 (Case House No. 1) – possible COPCs: NG, dynamite, TNT, RDX (identified by CSC as contaminants in Bldg. 20)
A11H-025	AUS-A11H-025-SL-0X	East of former Building 20	Sewer Sed.	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Sewer manhole located on eastern edge of berm which surrounded former Building 20 (Case House No. 1) – possible COPCs: all contaminants found in Area 11 (TCL Volatiles were not analyzed for since they would be expected to have volatilized by now)
A11H-026	AUS-A11H-026-SD-0X	North-northwest of former Building 20	Shovel sample	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin + PETN, TOC	Located in northeast-flowing ditch on south side of Dynamite Area Rd. (north of former Building 20) which appears to receive drainage from former Buildings 18, 20, 21, 22, and 29 – possible COPCs: Dynamite, NG, TNT, RDX, PETN (identified by CSC in the above-mentioned buildings)
A11H-027	AUS-A11H-027-SS-0X	North of former Building 24-1	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located just north of former Building 24-1 (Dynamite Maintenance Shop/Lab) – possible COPCs: all compounds used in area (from laboratory)
	AUS-A11H-027-SS-01			6-12 in.	TCL Volatiles	

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-028	AUS-A11H-028-SS-0X	East of former Building 24-3	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located on north side of potential former sump that is located on east side of former Building 24-3 (Dynamite Parts Cleaning) – sump is connected via drainpipe to former Building 24-3 – sump is currently filled in with soil fill, so no sample is possible from inside sump – possible COPCs: all compounds from area and solvents and oils (all from cleaning parts and equipment)
	AUS-A11H-028-SS-02			12-24 in.	TCL Volatiles	
	AUS-A11H-028-SS-05		Test pit samples	4-5 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	
	AUS-A11H-028-SS-??			Below sump	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	
	AUS-A11H-028-GW-00		Test pit water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives +Nitroglycerin, Nitrate+Nitrite, Ammonia as N	
A11H-029	AUS-A11H-029-SL-0X	North of former Building 24-3	Sewer Sed.	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Sewer manhole located approximately 20 feet north of former Building 24-3 (Dynamite Parts Cleaning) – possible COPCs: all compounds used in area (TCL Volatiles were not analyzed for since they would be expected to have volatilized by now)
A11H-030	AUS-A11H-030-SD-0X	Northeast of former Building 24-3	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives, TAL Metals	Located in north-flowing drainage ditch, just downstream of sump associated with former Building 24-3 (Dynamite Parts Cleaning) – next to culvert which also receives drainage from near Building 19 (Shell House) – slight sheen on water in this location – possible COPCs: all compounds used in area and solvents and oils (all from cleaning parts and equipment)
	AUS-A11H-030-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, SW846 Explosives, TAL Metals	

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-031	AUS-A11H-031-SD-0X	Southeast of former Building 17	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Small ponded area southeast of former Building 17 (Talley Mix House where dynamite was mixed) – ponded area is on east side of roadway – possible COPCs: nitrocellulose, NG, TNT, RDX, dynamite (identified by CSC in Building 17); ANOIL, sulfur, dinitrotoluene, sodium nitrate (in dynamite)
	AUS-A11H-031-SW-00		Surface water	NA	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, TDS, Perchlorates, Sulfates, Ammonia as N, Nitrate + Nitrite	
A11H-032	AUS-A11H-032-SS-02	Former Building 17	Hand auger	1-2 ft	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located on mound which is former Building 17 (Talley Mix House) location – possible COPCs: nitrocellulose, NG, TNT, RDX, dynamite (identified by CSC in Building 17); ANOIL, sulfur, dinitrotoluene, sodium nitrate (in dynamite)
	AUS-A11H-032-SS-05			4-5 ft or refusal	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	
A11H-033	AUS-A11H-033-SD-0X	Southeast of former Building 16	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located in north flowing ditch in southwest corner of area of former Building 16 (Gel Cartridge Pack House) – location is next to culvert which receives drainage from the area of former Building 17 (Talley Mix House) – possible COPCs: nitrocellulose, NG, TNT, RDX, dynamite (identified by CSC in Buildings 16 & 17); ANOIL, sulfur, dinitrotoluene, sodium nitrate (in dynamite)
A11H-034	AUS-A11H-034-SS-02	Former Building 16	Hand auger	1-2 ft	SW846 Explosives + Nitroglycerin	Located on mound which is former Building 16 (Gel Cartridge Pack House) location – possible COPCs: nitrocellulose, NG, dynamite, TNT (identified by CSC as contaminants in Bldg. 16)
	AUS-A11H-034-SS-05			4-5 ft or refusal	SW846 Explosives + Nitroglycerin	
A11H-035	AUS-A11H-035-SD-0X	North of former Building 16	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin	Located in west-flowing ditch on north side of area of former Building 16 (Gel Cartridge Pack House), near a drain pipe which appears to originate in former Building 16 – possible COPCs: nitrocellulose, NG, dynamite, TNT (identified by CSC as contaminants in Bldg. 16)
A11H-036	AUS-A11H-036-SD-0X	Southwest of former Building 15	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Sewer manhole located in southwest corner of area of former Building 15 (Cil Vibra Pack House), near culvert from area of Building 16 (Gel Cartridge Pack House) – possible COPCs: all used in this area

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-037	AUS-A11H-037-SS-02	Former Building 15	Hand auger	1-2 ft	SW846 Explosives + Nitroglycerin	Located on mound which is former Building 15 (Cil Vibra Pack House) location – possible COPCs: NG, dynamite, TNT and RDX (identified by CSC as contaminants in Building 15)
	AUS-A11H-037-SS-05			4-5 ft or refusal	SW846 Explosives + Nitroglycerin	
A11H-038	AUS-A11H-038-SD-0X	Northeast of former Building 15	Shovel sample	0-6 in.	SW846 Explosives + Nitroglycerin, TOC	Located in north-flowing ditch in northeast corner of area of former Building 15 (Cil Vibra Pack House) – next to culvert which leads to area of former Building 13 (Hall Pack House – Dynamite) – possible COPCs: NG, dynamite, TNT and RDX (identified by CSC as contaminants in Building 15)
A11H-039	AUS-A11H-039-SS-02	Former Building 12	Hand auger	1-2 ft	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Dioxin	Located on mound which is former Building 12 (Mix House No. 2) location – possible COPCs: NG, TNT, RDX, dynamite (identified by CSC in Building 12); ANOIL, nitrocellulose, sulfur, dinitrotoluene, sodium nitrate (in dynamite), possibly dioxin (from flashing bldg. because there is possibility that chlorinated solvents may have been used in this building)
	AUS-A11H-039-SS-05			4-5 ft or refusal	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	
A11H-040	AUS-A11H-040-SD-0X	Northeast of former Building 12	Hand auger or trowel	0-6 in	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Ponded area that is located in northeast corner of area of former Building 12 (Mix House No. 2) – culvert heads under roadway to south in this location – possible COPCs: NG, TNT, RDX, dynamite (identified by CSC in Building 12); ANOIL, nitrocellulose, sulfur, dinitrotoluene, sodium nitrate (in dynamite)
	AUS-A11H-040-SW-00		Surface water	NA	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals, Nitrate+Nitrite, Ammonia as N, TDS	

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-041	AUS-A11H-041-SD-0X	North of former Building 12	Hand auger or trowel	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Ponded area that is located north of former Building 12 (Mix House No. 2) and east of former Building 15 (Cil Vibra Pack House) – possible COPCs: NG, TNT, RDX, dynamite (identified by CSC in Building 12); ANOIL, nitrocellulose, sulfur, dinitrotoluene, sodium nitrate (in dynamite)
	AUS-A11H-041-SW-00		Surface water	NA	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
A11H-042	AUS-A11H-042-SD-0X	Northeast of former Building 12	Hand auger or trowel	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin	Located in north-flowing ditch located on east side of roadway that runs along eastern edge of High SW846 Explosives Area – sample is just downstream from culvert that drains area of former Building 12 (Mix House No. 2) – possible COPCs: NG, TNT, RDX, dynamite (identified by CSC in Building 12); ANOIL, nitrocellulose, sulfur, dinitrotoluene, sodium nitrate (in dynamite)
A11H-043	AUS-A11H-043-SD-0X	East of former Building 13	Hand auger or trowel	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin	Located in ponded area that is just south of area of former Building 13 (Hall Pack House on east side of roadway) in area that's believed to be the former location of Building 11 (former Mix House) which exploded during Olin's tenure – possible COPCs: NG, TNT, RDX, dynamite (identified by CSC in other mix houses); ANOIL, nitrocellulose, sulfur, dinitrotoluene, sodium nitrate (in dynamite)
A11H-044	AUS-A11H-044-SS-02	East of former Building 13	Hand auger	1-2 ft	TCL BNAs, SW846 Explosives + Nitroglycerin	Located on a northwest-southeast trending mound in the area which is believed to be the former location of Building 11 (former Mix House) – mound may be burying debris from another unidentified building that was present in this location – possible COPCs: NG, TNT, RDX, dynamite (identified by CSC in other mix houses); ANOIL, nitrocellulose, sulfur, dinitrotoluene, sodium nitrate (in dynamite)
	AUS-A11H-044-SS-05			4-5 ft or refusal	TCL BNAs, SW846 Explosives + Nitroglycerin	

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-045	AUS-A11H-045-SD-0X	Southwest of former Building 25	Hand auger or trowel	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Located at confluence of a north-flowing ditch and a east-flowing ditch that is located in the northeast corner of the area that's believed to be the former location of Building 11 (former Mix House) – next to culvert which drains to the east – possible COPCs: NG, TNT, RDX, dynamite (identified by CSC in other mix houses); ANOIL, sulfur, nitrocellulose, dinitrotoluene, sodium nitrate (in dynamite)
A11H-046	AUS-A11H-046-SD-0X	East of former Building 25	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives + Nitroglycerin, TAL Metals	Located in north-flowing ditch that is just east of former Building 25 (Nitrocotton-TNT Screening House) – next to foundation of the building which is still in place – possible COPCs: nitrocellulose, TNT, NG, RDX, dynamite (identified by CSC as contaminants in Building 25)
A11H-047	AUS-A11H-047-SS-02	Former Building 14	Hand auger	1-2 ft	TAL Metals, SW846 Explosives + Nitroglycerin	Located on mound which is former Building 14 (Starrett and "LL" Pack House – Dynamite) location – possible COPCs: NG, dynamite, RDX, TNT (identified by CSC as contaminants in Building 14)
	AUS-A11H-047-SS-05			4-5 ft or refusal	TAL Metals, SW846 Explosives + Nitroglycerin	
A11H-048	AUS-A11H-048-SD-0X	Northeast of former Building 14	Shovel sample	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Ponded area in northeast corner of area of former Building 14 (Starrett and "LL" Pack House – Dynamite) – downstream of small debris area that is located in the southeast corner —may receive some drainage from area of former Building 13 (Hall Pack House – Dynamite) – possible COPCs: NG, dynamite, RDX, TNT (identified by CSC as contaminants in Buildings 13 & 14)
A11H-049	AUS-A11H-049-SS-0X	Northwest of former Building 25	Shovel sample	0-6 in.	TCL BNAs, TAL Metals	Area with several pallets and a crushed drum – could possibly have been a former drum storage area – possible COPCs: unknown
	AUS-A11H-049-SS-01			6-12 in.	TCL Volatiles	
A11H-050	AUS-A11H-050-SD-0X	Northeast of former Building 27	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located at confluence of two dry ditches, next to former Building 27 (Tractor House), near a culvert which drains to the east into a south-flowing ditch – possible COPCs: unknown

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-051	AUS-A11H-051-SD-0X	Western half of West Holding Pond	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located in north-flowing ditch in former West Holding Pond (bermed area east of Building 27 (Tractor House) and across roadway), near where two smaller tributaries (also inside West Holding Pond) join the north-flowing ditch – West Holding pond previously received drainage from both A11H and A11N– possible COPCs: NG, acids (nitric and sulfuric), possibly TAL Metals (due to precipitation caused by acids); dynamite and other constituents from mix houses (sodium nitrate, nitrocellulose, ANOIL, TNT, RDX, sulfur, dinitrotoluene)
	AUS-A11H-051-SW-00		Surface Water	NA	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, TDS, Perchlorates, Sulfates, Nitrate+Nitrite, Alkalinity	
A11H-052	AUS-A11H-052-SS-0X	Eastern half of West Holding Pond	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located in former West Holding Pond at a location which appears to have received inflow during past from NG area – scarred area – possible COPCs: NG, acids (nitric and sulfuric), possibly TAL Metals (due to precipitation caused by acids)
A11H-053	AUS-A11H-053-SS-02	Southwest of former Building 22	Hand auger	1-2 ft	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Sample located on one of the mounds located along the former roadway to Building 22 – origin of dumped material is not known - possible COPCs: unknown
A11H-054	AUS-A11H-054-SD-0X	Northeast of former Building 26	Shovel sample	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located at confluence of two ditches that flow from A11H (High SW846 Explosives Area) into A11N (the Nitroglycerin Area) – possible COPCs: SW846 Explosives, TAL Metals, NG
A11H-055	AUS-A11H-055-SD-0X	Northwest of former Building 26	Shovel sample	0-6 in.	SW846 Explosives	Ponded area north of Dynamite Area Rd & west of roadway that leads north toward former Building 7 (Melt Loading House and Dope House) – possible COPCs: SW846 Explosives (from drainage from high SW846 Explosives area)
A11H-056	AUS-A11H-056-SD-0X	Southeast of former Building 8	Shovel sample	0-6 in.	SW846 Explosives	Located in possible drainage ditch located southeast of former Building 8 (Change House and Dynamite Office) – possible COPCs: SW846 Explosives (from former Change House)

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-057	AUS-A11H-057-SD-0X	South of former Building 67	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives, TAL Metals	Located in ponded area just south of Building 67-3 (Ammonium Nitrate Loading Dock) along former railroad alignment – possible COPCs: TCL BNAs and TAL Metals (from railroad operations), TNT and AN (from former Melt Loading Building – Bldgs. 7 & 67)
	AUS-A11H-057-SW-00		Surface water	NA	TCL BNAs, SW846 Explosives, TAL Metals, Perchlorates, Phosphorus (orthophosphate), Ammonia as N, Nitrate+Nitrite, TDS	
A11H-058	AUS-A11H-058-SD-0X	Former Building 67	Shovel sample	0-6 in.	SW846 Explosives, TAL Metals	Located in ponded depression where a 3" and a 1" pipe appear to enter the ponded area – in location of former Buildings 7 & 67 (IOP Melt Loading House and Inert Storage and Dope House) – possible COPCs: TNT and AN (from former Melt Loading Building – Bldgs. 7 & 67), chromates (from AN production area nearby)
	AUS-A11H-058-SW-00		Surface water	NA	SW846 Explosives, TAL Metals, mmonia as N, Nitrate +Nitrite, Phosphorus (orthophosphate)	
A11H-059	AUS-A11H-059-SS-0X	South of former Building 7	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives, TAL Metals	Located just outside of former Building 7 (Melt Loading House and Inert Storage and Dope House) in possible location of doorway that led to a pouring room (75 ft from the eastern edge of the building) along former railroad – possible COPCs: organics and TAL Metals (from railroad), TNT and AN (from former Melt Loading Building – Bldgs. 7 & 67)
A11H-060	AUS-A11H-060-SS-0X	North of former Building 7	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives, TAL Metals	Located off northern corner of former Building 7, near machine rooms and equipment cleaning rooms – possible COPCs: organics (solvents and oils from equipment cleaning rooms), TNT and AN (from former Melt Loading Building – Bldgs. 7 & 67), chromates (from AN production area nearby)
	AUS-A11H-060-SS-01			6-12 in.	TCL Volatiles	

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-061	AUS-A11H-061-SS-0X	East of former Building 7	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives, TAL Metals	Former settling tanks location according to IOP drawings of the Melt Loading Building (Buildings 7 and 67) – this may have been the sump that received spilled SW846 Explosives from the pouring operations in this building – this sump was not identified in the field reconnaissance – possible COPCs: organics (solvents and oils from equipment cleaning rooms), TNT and AN (from former Melt Loading Building – Bldgs. 7 & 67)
	AUS-A11H-061-SS-02			1-2 ft	TCL Volatiles	
	AUS-A11H-061-SS-05		Test pit samples	4-5 ft	TCL Volatiles, TCL BNAs, SW846 Explosives, TAL Metals	
	AUS-A11H-061-SS-??			Below sump	TCL Volatiles, TCL BNAs, SW846 Explosives, TAL Metals	
	AUS-A11H-061-GW-00		Test pit water	NA	TCL Volatiles, TCL BNAs, SW846 Explosives, TAL Metals, Ammonia as N, Nitrate + Nitrite	
A11H-062	AUS-A11H-062-SD-0X	East of former Building 7	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives, TAL Metals, Perchlorates	Ponded area located southeast of former Building 7 (Melt Loading Building and Dope House) along former railroad alignment – potential for SW846 Explosives contamination – possible COPCs: organics and TAL Metals (from railroad), TNT and AN (from former Melt Loading Building – Bldgs. 7 & 67)
A11H-063	AUS-A11H-063-SD-0X	East of former Building 7	Shovel sample	0-6 in.	TCL BNAs, SW846 Explosives, TAL Metals	Located north (just outside) of "three stage sump" (which may actually be settling tanks or it may be the evaporation basin seen in the IOP drawings) – possible COPCs: organics (solvents and oils from equipment cleaning rooms), TNT and AN (from former Melt Loading Building – Bldgs. 7 & 67)
	AUS-A11H-063-SD-01			6-12 in.	TCL Volatiles	
A11H-064	AUS-A11H-064-SL-0X	East of former Building 7 – "three stage sump"	Sump Sed. sample	NA	TCL BNAs, SW846 Explosives, TAL Metals	"Three stage sump" identified during site reconnaissance – believed to be associated with former Buildings 7 and 67 (former Melt Loading Building) – possible COPCs: organics (solvents and oils from equipment cleaning rooms), TNT and AN (from former Melt Loading Building – Bldgs. 7 & 67)
	AUS-A11H-064-SW-00		Sump water sample	NA	TCL Volatiles, TCL BNAs, SW846 Explosives, TAL Metals	

TABLE 10-2
SAMPLE LOCATIONS FOR AREA 11 – HIGH SW846 EXPLOSIVES AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11H-065	AUS-A11H-065-SS-0X	Southeast of former Building 67-1	Shovel sample	0-6 in.	TCL BNAs, TAL Metals	Former location of three ASTs of unknown contents – ASTs were located just southeast of former Building 67-1 (Apricot Pit Storage) – possible COPCs: unknown
	AUS-A11H-065-SS-01			6-12 in.	TCL Volatiles	
A11H-066	AUS-A11H-066-SS-0X	South of former Building 23	Shovel sample	0-6 in.	PAHs, TAL Metals	South of former Building 23 (ANOIL Manufacturing Bldg.) – in area of soil discoloration as seen in aerial photographs, that may be due to liquid flows – possible COPCs: AN, organics and TAL Metals (from fuel oil)
	AUS-A11H-066-SS-02			1-2 ft	TCL Volatiles	
A11H-067	AUS-A11H-067-SS-0X	East of former Building 23	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in area of disturbed ground and a former open storage area according to aerial photographs – appears that material was deposited here also – possible COPCs: organics and TAL Metals (fuel oil), possibly SW846 Explosives
A11H-068	AUS-A11H-068-SS-0X	East of former Building 23	Shovel sample	0-6 in.	TAL Metals, SW846 Explosives	Located in area of disturbed ground and a former open storage area according to aerial photographs – possible COPCs: unknown
A11H-W01	AUS-A11H-W01-SS-0X	Northwest of former Building 23	Soil boring	0-6 in.	TAL Metals, SW846 Explosives	Located northwest of former Building 23 (ANOIL Manufacturing Building) in downgradient direction to determine the potential for subsurface soil and groundwater contamination as a result of surficial spillage near this building – possible COPCs: AN, organics and TAL Metals (from fuel oil)
	AUS-A11H-W01-SS-02			1-2 ft	TCL Volatiles	
	AUS-A11H-W01-SS-05			4-5 ft	TCL Volatiles, PAHs, SW846 Explosives, TAL Metals	
	AUS-A11H-W01-SS-??			BWT	TCL Volatiles, PAHs, SW846 Explosives, TAL Metals	
	AUS-A11H-W01-GW-00		Monit Well	NA	TCL Volatiles, PAHs, SW846 Explosives + Nitroglycerin, TAL Metals, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	

BWT = Below Water Table
COPCs = Chemicals of Potential Concern
NA = Not Applicable
Shaded samples will be collected by the UXO subcontractor.

TABLE 10-3
SAMPLE LOCATIONS FOR AREA 11 - NITROGLYCERIN AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11N-001	AUS-A11N-001-SD-0X	Just south of Dynamite Area Rd.	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin + PETN	Located in ditch just south of intersection of Dynamite Area Rd. and road that runs northwest-southeast through the Nitroglycerin Area – possible COPCs: SW846 Explosives (from drainage from A11H), NG, acids (nitric and sulfuric), possibly TAL Metals (due to precipitation caused by acids)
	AUS-A11N-001-SW-00		Surface water	NA	TAL Metals, SW846 Explosives + Nitroglycerin + PETN, Nitrate + Nitrite, Sulfates, Alkalinity	
A11N-002	AUS-A11N-002-SD-0X	Just south of Dynamite Area Rd.	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located in ditch south of Dynamite Area Rd., north of the former Center Holding Pond – possible COPCs: SW846 Explosives (from drainage from A11H), NG, acids (nitric and sulfuric), possibly TAL Metals (due to precipitation caused by acids)
A11N-003	AUS-A11N-003-SD-0X	Just north of Dynamite Area Rd.	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located in ditch north of Dynamite Area Rd., north of the former East Holding Pond – possible COPCs: SW846 Explosives (from drainage from A11H), NG, acids (nitric and sulfuric), possibly TAL Metals (due to precipitation caused by acids)
A11N-004	AUS-A11N-004-SD-0X	Northwest of former Center Holding Pond	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin + PETN	Located in east-flowing creek at culvert on east side of road (road runs northwest-southeast through the Nitroglycerin Area) – creek receives drainage from High SW846 Explosives Area – possible COPCs: organics (form SW846 Explosives production), SW846 Explosives (from drainage from A11H), NG, acids (nitric and sulfuric), possibly TAL Metals (due to precipitation caused by acids)
	AUS-A11N-004-SD-01			6-12 in.	TCL Volatiles	
A11N-005	AUS-A11N-005-SD-0X	North of East Holding Pond	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	Located in east flowing creek, just north of the East Holding Pond at confluence with the ditch that connects the East Holding Pond with the east-flowing creek– possible COPCs: SW846 Explosives (from drainage from A11H), NG, acids (nitric and sulfuric), possibly TAL Metals (due to precipitation caused by acids), organics (due to presence of a sheen on water in some ponded areas of the former East Holding Pond)
	AUS-A11N-005-SW-00		Surface water	NA	TCL Volatiles, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates, Sulfate, TDS, Nitrate + Nitrite, Alkalinity	

TABLE 10-3
SAMPLE LOCATIONS FOR AREA 11 - NITROGLYCERIN AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11N-006	AUS-A11N-006-SD-0X	Northeast of East Holding Pond	Hand auger or trowel	0-6 in	TAL Metals, SW846 Explosives + Nitroglycerin	Located in ponded area of east-flowing creek near drainpipe which drains the area to the north of the Nitroglycerin Area – location is near MW-COP2-4 – possible COPCs: SW846 Explosives (from drainage from A11H), NG, acids (nitric and sulfuric), possibly TAL Metals (due to precipitation caused by acids)
A11N-007	AUS-A11N-007-SS-08	Former Center Holding Pond	Hand auger	7-8 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located on northern portion of mound that is now present where Center Holding Pond was reportedly previously located – possible COPCs: unknown
A11N-008	AUS-A11N-008-SS-0X	Former East Holding Pond	Hand auger or trowel	0-6 in	TAL Metals, SW846 Explosives + Nitroglycerin	Located just south of ditch that leads from the former East Holding Pond to the east flowing creek – location is actually inside of former East Holding Pond – aerial photos showed scarring previously in this area - possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids)
A11N-009	AUS-A11N-009-SD-0X	West of former Center Holding Pond	Hand auger or trowel	0-6 in	TAL Metals, SW846 Explosives + Nitroglycerin, TOC	Located in the ditch that runs along the west side of the road that runs northwest-southeast through the Nitroglycerin Area – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids)
A11N-010	AUS-A11N-010-SD-0X	West of former Center Holding Pond	Hand auger or trowel	0-6 in	TAL Metals, SW846 Explosives + Nitroglycerin	Located in the ditch that runs along the east side of the road that runs northwest-southeast through the Nitroglycerin Area – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids)
A11N-011	AUS-A11N-011-SS-08	Former Center Holding Pond	Hand auger	7-8 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located on southern portion of mound that is now present where Center Holding Pond was reportedly previously located – possible COPCs: unknown

TABLE 10-3
SAMPLE LOCATIONS FOR AREA 11 - NITROGLYCERIN AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11N-012	AUS-A11N-012-SD-0X	Former East Holding Pond	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located in southern portion of former East Holding Pond in an area of ponding that has a sheen on it – historical aerial photos showed scarring from releases to this pond – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids), organics (possibly causing sheen on ponded area)
	AUS-A11N-012-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
A11N-013	AUS-A11N-013-SS-0X	South corner of former East Holding Pond	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located in an unvegetated area that is located at the southern corner of the former East Holding Pond – near where a ditch which drains the nitroglycerin production area, enters the East Holding Pond – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids)
A11N-014	AUS-A11N-014-SD-0X	East of semi-circular bermed area	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located in the ditch that runs along the west side of the road that runs northwest-southeast through the Nitroglycerin Area – sheen on water in this location– possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids), organics (possibly causing sheen on water)
	AUS-A11N-014-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates, Sulfates, TDS, Nitrate+Nitrite, Alkalinity	
A11N-015	AUS-A11N-015-SD-0X	East of semi-circular bermed area – across road	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located in ditch that runs north toward the former East Holding Pond which appears to receive drainage from the nitroglycerin production area– possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids)
A11N-016	AUS-A11N-016-SS-05	East of semi-circular bermed area – across road	Hand auger	4-5 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Mound of soil and debris located just east of the ditch that appears to run from the nitroglycerin production area to the former East Holding Pond – possible COPCs: unknown

TABLE 10-3
SAMPLE LOCATIONS FOR AREA 11 - NITROGLYCERIN AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11N-017	AUS-A11N-017-SS-03	Inside semi-circular bermed area	Hand auger	2-3 ft	TAL Metals, SW846 Explosives + Nitroglycerin	Large mound located in the semi-circular bermed area – the use of this bermed area is not known – there are other smaller mounds and debris inside this area – possible COPCs: SW846 Explosives, NG, TAL Metals (believed to formerly be an SW846 Explosives production facility inside this bermed area)
A11N-018	AUS-A11N-018-SS-0X	North of former Building 10	Hand auger or trowel	0-6 in.	TCL BNAs+Picric Acid, TAL Metals, SW846 Explosives + Nitroglycerin	Piping located under former roadway near former Building 10 (N.G. Storage) – location where several pipes are open to drain material to ground surface – possible COPCs: unknown
	AUS-A11N-018-SS-01			6-12 in.	TCL Volatiles	
A11N-019	AUS-A11N-019-SD-0X	North of former Building 10	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Ponded area located north-northeast of mound where former Building 10 (N.G. Storage) was razed – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids)
	AUS-A11N-019-SW-00		Surface water	NA	TAL Metals, SW846 Explosives + Nitroglycerin, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus(orthophos-phate)	
A11N-020	AUS-A11N-020-SS-02	Former Building 10	Hand auger	1-2 ft	TAL Metals, SW846 Explosives + Nitroglycerin	Located on top of mound that is present in former Building 10 (N.G. Storage) location – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids), ethylene glycol, dimethyl sebacate, ethyl centralite
	AUS-A11N-020-SS-05			4-5 ft or refusal	TAL Metals, SW846 Explosives + Nitroglycerin	
A11N-021	AUS-A11N-021-SS-0X	East of former Building 10	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Long section of piping that leads into the hillside and appears to be heading towards the railroad tank cars – locate an open end to this piping if possible and sample soil at this location (possibly on north end of piping) – possible COPCs: unknown
	AUS-A11N-021-SS-01			6-12 in.	TCL Volatiles	
A11N-022	AUS-A11N-022-SS-0X	In depression between Buildings 9 and 10	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Located on south end of 20 ft deep depression that is located between Buildings 9 (Nitrator) and 10 (N.G. Storage) – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids), ethylene glycol, dimethyl sebacate, ethyl centralite

TABLE 10-3
SAMPLE LOCATIONS FOR AREA 11 - NITROGLYCERIN AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11N-023	AUS-A11N-023-SS-0X	In depression south of semi-circular bermed area	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located on north end of 20 ft deep depression that is located between Buildings 9 (Nitrator) and 10 (N.G. Storage) – there was possible dumping in this drainage ditch according to historical aerial photos – near 4 former ASTs (2 horiz. and 2 vert.) – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids), ethylene glycol, dimethyl sebacate, ethyl centralite
A11N-024	AUS-A11N-024-SD-0X	Buried railroad tank cars location	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Collect soil sample (SD sample) between two railroad tank cars (RRTC) and collect sample of liquid material inside of railroad tank car (TK sample) – collect liquid sample from unopened tank car using a remote coring device – possible COPCs: unknown
	AUS-A11N-024-TK-00		Liquid sample from RRTC	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Nitrate+Nitrite, Sulfates, Alkalinity	
A11N-025	AUS-A11N-025-SD-0X	Southwest of former Building 9	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin, TOC	Located in ditchline located just south of Building 9, that flows eastward – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids), ethylene glycol, dimethyl sebacate, ethyl centralite
A11N-026	AUS-A11N-026-SS-02	Former Building 9	Hand auger	1-2 ft	TAL Metals, SW846 Explosives + Nitroglycerin	Located on mound that is present at the former location of Building 9 (Nitrator) – possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids), ethylene glycol, dimethyl sebacate, ethyl centralite
	AUS-A11N-026-SS-05			4-5 ft or refusal	TAL Metals, SW846 Explosives + Nitroglycerin	
A11N-027	AUS-A11N-027-SS-0X	East of former Building 9	Hand auger or trowel	0-6 in.	TAL Metals, SW846 Explosives + Nitroglycerin	Sample to be collected outside doorway of un-numbered concrete bunker which is located east of Building 9 (Nitrator) - on opposite side of roadway– possible COPCs: NG, acids (nitric and sulfuric), TAL Metals (due to precipitation caused by acids
A11N-028	AUS-A11N-028-SS-0X	Southwest of buried railroad tank cars	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Sample located in potential debris dumping area – as determined by irregular topography – possible COPCs: unknown

TABLE 10-3
SAMPLE LOCATIONS FOR AREA 11 - NITROGLYCERIN AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11N-029	AUS-A11N-029-SS-0X	Inside semi-circular bermed area	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	Located near base of former large mound where refuse was located according to historical aerial photographs – former large mound may have previously been an SW846 Explosives production facility because it may have been a bunker-type building within a bermed area– possible COPCs: unknown
A11N-030	AUS-A11N-030-SS-05	Southwest of former Building 9 – across roadway	Test pit samples	4-5 ft (within trench)	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives, Dioxin	Location of former trench which appears to have been used for disposal activities – as seen in 1980 aerial photograph – SW846 Explosives manufacturing was no longer being done at the site at this time – possible COPCs: PAHs, TAL Metals and dioxin (resulting from possible burning), SW846 Explosives (that may have been disposed of in these trenches)
	AUS-A11N-030-SS-??			Beneath trench	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives	
	AUS-A11N-030-GW-00		Test pit water	NA	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives, Nitrate+Nitrite, Alkalinity, Sulfates	
A11N-031	AUS-A11N-031-SS-05	Southwest of former Building 9 – across roadway	Test pit samples	4-5 ft (within trench)	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives, Dioxin	Location of former trench which appears to have been used for disposal activities – as seen in 1980 aerial photograph – SW846 Explosives manufacturing was no longer being done at the site at this time – possible COPCs: PAHs, TAL Metals and dioxin (resulting from possible burning), SW846 Explosives (that may have been disposed of in these trenches)
	AUS-A11N-031-SS-??			Beneath trench	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives	
	AUS-A11N-031-GW-00		Test pit water	NA	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives, Nitrate+Nitrite, Alkalinity, Sulfates	
MW-COP2-1	AUS-0A12-MW-COP2-1-GW-00	Former Center Holding Pond	Ground water	NA	TCL Volatiles, TCL BNAs, TAL Metals, TDS, SW846 Explosives + Nitroglycerin + PETN, Perchlorates, Nitrate +Nitrite, Alkalinity, Sulfates	*Sample existing monitoring well if it is still present on site.*

TABLE 10-3
SAMPLE LOCATIONS FOR AREA 11 - NITROGLYCERIN AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
MW-COP2-4	AUS-0A12-MW-COP2-4-GW-00	Northeast of former Center Holding Pond	Ground water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin + PETN, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus(orthophosphate)	*Sample existing monitoring well if it is still present on site.*

BWT = Below Water Table
COPCs = Chemicals of Potential Concern
NA = Not Applicable
Shaded samples will be collected by the UXO subcontractor.

TABLE 10-4
SAMPLE LOCATIONS FOR AREA 11 – PILOT PROPELLANT PLANT/CAP PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11P-001	AUS-A11P-001-SD-0X	Northwest corner of Chemical Area Rd. and Service Area Rd.	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives + Nitroglycerin, Perchlorates	Location in south flowing ditch located at west corner of intersection of Chemical Area Rd. and Service Area Rd. – receives drainage from Building 87 (unknown Storage/ possible CAP testing) and possibly from Building 85 (Drilling and Boostering/Pilot Propellant Plant/Storage Bldg.) – possible COPCs: NG (identified by CSC as possible contaminant in this Bldg. 87); CAP contaminants[1]; solid propellant contaminants[2]; gas generator contaminants[3]; jet starter cartridge contaminants[4]
	AUS-A11P-001-SD-01			6-12 in.	TCL Volatiles	
A11P-002	AUS-A11P-002-SS-02	Former Building 87	Hand auger	1-2 ft	TAL Metals, TCL Explosives + Nitroglycerin	Located on soil mound that covers the former location of Building 87 (unknown Storage/possible CAP testing) – possible COPCs: NG (identified by CSC as possible contaminant in this building); CAP contaminants[1]
	AUS-A11P-002-SS-05			4-5 ft or refusal	TAL Metals, TCL Explosives + Nitroglycerin	
A11P-003	AUS-A11P-003-SS-0X	Southeast of former Building 87	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives + Nitroglycerin	Located along side of Building 87 (unknown Storage/possible CAP testing) – next to former roadway that leads to building – possible COPCs: NG (identified by CSC as possible contaminant in this building); CAP contaminants[1]
A11P-004	AUS-A11P-004-SW-00	Northeast of former Building 87	Surface water	N/A	TAL Metals, TCL Explosives +Nitroglycerin	Located in ponded area located just northeast of Building 87 (unknown Storage/possible CAP testing) – possible COPCs: NG (identified by CSC as possible contaminant in this building); CAP contaminants[1]
A11P-005	AUS-A11P-005-SD-0X	Northeast of former Building 87	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives + Nitroglycerin	Located in ditch just downstream of ponded area that is located northeast of Building 87 (unknown Storage/possible CAP testing) – possible COPCs: NG (identified by CSC as possible contaminant in this building); CAP contaminants[1]
A11P-006	AUS-A11P-006-SD-0X	In ditch southeast of former Building 87	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives + Nitroglycerin	Located in ditch that runs parallel to former roadway to Building 87 (unknown Storage Bldg./possible CAP testing on south side of road) – possible COPCs: NG (identified by CSC as possible contaminant in this building); CAP contaminants[1]

TABLE 10-4
SAMPLE LOCATIONS FOR AREA 11 – PILOT PROPELLANT PLANT/CAP PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11P-007	AUS-A11P-007-SS-0X	South of former Building II-1-21	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives + Nitroglycerin	Located just east of former Building 85-3 which was used as nitroglycerin storage – possible COPCs: NG (identified by CSC as possible contaminant in this building); CAP contaminants[1]
A11P-008	AUS-A11P-008-SS-0X	South of former Building 85-4	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives, Perchlorates	Located just west of Building 85-2 which was used for propellant grain curing and as a compressor building – likely assoc. with Bldg. 85 (Drilling & Boostering/Pilot Propellant Plant) – possible COPCs: solid propellant contaminants[2]
	AUS-A11P-008-SS-01			6-12 in.	TCL Volatiles	
A11P-009	AUS-A11P-009-SS-0X	South of former Building 85-5	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives, Perchlorates	Located just north of Building 85-1(Dryer Bldg. – lead azide), near former building II-1-19 which was used for propellant grain curing – likely assoc. with Bldg. 85 (Drilling and Boostering/Pilot Propellant Plant) – possible COPCs: CAP contaminants[1]; solid propellant contaminants[2]
	AUS-A11P-009-SS-01			6-12 in.	TCL Volatiles	
A11P-010	AUS-A11P-010-SD-0X	In ditch south of former Building 85	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives + Nitroglycerin, Perchlorates	Located in ditch just south of Building 85 (Drilling and Boostering/Pilot Propellant Plant) which was the former Pilot Propellant Plant – potential for contamination associated with propellants – also near railroad line – possible COPCs: solid propellant contaminants[2]; gas generator contaminants[3]; jet starter cartridge contaminants[4]
	AUS-A11P-010-SW-00		Surface water	N/A	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, TCL Explosives, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Perchlorates, Phosphorus (orthophosphate)	
A11P-011	AUS-A11P-011-SS-0X	Northwest of former Building 85-1	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located just southwest of Building 85-1 which was used for drying lead azide and lead styphnate and possibly mercury fulminate for the production of Big Inch Caps – outside a possible doorway – possible COPCs: CAP contaminants[1]
A11P-012	AUS-A11P-012-SS-0X	Northeast of former Building 85-1	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located just east of Building 85-1 which was used for drying lead azide and lead styphnate and possibly mercury fulminate for the production of Big Inch Caps – possible COPCs: CAP contaminants[1]

TABLE 10-4
SAMPLE LOCATIONS FOR AREA 11 – PILOT PROPELLANT PLANT/CAP PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11P-013	AUS-A11P-013-SD-0X	In ditch northwest of former Building 86	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located in ditch which runs northeast on south side of Chemical Area Rd. which appears to receive drainage from Building 86 – Ingredient Storage for Big Inch Caps – possible COPCs: CAP contaminants[1]
A11P-014	AUS-A11P-014-SS-0X	West of former Building 86	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located on westernmost side of Building 86 – Ingredient Storage for Big Inch Caps – possible COPCs: CAP contaminants[1]
A11P-015	AUS-A11P-015-SS-0X	Southeast of former Building 49-1	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located southeast of Building 49-1 – Big Inch Screening House (lead azide, lead styphnate and possibly RDX may have been screened in this building) – possible COPCs: CAP contaminants[1]
A11P-016	AUS-A11P-016-SS-0X	Northwest of former Building 49	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located on southeast side of Building 49 – Big Inch Cap Assembly Line, where caps were manufactured in what appears to be a doorway based on aerial photograph – possible COPCs: CAP contaminants[1]
A11P-017	AUS-A11P-017-SS-0X	Southwest of former Building 49	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located on southwest side of Building 49 – Big Inch Cap Assembly Line, where the caps were manufactured – possible COPCs: CAP contaminants[1]
A11P-018	AUS-A11P-018-SS-0X	Northwest of former Building 85	Hand auger or trowel	0-6 in.	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, TCL Explosives, Perchlorates	Located near doorway on northeast side of Building 85 (former Drilling and Boostering/Pilot Propellant Plant Building) near former Building II-1-35 (Booster Service Magazine/Maintenance Shop and Stores) – possible COPCs: organics and TAL Metals (from shop); solid propellant contaminants[2]; gas generator contaminants[3]; jet starter cartridge contaminants[4] (from Bldg. 85)
A11P-019	AUS-A11P-019-SD-0X	Ponded area south of former Building 49-5	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives, Perchlorates	Located in ponded area that is located just east of Building 85 (Drilling and Boostering/Pilot Propellant Plant) and south of Building 49-5 (Electric Control House) – possible COPCs: solid propellant contaminants[2]; gas generator contaminants[3]; jet starter cartridge contaminants[4] (from Bldg. 85)
	AUS-A11P-019-SW-00		Surface water	N/A	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, TCL Explosives, Perchlorates, Ammonia as N, Nitrate + Nitrite, TDS	

TABLE 10-4
SAMPLE LOCATIONS FOR AREA 11 – PILOT PROPELLANT PLANT/CAP PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11P-020	AUS-A11P-020-SD-0X	Ditch south of former Building 49-5	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives, Perchlorates	Located in northeast-southwest trending ditch, southeast of Building 85 (Drilling and Boostering/Pilot Propellant Plant) - also near railroad line – possible COPCs: solid propellant contaminants[2]; gas generator contaminants[3]; jet starter cartridge contaminants[4] (from Bldg. 85)
A11P-021	AUS-A11P-021-SD-0X	Ditch north of Chemical Area Rd.	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives + Nitroglycerin	Located in a northeast flowing ditch that is located on the northwest side of the Chemical Area Rd. – receives drainage from Building 87 (unknown Storage/possible testing of Big Inch Caps) – possible COPCs: NG (identified by CSC as possible contaminant in Bldg. 87); CAP contaminants[1]
A11P-022	AUS-A11P-022-SS-0X	Depressed area north of former Building 49-1	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located in a depressed area northeast of Building 49-1 (Big Inch Screening House), which appears to drain through a concrete spillway located on the northeast side - possible COPCs: CAP contaminants[1]
A11P-023	AUS-A11P-023-SD-0X	Ponded area north of former Building 49-1	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located in a ponded area (which is part of a northeast flowing ditch), just northeast of the concrete spillway mentioned above – possible COPCs: CAP contaminants[1], volatile organics (possible because of film present on water further downstream)
	AUS-A11P-023-SW-00		Surface water	N/A	TCL Volatiles, TAL Metals, TCL Explosives, Nitrate + Nitrite, TDS	
A11P-024	AUS-A11P-024-SS-0X	North-northwest of former Building 86	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located in a low-lying area – COPCs: unknown
A11P-025	AUS-A11P-025-SD-0X	Culvert just southeast of Chemical Area Rd.	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives	Located at the confluence of 3 ditches, on the south side of a culvert that runs northwest under the Chemical Area Rd – possible COPCs: CAP contaminants[1] (due to drainage patterns)

TABLE 10-4
SAMPLE LOCATIONS FOR AREA 11 – PILOT PROPELLANT PLANT/CAP PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11P-026	AUS-A11P-026-SD-0X	Ditch located southeast of Chemical Area Rd. culvert	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives + Nitroglycerin, TOC	Located in the north flowing section of the ditch that originates in the depressed area with the concrete spillway – there was a film on the water in this location – possible COPCs: organics (film on water), possible CAP contaminants[1], possible solid propellant contaminants[2]; possible gas generator contaminants[3]; possible jet starter cartridge contaminants[4]
	AUS-A11P-026-SW-00		Surface water	N/A	TCL Volatiles, TCL BNAs, TAL Metals, Perchlorates, TCL Explosives + Nitroglycerin, Ammonia as N, Nitrate + Nitrite, TDS	
A11P-027	AUS-A11P-027-SL-0X	IOP manhole, 200 ft west of former Building 48-1	Sewer Sed.	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives	IOP sewer manhole which is intact – possible COPCs: TNT, AN, and if sewer received drainage from Bldg 85: possible solid propellant contaminants[2]; possible gas generator contaminants[3]; possible jet starter cartridge contaminants[4]
A11P-028	AUS-A11P-028-SS-0X	Southwest of former Building 48	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives + Nitroglycerin	Located near doorway on southwest side of Building 48 (Cooling Bldg./Starter Cartridge Assembly) which may have been used for production of jet starter cartridges and was used for IOP TNT melt/pour operations – possible COPCs: TNT, jet starter cartridge contaminants[4]
A11P-029	AUS-A11P-029-SD-0X	Ponded area southwest of former Building 48	Shovel Sample	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives + Nitroglycerin	Located in ponded area south of Building 48 (Cooling Bldg./Starter Cartridge Assembly) which may have been used for production of jet starter cartridges and was used for IOP TNT melt/pour operations – possible COPCs: TNT, jet starter cartridge contaminants[4]
	AUS-A11P-029-SW-00		Surface water	N/A	TCL BNAs, TAL Metals, TCL Explosives, Perchlorates, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate)	

TABLE 10-4
SAMPLE LOCATIONS FOR AREA 11 – PILOT PROPELLANT PLANT/CAP PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11P-030	AUS-A11P-030-SD-0X	Ditch south of former Building 48	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives + Nitroglycerin, Perchlorates	Located in ditch south of Building 48 (Cooling Building/Starter Cartridge Assembly) which may have been used for production of jet starter cartridges and was used for IOP TNT melt/pour operations – there was a slight sheen on the surface water in this location – also near railroad line – possible COPCs: TNT, jet starter cartridge contaminants[4]
	AUS-A11P-030-SW-00		Surface water	N/A	TCL Volatiles, TCL BNAs, TAL Metals, Perchlorates, TCL Explosives + Nitroglycerin, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
A11P-031	AUS-A11P-031-SS-0X	Former Building II-1-16	Shovel sample	0-6 in.	TAL Metals, TCL Explosives	Located just southwest of mounded area – mounded area is former location of Building II-1-16 (TNT Service Building and potential TCL Explosives testing building) – possible COPCs: TCL Explosives, TAL Metals, TNT
A11P-032	AUS-A11P-032-SD-0X	Ditch northeast of former Building II-1-16	Shovel sample	0-6 in.	TAL Metals, TCL Explosives	Located in ditch northeast of former Building II-1-16 (TNT Service Building and potential TCL Explosives testing building) – ditch may receive drainage from this building – possible COPCs: TCL Explosives, TAL Metals, TNT
	AUS-A11P-032-SW-00		Surface water	N/A	TAL Metals, TCL Explosives	
A11P-033	AUS-A11P-033-SS-0X	Northwest of former Building 48-1	Shovel sample	0-6 in.	TCL BNAs, Dioxin, PCBs	Sample located underneath a pile of power poles – possible COPCs: TCL BNAs, Dioxin, PCBs
A11P-034	AUS-A11P-034-SS-0X	Southeast of former Building 48-1	Shovel sample	0-6 in.	TCL Explosives	Located southeast of former Building 48-1 (TNT Screening Building and Storage) – possible COPCs: TNT
A11P-035	AUS-A11P-035-SS-0X	Mound northeast of former Building 48-1	Hand auger	3-4 ft	TCL Volatiles, TCL BNAs, TAL Metals, TCL Explosives	Location on top of 12 ft tall soil mound located just east-northeast of former Building 48-1 (TNT Screening Building and Storage) – mounded soil potentially from ponded area just southeast of mound, which has a sheen – possible COPCs: organics (sheen on water), TNT

TABLE 10-4
SAMPLE LOCATIONS FOR AREA 11 – PILOT PROPELLANT PLANT/CAP PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11P-036	AUS-A11P-036-SD-0X	Ponded area east of Building 48-1	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives, Ammonia as N, Nitrate + Nitrite, TOC	Location in ponded area that is located east of Building 48-1 (TNT Screening Building and Storage) that has a sheen – possibly associated with soil mound mentioned above at sample location 36 sheen – possible COPCs: organics (sheen on water), TNT
	AUS-A11P-036-SW-00		Surface water	N/A	TCL Volatiles, TCL BNAs, TAL Metals, TCL Explosives	
A11P-037	AUS-A11P-037-SS-0X	South of former Building 48	Shovel sample	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives	Located near doorway on southeast side of Building 48 (Cooling Building/Starter Cartridge Assembly) which may have been used for production of jet starter cartridges and was used for IOP TNT melt/pour operations – possible COPCs: TNT, jet starter cartridge contaminants[4], possible solvents
	AUS-A11P-037-SS-01			6-12 in.	TCL Volatiles	
A11P-038	AUS-A11P-038-SD-0X	Ditch southeast of former Building 48	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives	Located in the ditch on the south side of the Service Area Rd., just south of Building 48 (Cooling Building and Starter Cartridge Assembly) operations – possible COPCs: TNT, jet starter cartridge contaminants[4]
	AUS-A11P-038-SW-00		Surface water	N/A	TCL BNAs, TAL Metals, TCL Explosives, Ammonia as N, Nitrate + Nitrite, TDS, Phosphorus (orthophosphate)	
A11P-039	AUS-A11P-039-SD-0X	Ditch east of former Building 48	Hand auger or trowel	0-6 in.	TCL BNAs, TAL Metals, TCL Explosives	Located in the ditch located on the north side of the Service Area Rd., just east of Building 48 (Cooling Building and Starter Cartridge Assembly) – also near railroad line – possible COPCs: TNT, jet starter cartridge contaminants[4]
	AUS-A11P-039-SW-00		Surface water	N/A	TCL BNAs, TAL Metals, TCL Explosives, Ammonia as N, Nitrate + Nitrite	
A11P-040	AUS-A11P-040-SD-0X	Ditch east of former Building 87	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives + Nitroglycerin	Located in scarred area identified in aerial photographs, which appears to be a ditch that flows east from Building 87 (Storage Building/Possible Cap Testing Area) – possible COPCs: NG (identified by CSC as possible contaminant in Bldg. 87); CAP contaminants[1]
A11P-041	AUS-A11P-041-SD-0X	North of former Building 87	Hand auger or trowel	0-6 in.	TAL Metals, TCL Explosives + Nitroglycerin	Located north of Building 87 (Storage Building/Possible Cap Testing Area) – downwind from the testing area which is a likely spot for CAP-related contamination– possible COPCs: CAP contaminants[1]

TABLE 10-4
SAMPLE LOCATIONS FOR AREA 11 – PILOT PROPELLANT PLANT/CAP PRODUCTION AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11P-W01	AUS-A11P-W01-SS-0X	South of former Building 85	Soil boring	0-6 in.	TCL BNAs, TAL Metals, Explosive + Nitroglycerin, Perchlorates	Located just south of Building 85 which was the former Pilot Propellant Plant – potential for contamination associated with propellant/gas generator/jet starter cartridge development – location is near former railroad line and near former doorway to Building 85 – soil outside this doorway would likely have received washwater from the activities in this building – according to historical aerial photograph, this may have also been a loading dock – possible COPCs: solid propellant contaminants[2]; gas generator contaminants[3]; jet starter cartridge contaminants[4], possible solvents
	AUS-A11P-W01-SS-01			6-12 in.	TCL Volatiles + Hexane	
	AUS-A11P-W01-SS-05			4-5 ft	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, TCL Explosives + Nitroglycerin	
	AUS-A11P-W01-SS-??			BWT	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, TCL Explosives + Nitroglycerin	
	AUS-A11P-W01-GW-00		Monit. Well	NA	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, Perchlorates, TCL Explosives +Nitroglycerin, Sulfate, TDS, TSS, Nitrate + Nitrite, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	

BWT = Below Water Table
COPCs = Chemicals of Potential Concern
N/A = Not Applicable
Shaded samples will be collected by the UXO subcontractor.

1 Possible CAP Contaminants: Lead Azide, Lead Styphnate, Mercury Fulminate, RDX
2 Possible Solid Propellant Contaminants: AN, ammonium perchlorate, magnesium, aluminum, plastic binder, synthetic rubber, carbon black, ammonium oxalate
3 Possible Gas Generator Contaminants: AN, potassium perchlorate, hexane, plasticizers
4 Possible Jet Starter Cartridge Contaminants: NG, ball powder, AN, nitrocellulose, dioctyl phthalate

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-001	AUS-A11S-001-SD-0X	South of Chemical Area Rd. and north of former Building 66	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	Confluence of several drainage ditches (including the Main Drainage Ditch which originates in the Nitroglycerin Area) which drain the western portion of the Support Area – just south of Chemical Area Rd. – possible COPCs: organics and TAL Metals (from paints, oils, solvents, thinners from IOP, Hoosier Cardinal, Olin and CSC operations in Bldgs. 56 and 66 - i.e., painting and cleaning, tool & dye operations, garage); various SW846 Explosives from areas A11N and A11H; and acids (nitric & sulfuric from area A11A), ammonia (from area A11A)
	AUS-A11S-001-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin. Perchlorates, Alkalinity, Ammonia as N, Sulfates, Nitrate+Nitrite, TDS	
A11S-002	AUS-A11S-002-SD-0X	North of Chemical Area Rd and north of former Building 66	Hand Auger	0-6 in.	TAL Metals	Located in east-flowing ditch just north of Chemical Area Rd. and west of former Building 57 (former Paint Service Building and Welding Shop) – TAL Metals (from paint and welding), organics (from using thinners and solvents)
	AUS-A11S-002-SD-02			1-2 ft	TCL Volatiles	
A11S-003	AUS-A11S-003-SD-0X	West of former Scrap Yard	Hand Auger	0-6 in.	TAL Metals	Located in north-flowing ditch located just west of former Scrap Yard (located along western edge of disturbed area according to aerial photographs) – small debris area is just west of this ditch – possible COPCs: TAL Metals (from scrap yard)
A11S-004	AUS-A11S-004-SS-0X	Former Scrap Yard	Hand Auger	0-6 in.	TAL Metals, SW846 Explosives	Located in northern portion of former Scrap Yard in area of scrap metal debris – possible COPCs: TAL Metals and SW846 Explosives (from possible disposal in scrap yard)
A11S-005	AUS-A11S-005-SS-0X	Former Scrap Yard	Hand Auger	1-2 ft	TAL Metals, SW846 Explosives	Located in a four foot depression in the former Scrap Yard – where construction debris may have been buried– possible COPCs: TAL Metals and SW846 Explosives (from possible disposal in scrap yard)
A11S-006	AUS-A11S-006-SD-0X	South of former Scrap Yard	Hand Auger	0-6 in.	TAL Metals, SW846 Explosives	Located in east-flowing ditch just south of former Scrap Yard and north of Chemical Area Rd. – possible COPCs: TAL Metals & SW846 Explosives (from drainage from scrap yard)

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-007	AUS-A11S-007-SD-0X	North of Chemical Area Rd, at intersection with Service Area Rd.	Hand Auger	0-6 in.	TAL Metals, TOC	Located in the east-flowing ditch on the north side of Chemical Area Rd., downstream of the former Scrap Yard, near the Area 11 fence line – possible COPCs: TAL Metals (coming from off-site)
A11S-008	AUS-A11S-008-SD-0X	West of former Building 66	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin + PETN	Located in the Main Drainage Ditch/Creek that flows northward through Area 11 along the west side of the Support Area – location is just west of former Building 66 (Cleaning and Painting Building) – there was white foam in this location of the ditch – aerial photos from Hoosier Cardinal tenure, reveal scarring in this location of the ditch – possible COPCs: organics (from foam?), various SW846 Explosives (from Areas A11N and A11H), acids (nitric and sulfuric from area A11A), ammonia (from Area A11A)
	AUS-A11S-008-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin + PETN, Perchlorates, TDS, Ammonia as N, Sulfate, Nitrate+Nitrite	
A11S-009	AUS-A11S-009-SD-0X	West of former Building 66	Hand Auger	0-6 in.	TAL Metals	Ponded area located in western corner of former Building 66 (part of Cleaning and Painting Building/Storage Bldg.) – in area of former Hoosier Cardinal building of unknown purpose as identified on aerial photograph– possible COPCs: TAL Metals (from Hoosier Cardinal)
	AUS-A11S-009-SW-00		Surface water	NA	TAL Metals, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
A11S-010	AUS-A11S-010-SD-0X	South of former Building 66	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in ponded area just off southern corner of former Building 66 (Storage Building), along railroad tracks – possible COPCs: TCL BNAs and TAL Metals (from railroad activities), TNT and AN (due to proximity to former Melt Loading Building)
	AUS-A11S-010-SW-00		Surface water	NA	TCL BNAs, TAL Metals, SW846 Explosives	
A11S-011	AUS-A11S-011-SD-0X	North of former Building 66	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in a ponded area of the ditch that flows north from former Building 66 (part of Cleaning and Painting Building/Storage Bldg.), into the Main Drainage Ditch/Creek – there is an oily sheen on this ponded area and the soil is stained reddish brown – this may have been a former loading dock acc. to aerials – possible COPCs: TNT (reddish staining), organics (oily sheen on water), TAL Metals (paint)
	AUS-A11S-011-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-012	AUS-A11S-012-SD-0X	Southeast of former Building 66	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in a ponded area just south of former Building 66 (Cleaning and Painting Building) – in area of former driveway – along railroad tracks – possible COPCs: organics and TAL Metals (paints and railroad activities), SW846 Explosives (from possible IOP spillage into ditches)
	AUS-A11S-012-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, TDS, SW846 Explosives, Perchlorates	
A11S-013	AUS-A11S-013-SD-0X	Southeast of former Building 66	Hand Auger	0-6 in.	TAL Metals, TOC	Located in ditch on south side of Service Area Rd., just south of former Building 66 (Cleaning and Painting Building), where a culvert crosses under the Service Area Rd. – possible COPCs: organics (from thinners, solvents), TAL Metals from paints
	AUS-A11S-013-SW-00		Surface water	NA	TCL Volatiles, TAL Metals	
A11S-014	AUS-A11S-014-SS-0X	Northwest of former Building 57	Hand Auger	0-6 in.	TAL Metals	Located just northwest of former Building 57 (Paint Service Building and Weld Shop) – possible COPCs: organics and TAL Metals (from paints, thinners, solvents, and welding)
	AUS-A11S-014-SS-02			1-2 ft	TCL Volatiles	
A11S-015	AUS-A11S-015-SS-04	East of former Building 57	Hand Auger	3-4 ft	TCL Volatiles, TAL Metals	Located on a mound just east of former Building 57 (Paint Service Building and Weld Shop) – which is buried construction debris – possible COPCs: organics and TAL Metals (from paints, thinners, solvents, and welding)
A11S-016	AUS-A11S-016-SD-0X	North of former Building 57	Hand Auger	0-6 in.	TAL Metals	Located in ditch just northeast of former Bldg. 57 (Paint Service Building and Weld Shop) – that appears to drain area surrounding this bldg – possible COPCs: organics and TAL Metals (from paints, thinners, solvents, and welding)
	AUS-A11S-016-SD-02			1-2 ft	TCL Volatiles	
A11S-017	AUS-A11S-017-SS-0X	Former Building 56	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located in former Building 56 (Cleaning & Painting Building and Garage, Wash Room & Office) annex (former IOP Pump House) – location beneath 2" metal pipe which appears to be in place – possible COPCs: organics and TAL Metals (from paints, thinners, solvents)
	AUS-A11S-017-SS-02			1-2 ft	TCL Volatiles	
A11S-018	AUS-A11S-018-SS-0X	Former Building 56	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located in depression existing in area of former Building 56 (Cleaning and Painting Building and Garage, Wash Room and Office) - location is below a clay pipe which enters this depression – possible COPCs: organics and TAL Metals (from paints, thinners, solvents)
	AUS-A11S-018-SS-02			1-2 ft	TCL Volatiles	

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-019	AUS-A11S-019-SD-0X	Southeast of former Building 56	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in a ponded area located just south of former Building 57 (Cleaning and Painting Building and Garage, Wash Room and Office) – ponded area is located along railroad tracks – possible COPCs: organics and TAL Metals (from paints, thinners, solvents, railroad activities), SW846 Explosives (from possible IOP spillage into ditches)
	AUS-A11S-019-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
A11S-020	AUS-A11S-020-SS-0X	North of former Building 55	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located northwest of former Building 55 (Maintenance, Carpenter and Machine Shop) in former driveway – possible COPCs: organics and TAL Metals (from solvents and oils possibly used in maintenance/machine shop)
	AUS-A11S-020-SS-02			1-2 ft	TCL Volatiles	
A11S-021	AUS-A11S-021-SS-0X	South of former Building 55	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located southeast of former Building 55 in driveway (Maintenance, Carpenter and Machine Shop), along railroad tracks – possible COPCs: organics and TAL Metals (from solvents and oils possibly used in machine shop)
	AUS-A11S-021-SS-02			1-2 ft	TCL Volatiles	
A11S-022	AUS-A11S-022-SD-0X	South of former Building 65	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	Ponded area just south of former Building 65 (Storage), along railroad tracks – this ponded area is connected to dry drainage ditch located south of Service Area Rd. along former railroad tracks, via a culvert under the road – possible COPCs: organics and TAL Metals (from railroad activities), SW846 Explosives (from possible IOP spillage into ditches)
	AUS-A11S-022-SW-00		Surface water	NA	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates, TDS, TSS, Ammonia as N, Nitrate+Nitrite, Sulfate, Alkalinity, Phosphorus(orthophos)	
A11S-023	AUS-A11S-023-SD-0X	North of former Building 65	Hand Auger	0-6 in.	SW846 Explosives, TAL Metals	Small ponded area just south of Chemical Area Rd. and north of former Building 65 (General Storage) in which vegetation is a brownish-orangish color – possible COPCs: TNT (possible because of reddish orange color), TAL Metals (from upstream maintenance shop)
	AUS-A11S-023-SW-00		Surface water	NA	SW846 Explosives, TAL Metals	

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-024	AUS-A11S-024-SD-0X	North of Dynamite Area Rd.	Hand Auger	0-6 in.	TAL Metals, SW846 Explosives + PETN + Nitroglycerin	Located in north-flowing Main Drainage Ditch/Creek in southeast corner of Support Area, just north of Dynamite Area Rd. – possible COPCs: SW846 Explosives, NG (from Areas A11H and A11N), acids (nitric and sulfuric from area A11N), TAL Metals (possibly precipitates from acids)
	AUS-A11S-024-SW-00		Surface water	NA	TAL Metals, SW846 Explosives + PETN + Nitroglycerin, TDS, Nitrate + Nitrite, Sulfates, Alkalinity	
A11S-025	AUS-A11S-025-SD-0X	Southwest of former Building 80	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin + PETN	Located in ponded area just southwest of former Building 80 (Laboratory) – possible COPCs: all compounds used in Areas 11 and 12
A11S-026	AUS-A11S-026-SD-0X	Northwest of former Building 60	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located in L-shaped concrete structure on northwest side of former Building 60 (Boiler House) – structure is filled with water and is located in area of former blow-off basin – possible COPCs: unknown
	AUS-A11S-026-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals	
A11S-027	AUS-A11S-027-SS-0X	Northeast of former Building 60-1	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located just northeast of former Building 60-1 (Boiler House Shop) – possible COPCs: organics and TAL Metals (from solvents, oils, etc. used in shop)
	AUS-A11S-027-SS-02			1-2 ft	TCL Volatiles	
A11S-028	AUS-A11S-028-SD-0X	Approx. 290 ft southeast of Service Area Rd.	Hand Auger	0-6 in.	TAL Metals	Located in northwest-southeast trending ditchline that is located on west side of a roadway that runs in between former Buildings 80(Lab) and 82 (Component Magazine) – possible COPCs: unknown – may have received runoff from possible impoundment across roadway
A11S-029	AUS-A11S-029-SD-0X	East of former Building 75	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in a ditch (east of Building 75-Administration Bldg.) which appears to receive drainage from the former IOP Change House (Building 75) – location is just beneath where a 4" drain empties into the ditch – possible COPCs: organics, TAL Metals and SW846 Explosives (residues from change house)
	AUS-A11S-029-SD-02			1-2 ft	TCL Volatiles	
A11S-030	AUS-A11S-030-SL-0X	Northeast of former Building 60	Sewer Sed.	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Sewer manhole located north-northeast of Building 60 (Boiler House), near former railroad alignment – possible COPCs: organics, TAL Metals, SW846 Explosives (from IOP load line – no TCL Volatiles were analyzed for because they would likely have volatilized by now)

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-031	AUS-A11S-031-SD-0X	Northeast of former Building 60	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located in dry ditchline that runs roughly along the former railroad alignment – located at culvert that appears to connect this ditchline with ponded area northwest of this ditchline and across Service Area Rd. – possible COPCs: organics and TAL Metals (from railroad)
	AUS-A11S-031-SD-02			1-2 ft	TCL Volatiles	
A11S-032	AUS-A11S-032-SS-02	Former Building 66	Hand Auger	1-2 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	Sample soil mound in area of former Building 66 (Cleaning and Painting Building) – possible COPCs: organics and TAL Metals (from paints, thinners, solvents)
	AUS-A11S-032-SS-05			4-5 ft or refusal	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
A11S-033	AUS-A11S-033-SS-02	Former Building 55	Hand Auger	0-6 in.	TCL Volatiles, TCL BNAs, TAL Metals	Sample soil mound in area of former Building 55 (Maintenance/Carpenter and Machine Shop) – possible COPCs: organics and TAL Metals (from solvents and oils possibly used in maintenance/machine shop)
	AUS-A11S-033-SS-05			4-5 ft or refusal	TCL Volatiles, TCL BNAs, TAL Metals	
A11S-034	AUS-A11S-034-SD-0X	Northwest of former Building 68	Hand Auger	0-6 in.	PAHs, TAL Metals	Location just west of Bldg. 57 in ditch that flows northwest from former Building 66 (Painting & Cleaning Bldg.) that was used by the IOP and by Hoosier Cardinal/Ordill Machine Co. – acc. to historical aerial photographs, some discoloration is apparent in ditch in aerials – possible COPCs: organics & Metals (from paints, solvents, thinners, oils from IOP tenure & from tool & dye operations by Hoosier Cardinal)
	AUS-A11S-034-SD-02			1-2 ft	TCL Volatiles	
A11S-035	AUS-A11S-035-SS-0X	Southwest of former Building 60	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located in possible surface impoundment area according to historical aerial photographs – this area was likely used for coal storage – no reason to suspect SW846 Explosives in area – possible COPCs: unknown
	AUS-A11S-035-SS-02			1-2 ft	TCL Volatiles	
A11S-036	AUS-A11S-036-SS-0X	South of former Building 60	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located just southeast of possible surface impoundment in area of possible liquid pooling according to historical aerial photographs – possible COPCs: unknown (no reason to suspect SW846 Explosives in this area)
	AUS-A11S-036-SS-02			1-2 ft	TCL Volatiles	
A11S-037	AUS-A11S-037-SS-0X	Southeast of former Building 60	Hand Auger	0-6 in.	PAHs, TAL Metals	Located southeast of former Building 60 (Boiler House) – this appears to be the location of a former fuel AST that was used in association with the Boiler House – the area surrounding this AST was bermed – possible COPCs: organics and TAL Metals (from fuel oil)
	AUS-A11S-037-SS-02			1-2 ft	TCL Volatiles	

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-038	AUS-A11S-038-SS-01	Roadway between former Buildings 80 & 56	Hand Auger	6-12 in.	TCL BNAs, TAL Metals	Located in road which appears to have been oiled in the past acc. to historical aerial photographs – deeper sample collected because top 6" is likely disturbed – possible COPCs: organics & metals (from fuel oil)
	AUS-A11S-038-SS-02			1-2 ft	TCL Volatiles	
A11S-039	AUS-A11S-039-SS-01	Roadway just east of former Building 65	Hand Auger	6-12 in.	TCL BNAs, TAL Metals	Located in roadway which appears to have been oiled in the past according to aerial photographs – location is also along former railroad line – possible COPCs: organics and TAL Metals (from fuel oil)
	AUS-A11S-039-SS-02			1-2 ft	TCL Volatiles	
A11S-040	AUS-A11S-040-SD-0X	North of former Building 66	Hand Auger	0-6 in.	TCL BNAs, TAL Metals	Located in an apparent former drainage ditch identified in aerial photos that led from former Building 66 (Cleaning & Painting Bldg), during Hoosier Cardinal /Ordill Machine Co. operations – there appeared to be discoloration in ditch – possible COPCs: organics & metals (from tool & dye working operations)
	AUS-A11S-040-SD-02			1-2 ft	TCL Volatiles	
A11S-041	AUS-A11S-041-SD-0X	North of Chemical Area Rd. in Main Drainage Ditch/Creek	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in Main Drainage Ditch/Creek which appears to have received drainage from Areas A11S, A11H and A11N at one time – location is inside Area A11S – possible COPCs: organics and TAL Metals (from tool & dye working operations), SW846 Explosives (from upstream areas)
	AUS-A11S-041-SD-02			1-2 ft	TCL Volatiles	
A11S-042	AUS-A11S-042-SD-0X	North of Area A11S, in Main Drainage Ditch/Creek	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in Main Drainage Ditch/Creek which appears to have received drainage from Areas A11S, A11H and A11N at one time – location is north of Area A11S – possible COPCs: organics and TAL Metals (from tool & dye working operations), SW846 Explosives (from upstream areas)
	AUS-A11S-042-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, TDS, Ammonia as N, Nitrate+Nitrite	
A11S-043	AUS-A11S-043-SD-0X	Ponded or former ponded area (south) north of Area A11S	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in ponded area (southern part) which appears to have previously received production wastes from Hoosier Cardinal/Ordill Machine Co. according to aerial photos – it is not known if water is still present in this location – possible COPCs: organics and TAL Metals (from tool & dye working operations), SW846 Explosives (from upstream areas)
	AUS-A11S-043-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, TDS	

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-044	AUS-A11S-044-SD-0X	Ponded or former ponded area (north) north of Area A11S	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in ponded area (northern part) which appears to have previously received production wastes from Hoosier Cardinal/Ordill Machine Co. according to aerial photos – it is not known if water is still present in this location – possible COPCs: organics and TAL Metals (from tool & dye working operations), explosives (from upstream areas)
	AUS-A11S-044-SD-02			1-2 ft	TCL Volatiles	
A11S-045	AUS-A11S-045-SD-0X	Former parking area in southeast part of A11S	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Former drum storage area on eastern edge of former parking lot, that was identified in aerial photograph of unknown date (likely 1993) – approximately 50 rusted drums were located here - possible COPCs: unknown
	AUS-A11S-045-SD-02			1-2 ft	TCL Volatiles	
A11S-046	AUS-A11S-046-SD-0X	Ditch receiving drainage from former parking area in southeast part of A11S	Hand Auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Drainage ditch that receives drainage from former drum storage area on east edge of former parking lot, that was identified in aerial photograph of unknown date (likely 1993) – approx. 50 rusted drums in this location that are no longer present on site – poss. COPCs: unknown
	AUS-A11S-046-SD-02			1-2 ft	TCL Volatiles	
A11S-047	AUS-A11S-047-SD-0X	West of former Building 75-1	Hand Auger	0-6 in	TCL BNAs, TAL Metals, SW846 Explosives+nitroglycerin	According to Olin information, Building 75-1 may have been used as a laboratory at one time – sample was located just west of building – possible COPCs: all compounds used in Areas 11 and 12
	AUS-A11S-047-SD-02			1-2 ft	TCL Volatiles	
A11S-W01	AUS-A11S-W01-SS-0X	Northeast of former Scrap Yard	Soil Boring	0-6 in	TCL BNAs, TAL Metals, SW846 Explosives	Located just beneath drain that comes out of the east side of a former concrete structure that is located just northeast of the former Scrap Yard – possible COPCs: unknown
	AUS-A11S-W01-SS-02			1-2 ft	TCL Volatiles	
	AUS-A11S-W01-SS-10			9-10 ft (below drain)	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-A11S-W01-SS-??			BWT	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	
	AUS-A11S-W01-GW-00		Monit. Well	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-W02	AUS-A11S-W02-SS-0X	North of former Building 68	Soil boring	0-6 in.	PAHs, TAL Metals	Located just north of former Building 68 (Paint Shield Cleaning Building and Oil Stores) in what appears to have been a former drainage ditch according to aerial photographs that may have been used by Hoosier Cardinal – there is no evidence suggesting that SW846 Explosives would have been used in this building, so SW846 Explosives were not analyzed for in soil above the water table – SW846 Explosives were analyzed for below the water table since this are is downgradient of the high SW846 Explosives and nitroglycerin manufacturing areas – possible COPCs: organics and TAL Metals (from paints, solvents, thinners, oils) and SW846 Explosives (below water table only)
	AUS-A11S-W02-SS-02			1-2 ft	TCL Volatiles	
	AUS-A11S-W02-SS-05			4-5 ft	TCL Volatiles, PAHs, TAL Metals	
	AUS-A11S-W02-SS-??			BWT	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives + Nitroglycerin + PETN	
	AUS-A11S-W02-GW-00		Monit. Well	NA	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives + Nitroglycerin + PETN, Perchlorates	
A11S-W03	Magnetometer Survey	Southwest of former Building 60	Magnet-ometer	Surface	NA	A magnetometer survey of this area will be done during the staking of borings to identify if the USTs are still present on site. If they are still present, then this boring will be located next to former No. 2 Fuel Oil USTS – there were four USTs and it is not known if these were removed or left in place – if they do not appear to still be in place, then the boring will be placed in the vicinity of these former USTs to detect the possibility of any remaining contamination – possible COPCs: organics and TAL Metals (from possible fuel oil contamination), SW846 Explosives (only in groundwater from upgradient areas)
	AUS-A11S-W03-SS-12		Soil Boring	10-12 ft	TCL Volatiles, PAHs, TAL Metals	
	AUS-A11S-W03-SS-18			16-18 ft	TCL Volatiles, PAHs, TAL Metals	
	AUS-A11S-W03-SS-24			22-24 ft	TCL Volatiles, PAHs, TAL Metals	
	AUS-A11S-W03-GW-00		Monit. Well	NA	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives +Nitroglycerin, Nitrate + Nitrite, TDS	

TABLE 10-5
SAMPLE LOCATIONS FOR AREA 11 – SUPPORT AREA
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A11S-W04	AUS-A11S-W04-SS-0X	South of former IOP Building II-1-3 (Building 56 and 66)	Soil Boring	0-6 in.	TCL BNAs, TAL Metals	Located in possible former doorway of IOP Cleaning and Painting Building (Building 56 and 66) - there is no evidence suggesting that SW846 Explosives would have been used in this building, so SW846 Explosives were not analyzed for in soil above the water table – possible COPCs: organics and TAL Metals (from paints, solvents, thinners, etc.), TCL BNAs (in surface soil due to railroad activities), SW846 Explosives (only below water table from upgradient locations)
	AUS-A11S-W04-SS-02			1-2 ft	TCL Volatiles	
	AUS-A11S-W04-SS-05			4-5 ft	TCL Volatiles, TAL Metals	
	AUS-A11S-W04-SS-??			BWT	TCL Volatiles, TAL Metals, SW846 Explosives + Nitroglycerin	
	AUS-A11S-W04-GW-00		Monit. Well	NA	TCL Volatiles, TAL Metals, SW846 Explosives + Nitroglycerin, TDS, Nitrate+Nitrite	

BWT = Below Water Table
COPCs = Chemicals of Potential Concern
NA = Not Applicable
Shaded samples will be collected by the UXO subcontractor.

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-001	AUS-0A12-001-SD-0X	West of former burning grounds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	West flowing ditch in U.S. Powder Dump-near abandoned drums – receives drainage from western half of Area 12 – possible COPCs: TAL Metals and SW846 Explosives (from burning grounds) and possibly organics (from drums)
	AUS-0A12-001-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates, Ammonia as N, Nitrate + Nitrite	
0A12-002	AUS-0A12-002-SS-0X	West of former burning grounds	Hand auger	0-6 in.	TCL BNAs, TAL Metals	Abandoned drum in U.S. Powder Dump – possible COPCs: organics (from drum), TAL Metals (from burning ground)
	AUS-0A12-002-SS-02			1-2 ft	TCL Volatiles	
0A12-003	AUS-0A12-003-SD-0X	West of former burning grounds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	North flowing ditch in U.S. Powder Dump which receives drainage from debris field–just north of (downstream of) debris field – possible COPCs: unknown
0A12-004	AUS-0A12-004-SS-0X	West of former burning grounds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in U.S. Powder Dump – debris field – possible COPCs: unknown
	AUS-0A12-004-SS-02			1-2 ft	TCL Volatiles	
0A12-005	AUS-0A12-005-SD-0X	West of former burning grounds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in northwest flowing ditch near drums – this ditch drains the western half of the area that is south of the Southern Perimeter Road-between the road and the fence line – possible COPCs: organics (from drums), TAL Metals and SW846 Explosives (from burning grounds)
0A12-006	AUS-0A12-006-SD-0X	West of former burning grounds	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located at the confluence of two streams – one that flows westward, just north of the former burning grounds and the other which flows westward through the location of the former burning grounds – possible COPCs: TAL Metals and SW846 Explosives from burning grounds

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-007	AUS-0A12-007-SD-0X	Former burning grounds	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives, Perchlorates	Located in a ponded area which appears to line up with the westernmost burning area – possible COPCs: PAHs (from burning), organics, TAL Metals and SW846 Explosives (all of which may have been burned here), additional surface water parameters were analyzed for at this location
	AUS-0A12-007-SW-00		Surface water	NA	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
0A12-008	AUS-0A12-008-SS-0X	South of former burning grounds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Volatile organics were detected in soils in this area during previous investigations (see Figure 15-10 of HSR) - possible COPCs: volatile organics, TAL Metals, TCL BNAs, SW846 Explosives (from burning grounds possibly burning pits)
	AUS-0A12-008-SS-02			1-2 ft	TCL Volatiles + Hexane	
	AUS-0A12-008-SS-05		Test pit samples	4-5 ft	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-0A12-008-SS-??			BWT	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-0A12-008-GW-00		Test pit water	NA	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, SW846 Explosives	
0A12-009	AUS-0A12-009-SD-0X	Former burning grounds	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Located in the west flowing stream that runs through the former burning grounds – this location appears to be in the location of a former burn pit – possible COPCs: PAHs (from actual burning), SW846 Explosives and TAL Metals (from burning grounds)

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-010	AUS-0A12-010-SS-0X	Former burning grounds	Hand auger	0-6 in	PAHs, TAL Metals, SW846 Explosives	Located just south of the west flowing stream that runs through the former burning grounds – this location appears to be in the location of a former burn pit in an area that ponds water after a precipitation event – If there is no burn pit identified in this area, then the "below the burn pit" sample will become a "below the water table" sample – possible COPCs: PAHs (from actual burning), organics, SW846 Explosives and TAL Metals (from burning grounds), ammonium nitrate in groundwater (manufactured on eastern half of site)
	AUS-0A12-010-SS-02			1-2 ft	TCL Volatiles + Hexane	
	AUS-0A12-010-SS-05		Test pit samples	4-5 ft (within trench)	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives, Dioxin	
	AUS-0A12-010-SS-??			Below burn pit	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
	AUS-0A12-010-GW-00		Test pit water	NA	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives, Perchlorates, Ammonia as N, Nitrate + Nitrite, Phosphorus (orthophosphate)	
0A12-011	AUS-0A12-011-SS-03	South of former burning grounds	Hand auger	2-3 ft	TCL BNAs, TAL Metals, SW846 Explosives	Located on soil mound located just south of burning grounds (south of location 10) – it is not known why this mound was formed or where the soil came from, so this mound will be sampled to characterize the soil – possible COPCs: unknown
0A12-012	AUS-0A12-012-SD-0X	Former burning grounds	Hand auger	0-6 in	PAHs, TAL Metals, SW846 Explosives	Located in the west flowing stream that runs through the former burning grounds – this location could possibly be in the location of a former burn pit/pad – possible COPCs: organics, TAL Metals and SW846 Explosives (from burning gronds), PAHs (from actual burning)
	AUS-0A12-012-SW-00		Surface water	NA	TCL Volatiles, PAHs, TAL Metals, SW846 Explosives, Phosphorus (orthophosphate), Sulfates	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-013	AUS-0A12-013-SS-0X	South of former burning grounds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in a debris field located just south-southeast of the burning grounds – both TPH and TCL Volatiles were detected in deeper soils during previous investigations, therefore these compounds will be analyzed for in deeper soils – possible COPCs: organics (from previous investigations) TAL Metals, SW846 Explosives (from burning grounds)
	AUS-0A12-013-SS-02			1-2 ft	TCL Volatiles + Hexane	
	AUS-0A12-013-SS-05		Test pit samples	4-5 ft	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-0A12-013-SS-??			BWT	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-0A12-013-GW-00		Test pit water	NA	TCL Volatiles + Hexane, TCL BNAs, TAL Metals, SW846 Explosives	
0A12-014	AUS-0A12-014-SD-0X	North of former burning grounds	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Sample location near the edge of a ponded area which formed along the creek which runs westward through the area north of the burning grounds – possible COPCs: TAL Metals and SW846 Explosives (from burning grounds)
	AUS-0A12-014-SW-00		Surface water	NA	TAL Metals, SW846 Explosives	
0A12-015	AUS-0A12-015-SS-0X	Just east of former Burning Grounds	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Possible former trench location (approx. 50' by 8') located just east of the former burning grounds – it is possible that this trench was used for burning SW846 Explosives based on it's location – the possible trench was identified on a 1965 aerial photograph – If there is no evidence of a former trench identified in the test pit, then the dioxin sample will not be collected and the "beneath the trench" sample will become a "below the water table" sample – possible COPCs: PAHs and Dioxin (from burning), TAL Metals and SW846 Explosives (residues from burning), organics (may have been burned also, or used to ignite materials)
	AUS-0A12-015-SS-01			1-2 ft	TCL Volatiles + Hexane	
	AUS-0A12-015-SS-05		Test pit samples	4-5 ft (within trench)	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives, Dioxin	
	AUS-0A12-015-SS-??			Beneath trench	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
	AUS-0A12-015-GW-00		Test pit water	NA	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
0A12-016	AUS-0A12-016-SD-0X	Southeast of former burning grounds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in the west flowing stream that runs through the former burning grounds – there was foam and a sheen on water in this location – possible COPCs: organics (sheen on water), TAL Metals and SW846 Explosives (from burning grounds)
	AUS-0A12-016-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Ammonia as N, Nitrate + Nitrite	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-017	AUS-0A12-017-SD-0X	South of southern perimeter road on west side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in ponded area of northwest flowing ditch–this ditch drains the western half of the area that is south of the southern Area 12 road-between the road and the fence line – potential former dumping area – possible COPCs: TAL Metals and SW846 Explosives (from nearby burning grounds)
	AUS-0A12-017-SW-00		Surface water	NA	TAL Metals, SW846 Explosives, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
0A12-018	AUS-0A12-018-SS-0X	Area west of Area 12 – near shore of small lake	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Possible former trench location near shore of a small lake located west of Area 12 – it is possible that this trench was used for burning SW846 Explosives or for disposal based on it's location – the possible trench was identified on a 1980 aerial photograph – possible COPCs: PAHs and Dioxin (from burning), TAL Metals and SW846 Explosives (residues from burning), organics (may have been burned also, or used to ignite materials)
	AUS-0A12-018-SS-01			1-2 ft	TCL Volatiles + Hexane	
	AUS-0A12-018-SS-05		Test pit samples	4-5 ft	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
	AUS-0A12-018-SS-??			Beneath trench	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
	AUS-0A12-018-GW-00		Test pit water	NA	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
0A12-019	AUS-0A12-019-SD-0X	North of north perimeter road on west side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives, TOC	Sample located in ditch just north of road located north of RDX production area – methylene chloride was detected in MW-COP4-1 soil sample just south of this road during a previous investigation – possible COPCs: volatile organics (previous investigation – WCC Confirmation Study, 1988), TAL Metals and SW846 Explosives (from nearby burning grounds)
	AUS-0A12-019-SD-02			1-2 ft	TCL Volatiles	
0A12-020	AUS-0A12-020-SW-00	Small un-named lake west of Area 12	Surface water	NA	TCL Volatiles, TCL BNAs, SW846 Explosives + Nitroglycerin & PETN, TAL Metals, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	Sample of lake water from lake that is just west of the "Area West of Area 12" as seen in Figure 10-12 – to see if the lake water may have received contamination from this area or from possible disposal activities into the lake – possible COPCs: unknown

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-021	AUS-0A12-021-SD-0X	West of former Building 70	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Sample located at what appears to be beginning of west flowing creek that runs north of the burning grounds – this "outfall" appears to originate from Building 70 (Stores Change House or Storage Building) – possible COPCs: AN (former AN Change House), TAL Metals and SW846 Explosives (from nearby burning grounds)
	AUS-0A12-021-SW-00		Surface water	NA	TAL Metals, SW846 Explosives, Ammonia as N, Nitrate + Nitrite	
0A12-022	AUS-0A12-022-SS-0X	West of former Building 76-2	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Located in small, shallow burn pit located east of monitoring well MW-COP4-2 – possible COPCs: PAHs, TAL Metals and SW846 Explosives (from burning)
0A12-023	AUS-0A12-023-SS-0X	Southwest of former Building 76-2	Hand auger	0-6 in.	TCL BNAs, TAL Metals	Sample tar like material in drum and collect soil sample nearby this drum - located south-southwest of small burn pit – possible COPCs: unknown
	AUS-0A12-023-SS-02			1-2 ft	TCL Volatiles	
	AUS-0A12-023-DRUM		Drum sample	NA	TCL Volatiles, TCL BNAs, TAL Metals	
0A12-024	AUS-0A12-024-SD-0X	West of former Building 70	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	Sample location in ponded area which formed along the creek which runs westward through the area north of the burning grounds – appears to receive drainage from former Building 70 (AN Change House and Storage) and from Building 76-3 (RDX Tray Dryer Building) – possible COPCs: organics (from RDX production), AN, TAL Metals and SW846 Explosives (from burning ground residues), perchlorates (from possible photoflash signal testing), RDX and TNT (identified by CSC in Bldg. 76)
	AUS-0A12-024-SW-00		Surface water	NA	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
0A12-025	AUS-0A12-025-SD-0X	South of southern perimeter road on west side of Area 12	Hand auger	0-6 in.	PAHs, TAL Metals, TOC	Sample located in a northwest flowing ditch located along southern edge of the Area 12 southern perimeter road – downstream of former diesel fuel UST which may have spilled just upstream at one time – possible COPCs: diesel fuel, TAL Metals
0A12-026	AUS-0A12-026-SD-0X	North of former Building 76-3	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Sample located in dry ditch (at outfall) that based on it's location, may have come from building 76-3 (RDX Tray Dryer) – just north of Building 76-3 – possible COPCs: organics (from nearby RDX production), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
	AUS-0A12-026-SD-02			1-2 ft	TCL Volatiles	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-027	AUS-0A12-027-SS-0X	South of former Building 76-3	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located just south of Building 76-3 (between RDX Mixer House and Tray Drier Building) – possible COPCs: organics (from nearby RDX production), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
	AUS-0A12-027-SS-02			1-2 ft	TCL Volatiles	
0A12-028	AUS-0A12-028-SS-0X	South of former Building 76-3	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located next to drums identified between Building 76-2 and 76-3 (RDX Mixer House and Tray Drier Building) – possible COPCs: organics (from nearby RDX production and drums), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
	AUS-0A12-028-SS-02			1-2 ft	TCL Volatiles	
0A12-029	AUS-0A12-029-SS-0X	North of former Building 76-2	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located just north of Building 76-2 between Building 76-2 and 76-3 (between RDX Mixer House and Tray Drier Building) - likely location for spillage from mixing operations – several different compounds may have been used in mixing operations at this location – possible COPCs: organics (from RDX production – mixing), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
	AUS-0A12-029-SS-02			1-2 ft	TCL Volatiles	
	AUS-0A12-029-SS-05		Test pit samples	4-5 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-0A12-029-SS-??			BWT	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-0A12-029-GW-00		Test pit water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
0A12-030	AUS-0A12-030-SD-0X	West of former Building 76-2	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located at concrete trough which based on it's location, appears to be the outfall for Building 76-2 (RDX Mixer House) – outfall discharges in to west flowing creek that flows through burning grounds – possible COPCs: organics (from nearby RDX production - mixing), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
	AUS-0A12-030-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Phosphorus (orthophosphate), Nitrate + Nitrite, Ammonia as N, Sulfate, TDS	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-031	AUS-0A12-031-SS-0X	East of former Building 76-2	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located just east of Building 76-2 (between RDX Separation Building & RDX Mixer House) – likely area of RDX and other contamination between these bldgs. – possible COPCs: organics (from nearby RDX production - mixing), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
	AUS-0A12-031-SS-02			1-2 ft	TCL Volatiles	
0A12-032	AUS-0A12-032-SS-0X	North of former Building 76	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located just north of Building 76 (RDX Separation) along former IOP railroad line – possible COPCs: organics (from nearby RDX production and railroad line), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and SW846 Explosives (from burning grounds residues)
	AUS-0A12-032-SS-02			1-2 ft	TCL Volatiles	
0A12-033	AUS-0A12-033-SS-0X	West of former Building 76	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located just west of RDX Separation (Building 76) – possible COPCs: organics (from nearby RDX production), RDX & TNT (CSC identified in Bldg. 76), TAL Metals & SW846 Explosives (from burning grounds residues)
	AUS-0A12-033-SS-02			1-2 ft	TCL Volatiles	
0A12-034	AUS-0A12-034-SS-02	Former Building 76	Hand auger	1-2 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Dioxin	Mound sample collected from mound of soil covering former Building 76– possible COPCs: organics (from nearby RDX production), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues) possibly dioxin (from flashing bldg. because of possibility of chlorinated hydrocarbons being used in this building)
	AUS-0A12-034-SS-05			4-5 ft or refusal	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
0A12-035	AUS-0A12-035-SS-0X	South of former Building 76	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located just south of Building 76 (RDX Separation Bldg. and former Boiler House) in location of former blow-off basin – also potential for RDX and TNT spillage – there were also six ASTs located in this area during RDX production at the site – possible COPCs: organics (from nearby RDX production), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
	AUS-0A12-035-SS-02			1-2 ft	TCL Volatiles	
	AUS-0A12-035-SS-05		Test pit samples	4-5 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-0A12-035-SS-??			BWT	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-0A12-035-GW-00		Test pit water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Phosphorus (orthophosphate)	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-036	AUS-0A12-036-SS-0X	East of former Building 76	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located just east of Building 76 (RDX Separation) – possible COPCs: organics (from nearby RDX production), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
0A12-037	AUS-0A12-037-SS-0X	West of former Building 76-1	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located just west of Building 76-1 (Air Dryer and Steam Generator) – possible COPCs: organics (from nearby RDX production), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
	AUS-0A12-037-SS-02			1-2 ft	TCL Volatiles	
0A12-038	AUS-0A12-038-SD-0X	South of former Building 76-1	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located at apparent outfall of west flowing creek which runs through burning grounds – appears to be located just south of Building 76-1 – it may drain Building 76-1 – possible COPCs: organics (from nearby RDX production), RDX and TNT (identified by CSC in Bldg. 76), TAL Metals and other SW846 Explosives (from burning grounds residues)
	AUS-0A12-038-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Phosphorus (orthophosphate), Nitrate + Nitrite, Ammonia as N, Sulfate, TDS	
0A12-039	AUS-0A12-039-SS-0X	South of former Building 76-1	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located on northern half of un-vegetated area that is located just south of Building 76-1 – debris throughout this area (coal, slag, scrap, etc.) – possible COPCs: TAL Metals and SW846 Explosives (from Area 12 burning and disposal activities)
0A12-040	AUS-0A12-040-SS-0X	South of former Building 76-1	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located on southern half of un-vegetated area that is located just south of Building 76-1 – debris throughout this area (coal, slag, scrap, etc.) – possible COPCs: TAL Metals and SW846 Explosives (from Area 12 burning and disposal activities)
0A12-041	AUS-0A12-041-SS-0X	South of southern perimeter road on west side of Area 12	Hand auger	1-2 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	Dump area located just south of Area 12 southern perimeter road (south of RDX production area) – mound sample – possible COPCs: TAL Metals and SW846 Explosives (from Area 12 burning and disposal activities), possibly organics (organics sampled for in 2 of 4 locations in this debris area)

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-042	AUS-0A12-042-SS-0X	South of southern perimeter road on west side of Area 12	Hand auger	1-2 ft	TAL Metals, SW846 Explosives	Dump area located just south of Area 12 southern perimeter road (south of RDX production area) – mound sample – possible COPCs: TAL Metals and SW846 Explosives (from Area 12 burning and disposal activities)
0A12-043	AUS-0A12-043-SD-0X	South of southern perimeter road on west side of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Dump area located just south of Area 12 southern perimeter road (south of RDX production area) – ponded depression sample – possible COPCs: TAL Metals and SW846 Explosives (from Area 12 burning and disposal activities), possibly organics (organics sampled for in 2 of 4 locations in this debris area)
	AUS-0A12-043-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
0A12-044	AUS-0A12-044-SD-0X	South of southern perimeter road on west side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Dump area located just south of Area 12 southern perimeter road (south of RDX production area) – ponded depression sample – possible COPCs: TAL Metals and SW846 Explosives (from Area 12 burning and disposal activities)
	AUS-0A12-044-SW-00		Surface water	NA	TAL Metals, SW846 Explosives	
0A12-045	AUS-0A12-045-SS-0X	North of north perimeter road on west side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Sample located somewhere around perimeter of former Building ANP-1-11 (Timekeepers Bldg.) – empty blasting caps and solid propellant were found on foundation of this building indicating that SW846 Explosives may have been ignited on this foundation – possible COPCs: TAL Metals and SW846 Explosives (residues from ignition)
0A12-046	AUS-0A12-046-SD-0X	East of north-south running road in center of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located at beginning of east flowing ditch (at confluence with north and south flowing ditches) – located on east side of road that runs north-south through Area 12 – there were previously several Silas Mason buildings located in this area – possible COPCs: AN(manuf. on east side of site) , RDX (due to proximity to RDX production area), organics (due to sheen present in water just upstream of this location), TAL Metals and SW846 Explosives (due to burning activities in Area 12)
	AUS-0A12-046-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Ammonia as N, Nitrate + Nitrite	
0A12-047	AUS-0A12-047-SD-0X	East of north-south running road in center of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in north flowing ditch on east side of road that runs north-south through Area 12 – water has a slight sheen in this location – possible COPCs: organics (sheen on water), AN (manuf. on east side of site), TAL Metals and SW846 Explosives (due to Area 12 burning activity)
	AUS-0A12-047-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-048	AUS-0A12-048-SD-0X	South of southern perimeter road on west side of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	Sample located in a northwest flowing ditch located along southern edge of the Area 12 southern perimeter road where water has sheen – possible COPCs: unknown (ditch may receive drainage from dump area)
	AUS-0A12-048-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Ammonia as N, Nitrate + Nitrite	
0A12-049	AUS-0A12-049-SD-0X	South of north perimeter road on east side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in east? flowing ditch on south side of Area 12 north perimeter road – near intersection with north-south running road – possible COPCs: AN (near former AN production area), TAL Metals and SW846 Explosives (former burning activities in Area 12)
0A12-050	AUS-0A12-050-SD-0X	North of north perimeter road on east side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located by 5" drain which may come from an unknown Silas Mason building that was located on the northeast corner of the intersection of the Area 12 north-south running road and the northern perimeter road – the use of this building is not known however solid propellant debris is visible on foundation so it is possible that this foundation was also used to ignite explosive materials – possible COPCs: TAL Metals and SW846 Explosives (from ignition of explosive materials)
0A12-051	AUS-0A12-051-SS-0X	Northeast of former Building ANP-1-7	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Location of former scarred area just east of former enclosure with probable standing liquid that was identified in 1951 aerial photograph – scarred area may be result of liquid release from Silas Mason – possible COPCs: unknown
	AUS-0A12-051-SS-02			1-2 ft	TCL Volatiles	
0A12-052	AUS-0A12-052-SS-02	North of east-flowing creek in east half of Area 12	Hand auger	1-2 ft	TAL Metals, SW846 Explosives	Located on one of mounded areas that surround the foundation of former IOP Neutral Liquor Building (Building ANP-1-7) – location to be determined in field – possible COPCs: TAL Metals, SW846 Explosives, AN

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-053	AUS-0A12-053-SS-0X	North of east-flowing creek in east half of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located on western half of construction debris area that is located just south of Neutral Liquor Building Mound (Building ANP-1-7) – possible COPCs: AN (unknown Silas Mason buildings located in this area), TAL Metals, SW846 Explosives (due to proximity to RDX area)
0A12-054	AUS-0A12-054-SS-0X	North of east-flowing creek in east half of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located on eastern half of construction debris area that is located just south of Neutral Liquor Building Mound (Building ANP-1-7) – possible COPCs: AN (unknown Silas Mason buildings located in this area), TAL Metals, SW846 Explosives (due to proximity to RDX area)
	AUS-0A12-054-SS-02			1-2 ft	TCL Volatiles	
0A12-055	AUS-0A12-055-SD-0X	North of east-flowing creek in east half of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in ditch leading from ponded area (just south of former Building 71 – Warehouse and Paper Stores) to east flowing creek that flows through center of eastern half of Area 12 – possible COPCs: AN, TAL Metals and SW846 Explosives (from Area 12 burning activities)
0A12-056	AUS-0A12-056-SS-0X	South of east-flowing creek in east half of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located on western half of overgrown area with powder can lids (south of east flowing creek which runs through center of eastern half of Area 12) – possible COPCs: AN, TAL Metals and SW846 Explosives (from Area 12 burning activities), TCL BNAs (from possible powder disposal)
0A12-057	AUS-0A12-057-SD-0X	South of east-flowing creek in east half of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	Located in ponded area approximately 250 ft east of Area 12 north-south running road and 250 ft north of Area 12 south perimeter road – possible COPCs: AN, perchlorates (from possible photoflash signal testing), TAL Metals and SW846 Explosives (from possible nearby burning activities – in two trenches located east of this location)
	AUS-0A12-057-SW-00		Surface water	NA	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-058	AUS-0A12-058-SS-0X	South of east-flowing creek in east half of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located near buried propellant can lids located approximately 275 ft east of Area 12 north-south running road and 130 feet north of Area 12 south perimeter road (south of ponded area) – possible COPCs: AN, TCL BNAs (from propellants), TAL Metals and SW846 Explosives (from possible nearby burning activities – in two trenches located east of this location)
0A12-059	AUS-0A12-059-SS-024	Former Building 71	Hand auger	1-2 ft	TAL Metals, SW846 Explosives	Sample of mounded soil over former Building 71 (Warehouse and Paper Stores) location – possible COPCs: TAL Metals and SW846 Explosives (from Area 12 burning activities)
	AUS-0A12-059-SS-05			4-5 ft or refusal	TAL Metals, SW846 Explosives	
0A12-060	AUS-0A12-060-SD-0X	South of former Building 71	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	Sample located in ponded area just south and east of Building 71 (Warehouse and Paper Stores) - ponded area is 3-4 ft deep – also location of former railroad spur that was used by Silas Mason – area was previously scarred as seen in historical aerial photographs – possible COPCs: organics (from former railroad), perchlorates (form possible former photoflash testing), TAL Metals and SW846 Explosives (from former Area 12 burning activities), AN
	AUS-0A12-060-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
0A12-061	AUS-0A12-061-SD-0X	East of former Building 71	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Sample located in eastern portion of ponded area located south and east of Building 71(Warehouse and Paper Stores) – possible COPCs: TAL Metals and SW846 Explosives (from former Area 12 burning activities)
0A12-062	AUS-0A12-062-SD-0X	North of north perimeter road on east side of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in east flowing ditch that is just north of Area 12 north perimeter road (northeast of Building 71 - Warehouse and Paper Stores) – there is a slight sheen on water at this location – possible COPCs: organics (sheen on water), AN, TAL Metals and SW846 Explosives (from Area 12 burning activities)
	AUS-0A12-062-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Ammonia as N, Nitrate + Nitrite	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-063	AUS-0A12-063-SD-0X	South of north perimeter road on east side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in east flowing ditch that runs just south of Area 12 north perimeter road – just west of culvert under roadway to Building 71 (Warehouse and Paper Stores) – possible COPCs: AN, TAL Metals and SW846 Explosives (from Area 12 burning activities)
	AUS-0A12-063-SW-00		Surface water	NA	TAL Metals, SW846 Explosives	
0A12-064	AUS-0A12-064-SS-0X	South of east-flowing creek in east half of Area 12	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Located on western half of overgrown area with powder can lids (south of east flowing creek which runs through center of eastern half of Area 12) in location of potential former disposal (possible burning) trench according to aerial photograph – If there is no evidence of a former trench identified in the test pit, then the dioxin sample will not be collected and the "beneath the trench" sample will become a "below the water table" sample – possible COPCs: PAHs and Dioxin (from burning), TAL Metals and SW846 Explosives (residues from burning), organics (may have been burned also, or used to ignite materials)
	AUS-0A12-064-SS-01			1-2 ft	TCL Volatiles + Hexane	
	AUS-0A12-064-SS-05		Test pit samples	4-5 ft (within trench)	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives, Dioxin	
	AUS-0A12-064-SS-??			Beneath trench	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
	AUS-0A12-064-GW-00		Test pit water	NA	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
0A12-065	AUS-0A12-065-SD-0X	North of south perimeter road on east side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in ditch that is just north of Area 12 south perimeter road – flow direction is not known (east flowing is assumed) – location is southeast of location 0A12-058 – possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
0A12-066	AUS-0A12-066-SD-0X	South of southern perimeter road on east side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Location in east flowing ditch located just south of Area 12 south perimeter road– possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
	AUS-0A12-066-SW-00		Surface water	NA	TAL Metals, SW846 Explosives, Nitrate + Nitrite, Ammonia as N	
0A12-067	AUS-0A12-067-SS-0X	South of southern perimeter road on east side of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in potential dumping area approximately 120 feet south of location 0A12-066 – possible COPCs: unknown
0A12-068	AUS-0A12-068-SD-0X	East flowing creek on east side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives, TOC	Located in east flowing creek that flows through center of eastern half of Area 12 – near bend in creek where the creek turns northeastward – possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
	AUS-0A12-068-SW-00		Surface water	NA	TAL Metals, SW846 Explosives	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-069	AUS-0A12-069-SD-0X	Northeast corner of east side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located at confluence of northeastward flowing creek and ditch that enters creek coming from area of Building 71(Warehouse and Paper Stores) – possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
0A12-070	AUS-0A12-070-SD-0X	East of east perimeter road in Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	Located at confluence of northeastward flowing creek and east flowing creek that runs along north side of northern perimeter road and north flowing creek that runs along east side of Area 12 east perimeter road – near where this creek flows off site to the northeast– possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning), organics (from sheen on water further upstream)
	AUS-0A12-070-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Ammonia as N, Nitrate + Nitrite	
0A12-071	AUS-0A12-071-SS-0X	East of east perimeter road in Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in a debris field that is situated between the north flowing ditch that runs along the east side of the Area 12 east perimeter road and another ditch that parallels this ditch approximately 100 feet east – location of potential former disposal trench according to aerial photograph– possible COPCs: organics (from disposal and/or burning activities), TAL Metals and SW846 Explosives (residues from Area 12 burning)
	AUS-0A12-071-SS-05		Test pit samples	4-5 ft.	TCL Volatiles + Hexane, TAL Metals, SW846 Explosives	
	AUS-0A12-071-SS-??			Below trench	TCL Volatiles + Hexane, TAL Metals, SW846 Explosives	
	AUS-0A12-071-GW-00		Test pit water	NA	TCL Volatiles + Hexane, TAL Metals, SW846 Explosives, Perchlorates	
0A12-072	AUS-0A12-072-SD-0X	East of east perimeter road in Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Sample north flowing ditch located on east side of debris field (southeast of 0A12-071) – possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
0A12-073	AUS-0A12-073-SD-0X	East of east perimeter road in Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Sample ditch which runs along the west side of debris field (ditch that runs just east of Area 12 east perimeter road) – possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
0A12-074	AUS-0A12-074-SD-0X	East of east perimeter road in Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in north flowing ditch which parallels the Area 12 east perimeter road approximately 100 feet from road – it appears to receive drainage from both directions along inside and outside of Area 12 south and east perimeter roads – possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
	AUS-0A12-074-SW-00		Surface water	NA	TAL Metals, SW846 Explosives, Nitrate + Nitrite, Ammonia as N	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-075	AUS-0A12-075-SD-0X	North of south perimeter road on east side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in ditch on west side of Area 12 east and south perimeter road – right next to culvert which appears to have been located next to former kettle and pan houses (ANP-1-3 and ANP-1-4) – possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
0A12-076	AUS-0A12-076-SS-0X	South of southern perimeter road on east side of Area 12	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Location of a drum near confluence of a north flowing ditch which enters the site from the south and a northeast flowing ditch which runs along the Area 12 south perimeter road– possible COPCs: organics (from drum), AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
	AUS-0A12-076-SS-02			1-2 ft	TCL Volatiles	
0A12-077	AUS-0A12-077-SD-0X	South of southern perimeter road on east side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located just downstream of a mound located along the north flowing ditch which enters the site from the south – possible COPCs: TAL Metals and SW846 Explosives (residues from Area 12 burning)
	AUS-0A12-077-SW-00		Surface water	NA	TAL Metals, SW846 Explosives	
0A12-078	AUS-0A12-078-SD-0X	South of southern perimeter road on west side of Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives, Perchlorates	Located in ponded area of northwest flowing ditch–this ditch drains the western half of the area that is south of the southern Area 12 road-between the road and the fence line – possible COPCs: TAL Metals and SW846 Explosives (from nearby burning grounds), perchlorates (possibly form photoflash testing in Area 12)
	AUS-0A12-078-SW-00		Surface water	NA	TAL Metals, SW846 Explosives, Perchlorates	
0A12-079	AUS-0A12-079-SW-00	North of north perimeter road on east side of Area 12	Water in sewer manhole	NA	TAL Metals, SW846 Explosives	Sewer manhole filled with water – located across Area 12 northern perimeter road from former Building 71 (Warehouse and Paper Stores) – possible COPCs: AN, TAL Metals and SW846 Explosives (residues from Area 12 burning)
0A12-080	AUS-0A12-080-SD-0X	Located west of Area 12 – near an un-named lake	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Location of ponded area with slight sheen (near banks of a small unnamed lake) near area which appears to have been used for disposal activities – as seen in 1980 aerial photograph – possible COPCs: organics (sheen on water), unknown
	AUS-0A12-080-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-081	AUS-0A12-081-SS-02	Located west of Area 12 – near an un-named lake	Hand auger	1-2 ft	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	Located on 20' diameter by 5 ft high mound in disturbed area near un-named lake west of Area 12 – disturbed area identified in aerial photographs – possible COPCs: unknown
0A12-082	AUS-0A12-082-SS-0X	Located west of Area 12 – near an un-named lake	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Located in barren area found in disturbed area near un-named lake west of Area 12 – disturbed area identified in aerial photographs – drum lids present in barren area – possible COPCs: unknown
	AUS-0A12-082-SS-02			1-2 ft	TCL Volatiles	
0A12-083	AUS-0A12-083-SS-0X	North of railroad located just south of Smokeless Powder Rd.	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	Former IOP railroad that was also used by Olin for unloading old cannon powder into the powder storage ponds which are located just north of the railroad line – possible COPCs: perchlorates, TAL Metals, TCL BNAs, SW846 Explosives (all from propellant/powder storage)
0A12-084	AUS-0A12-084-SS-0X	North of railroad located just south of Smokeless Powder Rd.	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	Former IOP railroad that was also used by Olin for unloading old cannon powder into the powder storage ponds which are located just north of the railroad line– possible COPCs: perchlorates, TAL Metals, TCL BNAs, SW846 Explosives (all from propellant/powder storage)
0A12-085	AUS-0A12-085-SS-0X	Former Pond #7	Hand auger	0-6 in.	TCL BNAs, TAL Metals, Perchlorates, SW846 Explosives + Nitroglycerin	No surficial soil samples were previously collected from Pond #7 (former pond locations may possibly be marked by current tree lines and depressions) – deeper samples were collected during previous investigations – possible COPCs: perchlorates, TAL Metals, organics, SW846 Explosives (all from propellant/powder storage)
	AUS-0A12-085-SS-02			1-2 ft	TCL Volatiles	
0A12-086	AUS-0A12-086-SS-0X	Former Pond #6	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	No surficial soil samples were previously collected from Pond #6 (former pond locations may possibly be marked by current tree lines and depressions) – deeper samples were collected during previous investigations – possible COPCs: perchlorates, TAL Metals, organics, SW846 Explosives (all from propellant/powder storage)
	AUS-0A12-086-SS-02			1-2 ft	TCL Volatiles	
0A12-087	AUS-0A12-087-SS-0X	Between former Ponds #5 and #6	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	Area between Powder Storage Ponds that may not have been flashed, and which may have received overflow from ponds during periods of heavy precipitation– deeper samples were collected during previous investigations – possible COPCs: perchlorates, TAL Metals, organics, SW846 Explosives (all from propellant/powder storage)
	AUS-0A12-087-SS-02			1-2 ft	TCL Volatiles	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-088	AUS-0A12-088-SD-0X	Creek east of Storage Ponds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	"Outfall" of creek that drains the former Powder Storage Pond area – deeper samples were collected during previous investigations – possible COPCs: perchlorates, TAL Metals, organics, SW846 Explosives (all from propellant/powder storage)
	AUS-0A12-088-SD-02			1-2 ft	TCL Volatiles	
0A12-089	AUS-0A12-089-SS-0X	Former Pond #3	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	No surficial soil samples were previously collected from Pond #3 (former pond locations may possibly be marked by current tree lines and depressions) – deeper samples were collected during previous investigations – possible COPCs: perchlorates, TAL Metals, organics, SW846 Explosives (all from propellant/powder storage)
	AUS-0A12-089-SS-02			1-2 ft	TCL Volatiles	
0A12-090	AUS-0A12-090-SD-0X	Creek east of storage ponds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	Three empty drums located in creek just downstream of Powder Storage Ponds – creek receives drainage from ponds– deeper samples were collected during previous investigations – possible COPCs: perchlorates, TAL Metals, organics, SW846 Explosives (all from propellant/powder storage and/or possibly from drums)
	AUS-0A12-090-SW-00		Surface water	NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives, Ammonia as N, Nitrate + Nitrite, Perchlorates	
0A12-091	AUS-0A12-091-SS-0X	Former Pond #1	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin, Perchlorates	No surficial soil samples were previously collected from Pond #1 (former pond locations may possibly be marked by current tree lines and depressions) – deeper samples were collected during previous investigations – possible COPCs: perchlorates, TAL Metals, organics, SW846 Explosives (all from propellant/powder storage)
	AUS-0A12-091-SS-02			1-2 ft	TCL Volatiles	
0A12-092	AUS-0A12-092-SD-0X	Creek flowing northeast from Area 12	Hand auger	0-6 in.	TAL Metals, SW846 Explosives	Located in creek that flows northeast from Area 12 off site – just downstream (northeast) of culvert that goes under roadways and railroad – possible COPCs: AN, TAL Metals and SW846 Explosives (from Area 12 burning residues)
	AUS-0A12-092-SW-00		Surface water	NA	TAL Metals, SW846 Explosives, Nitrate + Nitrite, Ammonia as N	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-093	AUS-0A12-093-SS-0X	Former Burning Grounds	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Located in possible former burning pit to determine depth of burning pit and contaminants found inside burning pit – If there is no burn pit identified in this area, then the dioxin sample will not be collected and the "below the burn pit" sample will become a "below the water table" sample – possible COPCs: PAHs and Dioxin (from burning), TAL Metals and SW846 Explosives (residues from burning), organics (may have been burned also, or used to ignite materials)
	AUS-0A12-093-SS-02			1-2 ft	TCL Volatiles + Hexane	
	AUS-0A12-093-SS-05		Test pit samples	4-5 ft (within trench)	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives, Dioxin	
	AUS-0A12-093-SS-??			Below burn pit	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
	AUS-0A12-093-GW-00		Test pit water	NA	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
0A12-094	AUS-0A12-094-SS-0X	Located west of Powder Storage Ponds	Hand auger	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives	Former Salvage Yard/Laydown Yard identified in aerial photographs that was located just west of the Powder Storage Ponds – potential for drums in this location – possible COPCs: unknown
	AUS-0A12-094-SS-02			1-2 ft	TCL Volatiles	
0A12-095	AUS-0A12-095-SS-0X	Former Water Tower location	Hand auger	0-6 in.	TAL Metals	Located just below water tower near westernmost leg to detect contamination associated with sandblasting activities done on the water tower – possible COPCs: lead (from sandblasting lead-based paint)
0A12-096	AUS-0A12-096-SS-0X	Southwest of former Building 76	Hand auger	0-6 in.	PCBs	Former location of electrical transformer – possible COPCs: PCBs (from leakage of possible PCB containing oils)
0A12-097	AUS-0A12-097-SS-0X	West of former Building 71	Hand auger	0-6 in.	TCL BNAs, TAL Metals	Location of two former ASTs that were located just east of former Building ANP-1-7 (Neutral Liquor Building) - the tanks were likely used only by Silas Mason – unknown contents in tanks – possible COPCs: unknown
	AUS-0A12-097-SS-01			1-2 ft	TCL Volatiles	
0A12-098	AUS-0A12-098-SS-0X	East of former Building ANP-1-7	Hand auger	0-6 in.	TCL BNAs, TAL Metals	Location of two former ASTs that were located just west of former Building 71 (Warehouse and Paper Stores) – the tanks were likely used only by Silas Mason – unknown contents in tanks – possible COPCs: unknown
	AUS-0A12-098-SS-01			1-2 ft	TCL Volatiles	

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-099	AUS-0A12-099-SS-0X	South of east-flowing creek in east half of Area 12	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Located on western half of overgrown area with powder can lids (south of east flowing creek which runs through center of eastern half of Area 12) in location of potential former disposal trench – If there is no evidence of a former trench identified in the test pit, then the dioxin sample will not be collected and the "beneath the trench" sample will become a "below the water table" sample – possible COPCs: PAHs and Dioxin (from burning), TAL Metals and SW846 Explosives (residues from burning), organics (may have been burned also, or used to ignite materials)
	AUS-0A12-099-SS-01			1-2 ft	TCL Volatiles + Hexane	
	AUS-0A12-099-SS-05		Test pit samples	4-5 ft (within trench)	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives, Dioxin	
	AUS-0A12-099-SS-??			Beneath trench	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
	AUS-0A12-099-GW-00		Test pit water	NA	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
0A12-100	AUS-0A12-100-SS-0X	Just north of former Burning Grounds	Hand auger	0-6 in.	PAHs, TAL Metals, SW846 Explosives	Possible former trench location (approx. 140' by 12') located just north of the former burning grounds in the former ditch line – it is possible that this trench was used for either disposing of wastes or burning SW846 Explosives based on it's location – the possible trench was identified on a 1980 aerial photograph – If there is no evidence of a former trench identified in the test pit, then the dioxin sample will not be collected and the "beneath the trench" sample will become a "below the water table" sample– possible COPCs: PAHs and Dioxin (from burning), TAL Metals and SW846 Explosives (residues from burning), organics (may have been burned also, or used to ignite materials)
	AUS-0A12-100-SS-01			1-2 ft	TCL Volatiles + Hexane	
	AUS-0A12-100-SS-05		Test pit samples	4-5 ft (within trench)	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives, Dioxin	
	AUS-0A12-100-SS-??			Beneath trench	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
	AUS-0A12-100-GW-00		Test pit water	NA	TCL Volatiles + Hexane, PAHs, TAL Metals, SW846 Explosives	
MW-COP3-1	AUS-0A12-MW-COP3-1-GW-00	West portion of storage ponds	Ground water	NA	TCL Volatiles + Hexane, TCL BNAs, SW846 Explosives + NG & PETN, TAL Metals, Perchlorates	*Sample existing monitoring well if it is still present on site.*

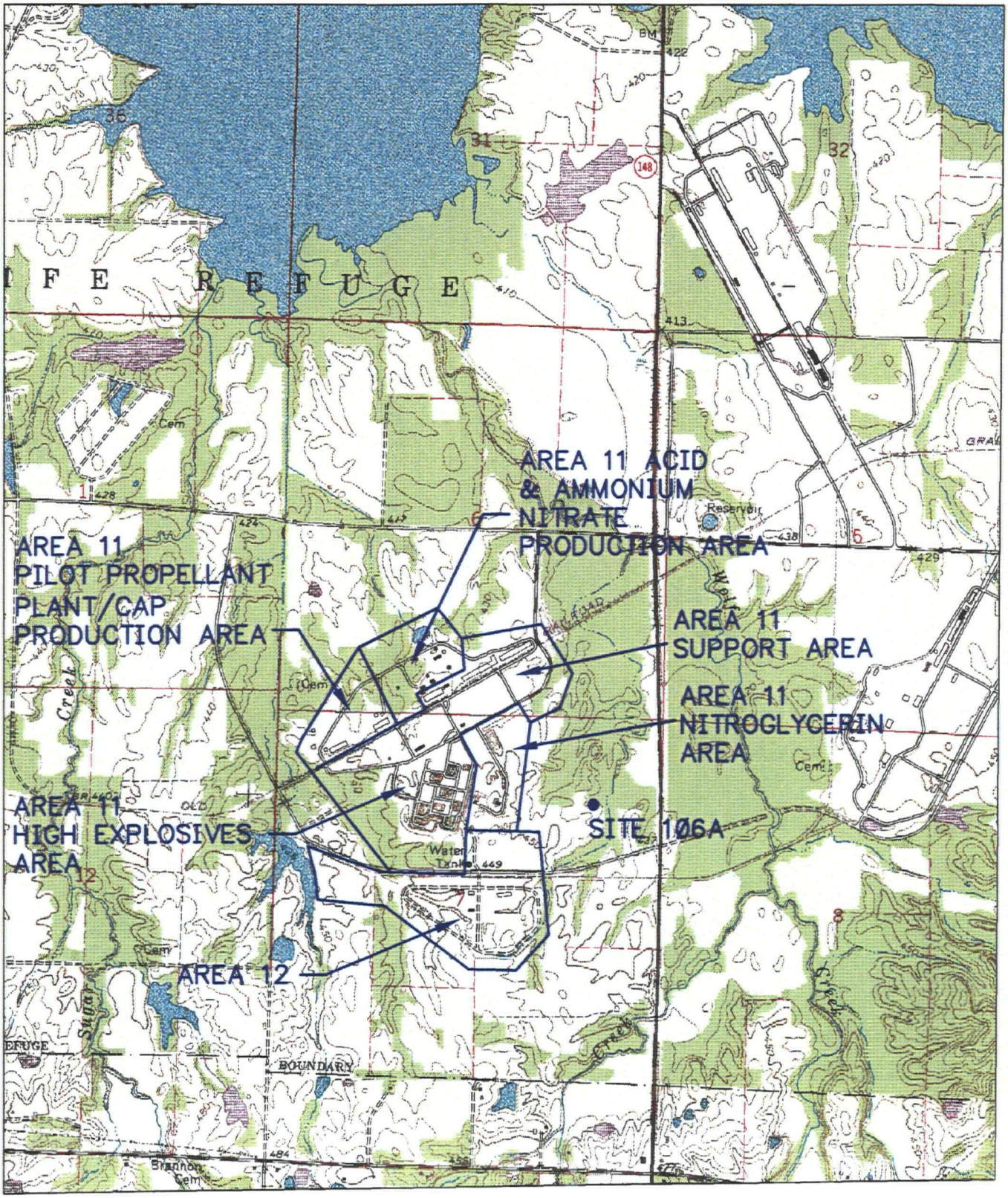
TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
MW-COP3-2	AUS-0A12-MW-COP3-2-GW-00	Southwest portion of storage ponds	Ground water	NA	TCL Volatiles + Hexane, TCL BNAs, SW846 Explosives + NG & PETN, TAL Metals, Perchlorates	*Sample existing monitoring well if it is still present on site.*
MW-COP3-3	AUS-0A12-MW-COP3-3-GW-00	Northeast corner of storage ponds	Ground water	NA	TCL Volatiles + Hexane, TCL BNAs, SW846 Explosives + NG & PETN, TAL Metals, Perchlorates	*Sample existing monitoring well if it is still present on site.*
MW-COP4-1	AUS-0A12-MW-COP4-1-GW-00	Northwest of former burning grounds	Ground water	NA	TCL Volatiles + Hexane, TCL BNAs, SW846 Explosives + NG & PETN, TAL Metals, Perchlorates	*Sample existing monitoring well if it is still present on site.*
MW-COP4-2	AUS-0A12-MW-COP4-2-GW-00	Southeast of former burning grounds	Ground water	NA	TCL Volatiles + Hexane, TCL BNAs, SW846 Explosives + NG &PETN, TAL Metals, Perchlorates	*Sample existing monitoring well if it is still present on site.*
MW-COP4-3	AUS-0A12-MW-COP4-3-GW-00	Southeast of former burning grounds	Ground water	NA	TCL Volatiles + Hexane, TCL BNAs, SW846 Explosives + NG &PETN, TAL Metals, Perchlorates	*Sample existing monitoring well if it is still present on site.*
MW-COP4-4	AUS-0A12-MW-COP4-4-GW-00	Northeast of former burning grounds	Ground water	NA	TCL Volatiles + Hexane, TCL BNAs, SW846 Explosives + NG &PETN, TAL Metals, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	*Sample existing monitoring well if it is still present on site.*

TABLE 10-6
SAMPLE LOCATIONS FOR AREA 12 – FORMER AMMONIUM NITRATE PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0A12-W01	AUS-0A12-W01-SS-0X	Just east of Old Contractor Road and west of Ponds #6 and #7	Soil Boring	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	This soil boring/monitoring well will not be drilled/installed if MW-COP3-1 is still present on site. This boring was located downgradient of most of Area 12 and upgradient of both the Nitroglycerin Area and the High SW846 Explosives Area. – possible COPCs: everything used in Area 12 below groundwater table
	AUS-0A12-W01-SS-01			1-2 ft	TCL VOLATILES	
	AUS-0A12-W01-SS-??			BWT	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives + Nitroglycerin	
	AUS-0A12-W01-GW-00		Monit. Well	NA	TCL Volatile, TCL BNAs, TAL Metals, SW846 Explosives +Nitroglycerin, Perchlorates, TDS, TSS, Nitrate+Nitrite, Sulfate, Ammonia as N, Alkalinity, Phosphorus (orthophosphate)	
0A12-W02	Magnetometer Survey	Near northeast corner of former powder storage ponds (between Pond #5 and Pond #6)	Magnet-ometer	Surface	NA	Initially a magnetometer survey will be done in this area if the tanks are not visible at the surface. The soil boring will be placed just north of the tanks. The monitoring well will not be installed if MW-COP3-3 is still present on site. If this well is still present on site, then only the soil boring will be drilled in this location. – This location is next to two buried tanks which were used for unknown purposes – there also may have been a pump located near these tanks as identified during the site reconnaissance – a sample may be collected from the liquid present inside one of the tanks, using a remote coring device – possible COPCs: unknown
	AUS-0A12-W02-SS-0X		Soil Boring	0-6 in.	TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	
	AUS-0A12-W02-SS-01			1-2 ft	TCL VOLATILES	
	AUS-0A12-W02-SS-05			4-5 ft	TCL Volatile, TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	
	AUS-0A12-W02-SS-??			BWT	TCL Volatile, TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	
	AUS-0A12-W02-TK-00			NA	TCL Volatiles, TCL BNAs, TAL Metals, SW846 Explosives	
	AUS-0A12-W02-GW-00		Monit. Well	NA	TCL Volatile, TCL BNAs, TAL Metals, SW846 Explosives, Perchlorates	

BWT = Below Water Table
COPCs = Chemicals of Potential Concern
NA = Not Applicable
Shaded samples will be collected by the UXO subcontractor.



SOURCE: USGS DIGITAL RASTER GRAPHIC

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SCALE MILES

AUS HISTORIC SEARCH REPORT CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68F0D97278.00

URS Greiner Woodward Clyde

A Division of URS Corporation

DRN. BY: djd 9/16/99 DSGN. BY: mm CHKD. BY:	Area 11 Location	FIG. NO. 10-1

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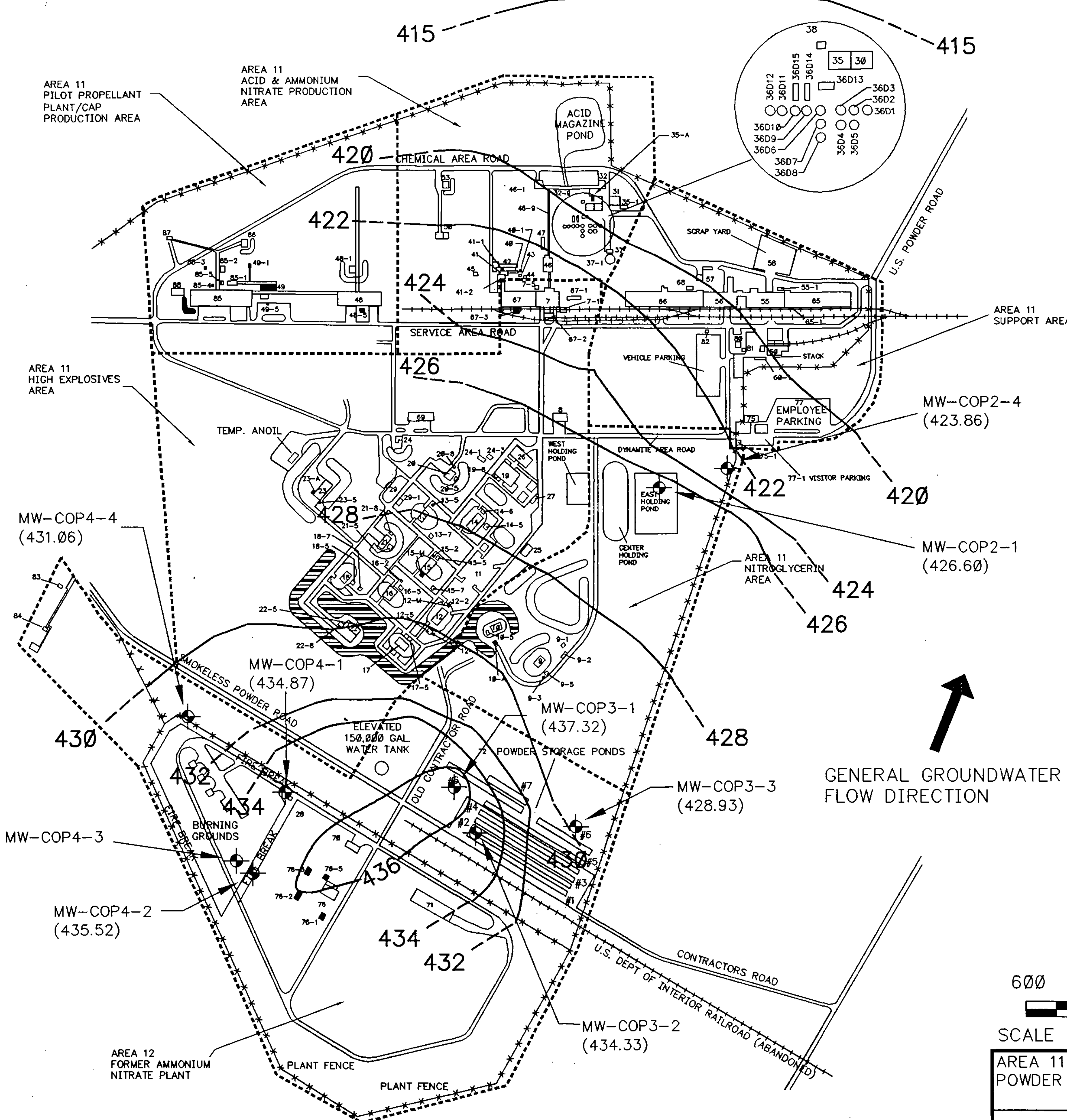
Olin Bldg.	Olin Design (1956-1964)	U.S. Powder	U.S. Powder Design (1964-[illegible])
7	Dope House	7	Dope House
7-A	Truck Shed	7-1	Truck Shed
7-E	Control House (Not Shown On Map)	7-5	Control House (New)
8	Dynamite & First Aid Office	8	Dynamite Off. & First Aid
9	Nitrator	9	Nitrator
9-A	Spent Acid	9-1	Spent Acid House
9-B	Soda House	9-2	Soda House
		9-3	Water Softener Bldg. (New)
9-E	Control House	9-5	Control House
10	N.G. Storage	10	N.G. Storage Bldg
10-A	Catch Tank		(Removed)
10-E	Control House	10-5	Control House
11	(Not Named) (Not Shown On Map)	11	Former Mix House (Not Shown On Map)
12	Mix House	12	Mix House No. 2 Eq. B Mixer
12-LS	DNT Storage (Not Shown On Map)		(Removed)
		12-3	Water Softener Bldg. (New)
12-E	Air Condition House	12-5	Control House
12-M	Motor House		(Removed)
12-P	Pump House	12-2	Storage Bldg
13	Pack House - Hall	13	Hall Pack House
13-E	Air Condition House	13-5	Control House
13-T	Toilet	13-7	Toilet
14	Pack House - Stazett	14	"LL" Pack House (Dynamite)
14-E	Air Condition House	14-5	Control House
14-M	Motor House	14-6	Storage Bldg
15	Pack House - Cil-Vibra Pack	15	Cil Vibra Pack House (Dynamite)
		15-2	Storage Bldg. (New)
15-E	Air Condition House	15-5	Control House
15-M	Motor House		(Removed)
15-T	Toilet	15-7	Toilet
16	Pack House	16	Gel Cartridge Pack House
		16-2	Storage Bldg. (New)
16-E	Air Condition House	16-5	Control House
17	Mix House - Talley	17	Talley Mix House (Dynamite)
17-E	Air Condition House	17-5	Control House
18	Pack House/NCN 4A Mix House	18	Powder Stripping House
18-E	Air Condition House	18-5	Control House
18-T	Toilet	18-7	Toilet
19	Shell House	19	Shell House
19-W	Wax House	19-8	Wax House
20	Case House No. 1	20	Case House No. 1
20-E	Electrical Control House	20-5	Control House
20-W	Wax House	20-9	Wax House
21	Case House No. 2	21	[illegible] & Storage
21-E	Electrical Control House	21-5	Control House
21-W	Wax House	21-9	Wax House
22	Case House No. 3	22	Torpex Operating/Storage Bldg.
22-E	Electrical Control House	22-5	Control House
22-W	Wax House	22-9	Wax House
23	ANOIL	23	ANOIL Mfg. Bldg.
23-A	Heated House		(Removed)
		23-5	Control House (New)
24	Dynamite Maintenance Shop	24	R&D Laboratory
24-A	Dynamite	24-1	Dynamite Maint. Shop
24-C	Parts Cleaning - Dynamite	24-3	Dynamite Parts Cleaning
25	N.G. - TNT Screening (Not Shown On Map)	25	N.G. TNT Screening (New)
26	Box Assembly	26	Box Assembly
27	Tractor House	27	Tractor House
28	Burning House	28	Burning House
		29	Loading Dock (New)
		29-1	Storage Bldg. (New)
30	Ammonia Oxidation House	30	Ammonia Oxidation Bldg
31	Cooling Tower & Control	31	Cooling Tower & Control Bldg
32	Office & Shop (Acid)	32	Acid Office & Shop
32-R	Ramp 32 to 48-A	32-9	Ramp 32 to 48-1
35	Nitric Acid Concentration	35	Nitric Acid Concentration
35-A	Switch House Sub No. #1		(Removed)
		35-1	Switch House - Sub Station #1 (New)
36-D1	Off. Site Tank	36-D1	Offsite Tank - 200 - Weak N.A.
36-D2	Off. Site Tank	36-D2	Offsite Tank - 201 - Weak N.A.
36-D3	Off. Site Tank	36-D3	Offsite Tank - 202 - Weak N.A.
36-D4	Off. Site Tank	36-D4	Offsite Tank - 203 - Weak N.A.
36-D5	Off. Site Tank	36-D5	Offsite Tank - 204 - Weak N.A.
36-D6	Off. Site Tank	36-D6	Offsite Tank - 400 - 68% Sulphuric
36-D7	Off. Site Tank	36-D7	Offsite Tank - 401 - 68% Sulphuric
36-D8	Off. Site Tank	36-D8	Offsite Tank - 402 - 68% Sulphuric
36-D9	Off. Site Tank	36-D9	Offsite Tank - 500 - Oleum Stor.
36-D10	Off. Site Tank	36-D10	Offsite Tank - 501 - Oleum Stor.
36-D11	Off. Site Tank	36-D11	Offsite Tank - 300 - Mixed Acid
36-D12	Off. Site Tank	36-D12	Offsite Tank - 301 - Mixed Acid
36-D13	Off. Site Tank	36-D13	Offsite Tank - 302 - M.A. Scale TK
36-D14	Off. Site Tank	36-D14	Offsite Tank - 303 - S.A. Circ. TK
37	Ammonia Compressor House	37	Ammonia Compressor House
37-A	Ammonia Hortonsphere	37-1	Ammonia Hortonsphere
38	Spent Acid House	38	Spent Acid House
40	Prill Tower & Wet End	40	Prill Tower Wet End
40-A	Control Bldg. (A.N.)	40-1	Control Bldg. A.N.
41	Cooling & Bagging	41	Cooling & Bagging Bldg.
41-A	A.N. Recovery Bldg	41-1	A.N. Recovery Bldg
41-B	A.N. Truck Dock	41-2	A.N. Truck Dock
42	Graining Bldg	42	Graining Bldg
43	A.N. Lab	43	A.N. Laboratory
44	Compressor House Steam	44	Compressor House (Steam)
45	A.N. Lunch Room	45	Lunch Room
46	A.N. Storage ([illegible] House)	46	A.N. Storage
46-A	A.N. Raw Material Storage	46-1	A.N. Raw Material Storage
46-R	Ramp 46 to 32-R	46-9	Ramp 46 to 32-9
47	Chemical Area Maintenance Shop	47	Chemical Area Maint. Shop
48	A.N. [illegible] Cartridge Assembly	48	Storage Bldg
	TNT Screening Building	48-1	Storage Bldg
		48-5	Electric Control House (New)
I-1-35	Maintenance Shop & Stores	49	Big Inch Cap Assembly Line
		49-1	Big Inch Screening House (New)
		49-5	Electric Control House (New)
50	(Not Named)	50	Storage Bldg
53	DYNOIL Mix House	53	Storage Bldg
55	Carpenter & Machine Shop	55	Carpenter Machine & Sht. Metal Shop
55-A	Steam Reg. For 55	55-1	Steam Regulator Station
56	Garage - Washroom - Office	56	Garage - Washroom & Office
57	Welding Shop	57	Welding Shop
58	Salvage Yard	58	Salvage yard
60	Boiler House	60	Boiler House
60-A	Boiler House Shop	60-1	Boiler House Shop
65	General Stores	65	General Stores
		65-1	Truck Scale (New)
66	Inert Stores No.1	66	Inert Stores No. 1
67	Inert Stores No.2	67	Inert Stores No. 2
67-A	Apricot Pit Storage	67-1	Apricot Pit Storage
67-B	Bag Sulphur Storage	67-2	Bag Sulphur Storage
		67-3	Bulk A.N. Loading (New)
68	Oil Stores	68	Oil Stores
69	Warehouse - Change House	69	R&D Office & Lab
70	Stores - Change House (Area 12)	70	Storage Bldg
71	Paper Stores (Area 12)	71	Warehouse & Paper Stores
	Powder Storage Ponds	72	Powder Storage Ponds
75	Administration Building	75	Administration Bldg
75-A	Guard House	75-1	Guard House
	Not known if Olin used the building	76	RDX Separation
		76-1	Air Dryer & Steam Gen. (New)
		76-2	Mixer House (RDX) (New)
		76-3	Tray Drier (RDX) (New)
		76-5	Electric Control House (New)
	Areas Shown But Not Named	77	Employee Parking
	Areas Shown But Not Named	77-1	Visitor Parking
	Areas Shown But Not Named	77-2	Vehicle Parking
80	Laboratory	80	Q.C. Laboratory
80-A	Laboratory Storage	81	Q.C. Storage
Not Listed	Component Magazine (Not Shown On Map)	82	Component Magazine
80-D	Cap Magazine	83	(Not Named)
80-E	Shooting House	84	Shooting House
I-1-17	Pilot Propellant Plant	85	Storage
I-1-18	Grain Curing Building	85-1	Dryer Bldg
	Refer to Footnote 1	85-2	Compressor Bldg.
		85-3	Storage Bldg. (New)
I-1-20	Grain Curing Building	85-4	Storage Bldg.
I-1-19	Grain Curing Building	85-5	Electric Control House
	Refer to Footnotes 1 & 2	86	Ingredient Storage for Big Inch Cap Line
	Refer to Footnote 1	87	Storage Bldg
I-1-22	Use unknown	88	Storage Bldg

Footnotes:
1. Buildings appear to have been built by Olin [illegible]
2. According to [illegible] (former Olin employee) the building was used to [illegible] at the Pilot Propellant Plant



NOTES:

1. SOURCES: U.S. POWDER COMPANY PLANT MAP REV. 1, MARCH 13, 1974
   OLIN MATHIESON CHEMICAL CORPORATION PLANT MAP LATEST REVISION MAY 29, 1963

2. U.S POWDER BUILDING NUMBERS ARE USED TO DESIGNATE ALL BUILDINGS EXCEPT FOR THOSE USED BY OLIN EXCLUSIVELY, WHICH DISPLAY OLIN BUILDING NUMBERS

3. ALL GROUNDWATER ELEVATION INFORMATION WAS OBTAINED FROM THE DRAFT FINAL RI/BRA REPORT FOR THE EMMA OU WHICH WAS SUBMITTED BY ESE, INC. IN SEPTEMBER 1994. ALL ELEVATIONS ARE MEASURED IN FEET ABOVE MEAN SEA LEVEL

LEGEND

- USED BY U.S POWDER EXCLUSIVELY
- USED BY OLIN EXCLUSIVELY
- BORDER OF URSGWC AREA DESIGNATIONS
- MONITORING WELLS
- 424 POTENTIOMETRIC CONTOUR

600 0 600

SCALE FEET

AREA 11 AND 12 SITE LAYOUT FOR U.S. POWDER AND OLIN OPERATIONS	PROJECT NO. 68FOD97278.00

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 10/6/99 DSGN. BY: jls CHKD. BY: jls	Groundwater Contour Patterns, October 1991 Crab Orchard NWR	FIG. NO. 10-2

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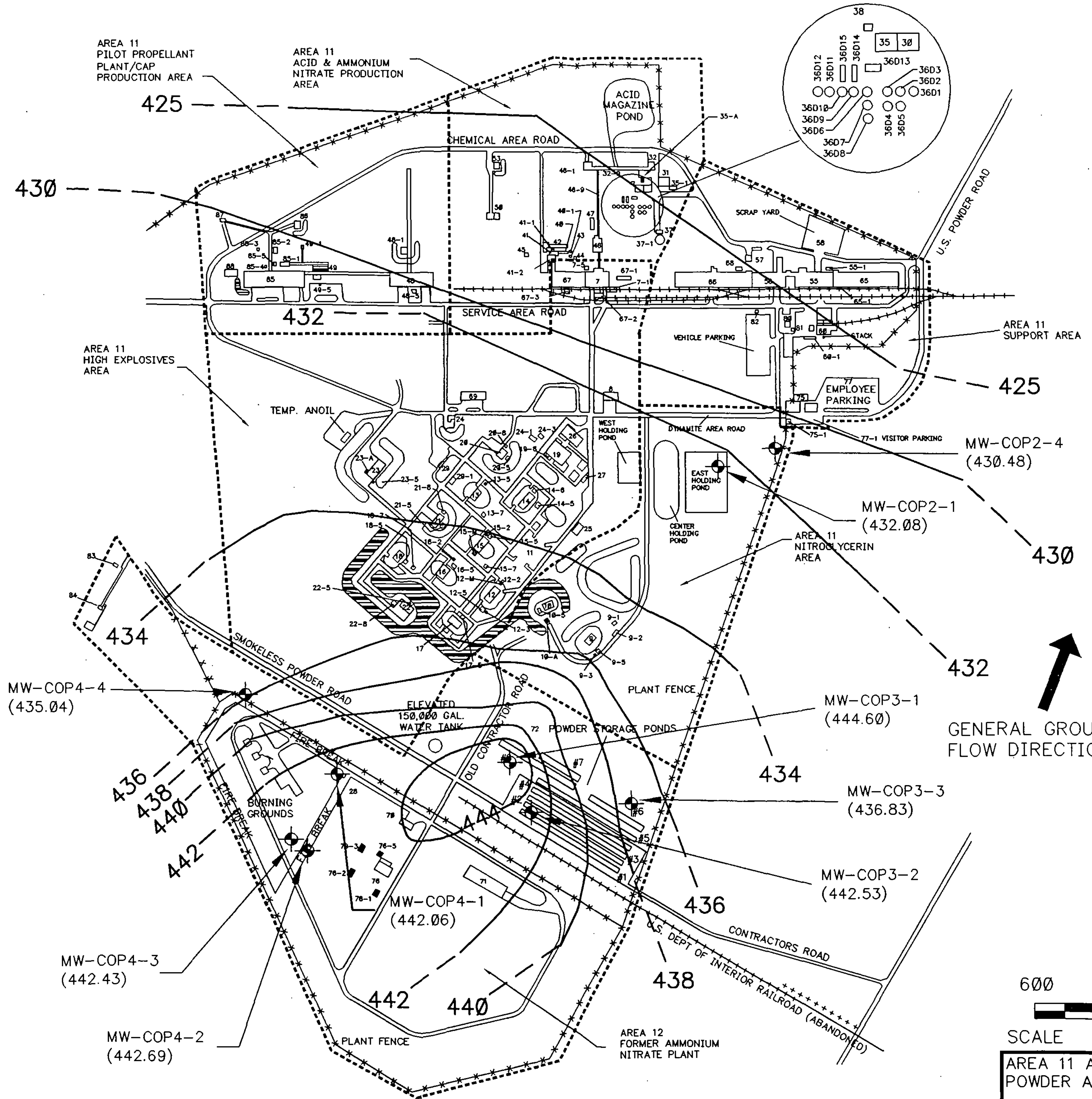
Olin Bldg	Olin Design (1955-1964)	U.S. Powder	U.S. Powder Design (1964-1982)
7	Dope House	7	Dope House
7-A	Truck Shed	7-1	Truck Shed
7-E	Control House (Not Shown On Map)	7-5	Control House (New)
8	Dynamite & First Aid Office	8	Dynamite Off. & First Aid
9	Nitrator	9	Nitrator
9-A	Spent Acid	9-1	Spent Acid House
9-B	Soda House	9-2	Soda House
		9-3	Water Softener Bldg. (New)
9-E	Control House	9-5	Control House
10	N.G. Storage	10	N.G. Storage Bldg
10-A	Catch Tank		(Removed)
10-E	Control House	10-5	Control House
11	(Not Named) (Not Shown On Map)	11	Former Mix House (Not Shown On Map)
12	Mix House	12	Mix House No. 2 (Fig. 8 Mixer)
12-S	[illegible] Station (Not Shown On Map)		(Removed)
		12-3	Water Softener Bldg (New)
12-E	Air Condition House	12-5	Control House
12-M	Motor House		(Removed)
12-P	Pump House	12-2	Storage Bldg
13	Pack House - Hall	13	Hall Pack House
13-E	Air Condition House	13-5	Control House
13-T	Toilet	13-7	Toilet
14	Pack House - Starrett	14	"LL" Pack House (Dynamite)
14-E	Air Condition House	14-5	Control House
14-M	Motor House	14-8	Storage Bldg
15	Pack House - C-I-Vibra Pack	15	C-I Vibra Pack House (Dynamite)
		15-2	Storage Bldg. (New)
15-E	Air Condition House	15-5	Control House
15-M	Motor House		(Removed)
15-T	Toilet	15-7	Toilet
16	Pack House	16	Gel Cartridge Pack House
		16-2	Storage Bldg. (New)
16-E	Air Condition House	16-5	Control House
17	Mix House - Talley	17	Talley Mix House (Dynamite)
17-E	Air Condition House	17-5	Control House
18	Pack House/MXU 4A Mix House	18	Powder Shipping House
18-E	Air Condition House	18-5	Control House
18-T	Toilet	18-7	Toilet
19	Shell House	19	Shell House
19-W	Wax House	19-8	Wax House
20	Case House No. 1	20	Case House No. 1
20-E	Electrical Control House	20-5	Control House
20-W	Wax House	20-8	Wax House
21	Case House No. 2	21	Superprime & Slurry
21-E	Electrical Control House	21-5	Control House
21-W	Wax House	21-8	Wax House
22	Case House No. 3	22	[illegible] Operation/Storage Bldg.
22-E	Electrical Control House	22-5	Control House
22-W	Wax House	22-8	Wax House
23	ANOIL	23	ANOIL Mfg. Bldg
23-A	Heated House		(Removed)
		23-5	Control House (New)
24	Dynamite Maintenance Shop	24	R&D Laboratory
24-A	Dynamite	24-1	Dynamite Maint. Shop
24-B	Parts Cleaning - Dynamite	24-3	Dynamite Parts Cleaning
25	N.C. TNT Screening (Not Shown On Map)	25	N.C. TNT Screening (New)
26	Box Assembly	26	Box Assembly
27	Tractor House	27	Tractor House
28	Burning House	28	Burning House
		29	Loading Dock (New)
		29-1	Storage Bldg. (New)
30	Ammonia Oxidation House	30	Ammonia Oxidation Bldg
31	Cooling Tower & Control	31	Cooling Tower & Control Bldg.
32	Office & Shop (Acid)	32	Acid Office & Shop
32-R	Ramp 32 to 49-A	32-9	Ramp 32 to 49-1
35	Nitric Acid Concentration	35	Nitric Acid Concentration
35-A	Switch House Sub No. #1		(Removed)
		35-1	Switch House - Sub Station #1 (New)
36-D1	Off Site Tank	36-D1	Offsite Tank - 200 - Weak N.A.
36-D2	Off Site Tank	36-D2	Offsite Tank - 201 - Weak N.A.
36-D3	Off Site Tank	36-D3	Offsite Tank - 202 - Weak N.A.
36-D4	Off Site Tank	36-D4	Offsite Tank - 203 - Weak N.A.
36-D5	Off Site Tank	36-D5	Offsite Tank - 204 - Weak N.A.
36-D6	Off Site Tank	36-D6	Offsite Tank - 400 - 68% Sulphuric
36-D7	Off Site Tank	36-D7	Offsite Tank - 401 - 68% Sulphuric
36-D8	Off Site Tank	36-D8	Offsite Tank - 402 - 68% Sulphuric
36-D9	Off Site Tank	36-D9	Offsite Tank - 500 - Oleum Stor.
36-D10	Off Site Tank	36-D10	Offsite Tank - 501 - Oleum Stor.
36-D11	Off Site Tank	36-D11	Offsite Tank - 300 - Mixed Acid
36-D12	Off Site Tank	36-D12	Offsite Tank - 301 - Mixed Acid
36-D13	Off Site Tank	36-D13	Offsite Tank - 302 - M.A. Scale TK
36-D14	Off Site Tank	36-D14	Offsite Tank - 303 - S.A. Circ. TK
37	Ammonia Compressor House	37	Ammonia Compressor House
37-A	Ammonia Hortonsphere	37-1	Ammonia Hortonsphere
38	Spent Acid House	38	Spent Acid House
40	Prill Tower & Wet End	40	Prill Tower Wet End
40-A	Control Bldg. (A.N.)	40-1	Control Bldg. A.N.
41	Cooling & Bagging	41	Cooling & Bagging Bldg.
41-A	A.N. Recovery Bldg.	41-1	A.N. Recovery Bldg
41-B	A.N. Truck Dock	41-2	A.N. Truck Dock
42	Graining Bldg.	42	Graining Bldg
43	A.N. Lab	43	A.N. Laboratory
44	Compressor House Steam	44	Compressor House (Steam)
45	A.N. Lunch Room	45	Lunch Room
46	A.N. Storage (Halfway House)	46	A.N. Storage
46-A	A.N. Raw Material Storage	46-1	A.N. Raw Material Storage
46-R	Ramp 46 to 32-R	46-9	Ramp 46 to 32-9
47	Chemical Area Maintenance Shop	47	Chemical Area Maint. Shop
48	A.N. [illegible] Slider Cartridge Assembly	48	Storage Bldg.
	TNT Screening Building	48-1	Storage Bldg.
		48-5	Electric Control House (New)
1-1-55	Maintenance Shop & Stores	49	Big Inch Cap Assembly Line
		49-1	Big Inch Screening House (New)
		49-5	Electric Control House (New)
50	(Not Named)	50	Storage Bldg
53	DYNOIL Mix House	53	Storage Bldg
55	Carpenter & Machine Shop	55	Carpenter Machine & Sht Metal Shop
55-A	Steam Reg. For 55	55-1	Steam Regulator Station
56	Garage - Washroom - Office	56	Garage - Washroom & Office
57	Welding Shop	57	Welding Shop
58	Salvage Yard	58	Salvage Yard
60	Boiler House	60	Boiler House
60-A	Boiler House Shop	60-1	Boiler House Shop
65	General Stores	65	General Stores
		65-1	Track Scale (New)
66	Inert Stores No. 1	66	Inert Stores No. 1
67	Inert Stores No. 2	67	Inert Stores No. 2
67-A	Apricot Pit Storage	67-1	Apricot Pit Storage
67-B	Bag Sulphur Storage	67-2	Bag Sulphur Storage
		67-3	Bulk A.N. Loading (New)
68	Oil Stores	68	Oil Stores
69	Warehouse - Change House	69	R&D Office & Lab
70	Stores - Change House (Area 12)	70	Storage Bldg.
71	Paper Stores (Area 12)	71	Warehouse & Paper Stores
	Powder Storage Ponds	72	Powder Storage Ponds
75	Administration Building	75	Administration Bldg
75-A	Guard House	75-1	Guard House
	Not known if Olin used the building	76	RDX Separation
		76-1	Air Dryer & Steam Gen. (New)
		76-2	Mixer House (RDX) (New)
		76-3	Tray Driers (RDX) (New)
		76-5	Electric Control House (New)
	Areas Shown But Not Named	77	Employee Parking
	Areas Shown But Not Named	77-1	Visitor Parking
	Areas Shown But Not Named	77-2	Vehicle Parking
90	Laboratory	80	Q.C. Laboratory
90-A	Laboratory Storage	81	Q.C. Storage
[illegible]	Component Magazine (Not Shown On Map)	82	Component Magazine
90-D	Cap Magazine	83	(Not Named)
90-E	Shooting House	84	Shooting House
I-1-17	Pilot Propellant Plant	85	Storage
I-1-18	Grain Curing Building	85-1	Dryer Bldg.
	Refer to Footnote 1	85-2	Compressor Bldg.
		85-3	Storage Bldg. (New)
I-1-20	Grain Curing Building	85-4	Storage Bldg.
I-1-19	Grain Curing Building	85-5	Electric Control House
	Refer to Footnotes 1 & 2	86	Ingredient Storage for Big Inch Cap Line
	Refer to Footnote 1	87	Storage Bldg
I-1-22	Use unknown	88	Storage Bldg

Footnotes:
1. [illegible]
2. [illegible]



NOTES:

1. SOURCES: U.S. POWDER COMPANY PLANT MAP REV. 1, MARCH 13, 1974
   OLIN MATHIESON CHEMICAL CORPORATION
   PLANT MAP LATEST REVISION MAY 29, 1963
2. U.S POWDER BUILDING NUMBERS ARE USED TO DESIGNATE ALL BUILDINGS EXCEPT FOR THOSE USED BY OLIN EXCLUSIVELY, WHICH DISPLAY OLIN BUILDING NUMBERS
3. ALL GROUNDWATER ELEVATION INFORMATION WAS OBTAINED FROM THE DRAFT FINAL RI/BRA REPORT FOR THE EMMA OU WHICH WAS SUBMITTED BY ESE, INC. IN SEPTEMBER 1994. ALL ELEVATIONS ARE MEASURED IN FEET ABOVE MEAN SEA LEVEL

LEGEND

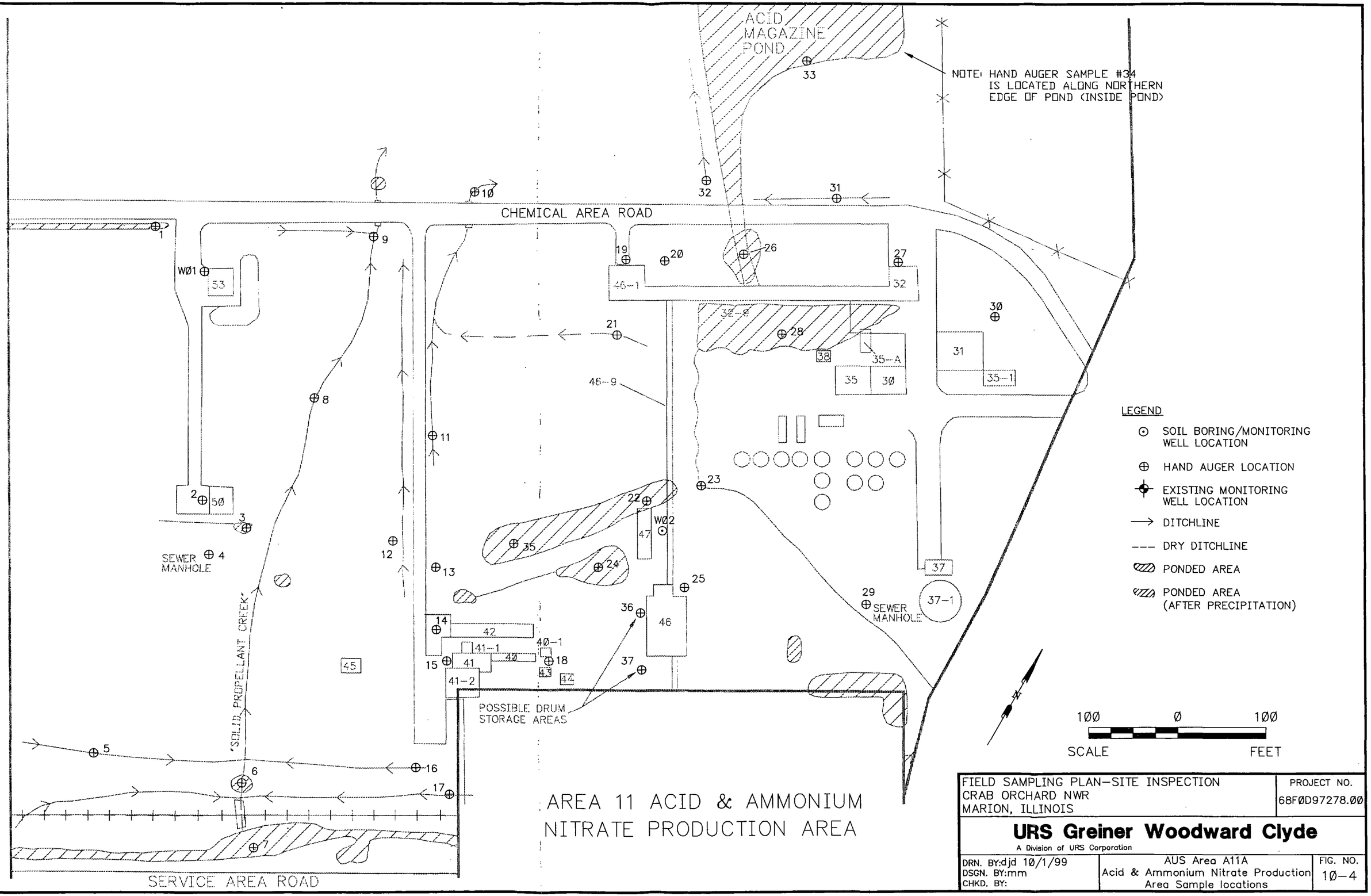
- USED BY U.S POWDER EXCLUSIVELY
- USED BY OLIN EXCLUSIVELY
- BORDER OF URSGWC AREA DESIGNATIONS
- MONITORING WELLS
- 424 POTENTIOMETRIC CONTOUR

AREA 11 AND 12 SITE LAYOUT FOR U.S. POWDER AND OLIN OPERATIONS	PROJECT NO. 68FOD97278.00

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 10/6/99 DSGN. BY: jls CHKD. BY: jls	Groundwater Contour Patterns, July 1993 Crab Orchard NWR	FIG. NO. 10-3

File: G:\68FOD9727800\FWSAUS\CRAB10-3A.DWG Last edited: 02/14/00 @ 1:12 p.m. @ WCC-ST.LOUIS



FIELD SAMPLING PLAN–SITE INSPECTION CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68F0D97278.00
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY:djd 10/1/99 DSGN. BY:mm CHKD. BY:	AUS Area A11A Acid & Ammonium Nitrate Production Area Sample locations
	FIG. NO. 10–4

File: F:\68F0D9727800\11AANFIG10-4.DWG Last edited: 02/24/00 @ 2:24 p.m. @ WCC-ST.LOUIS

SDMS US EPA Region V

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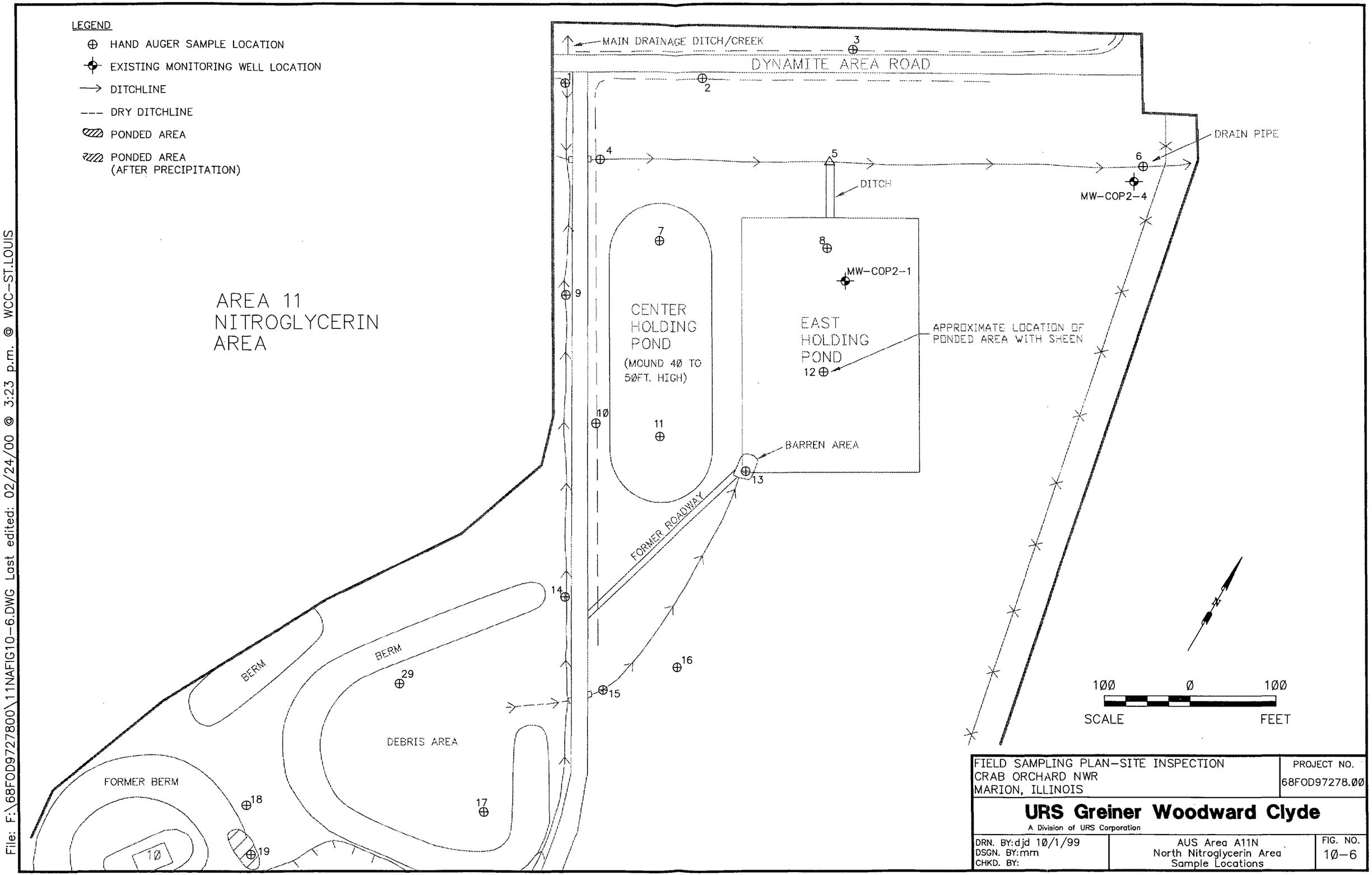
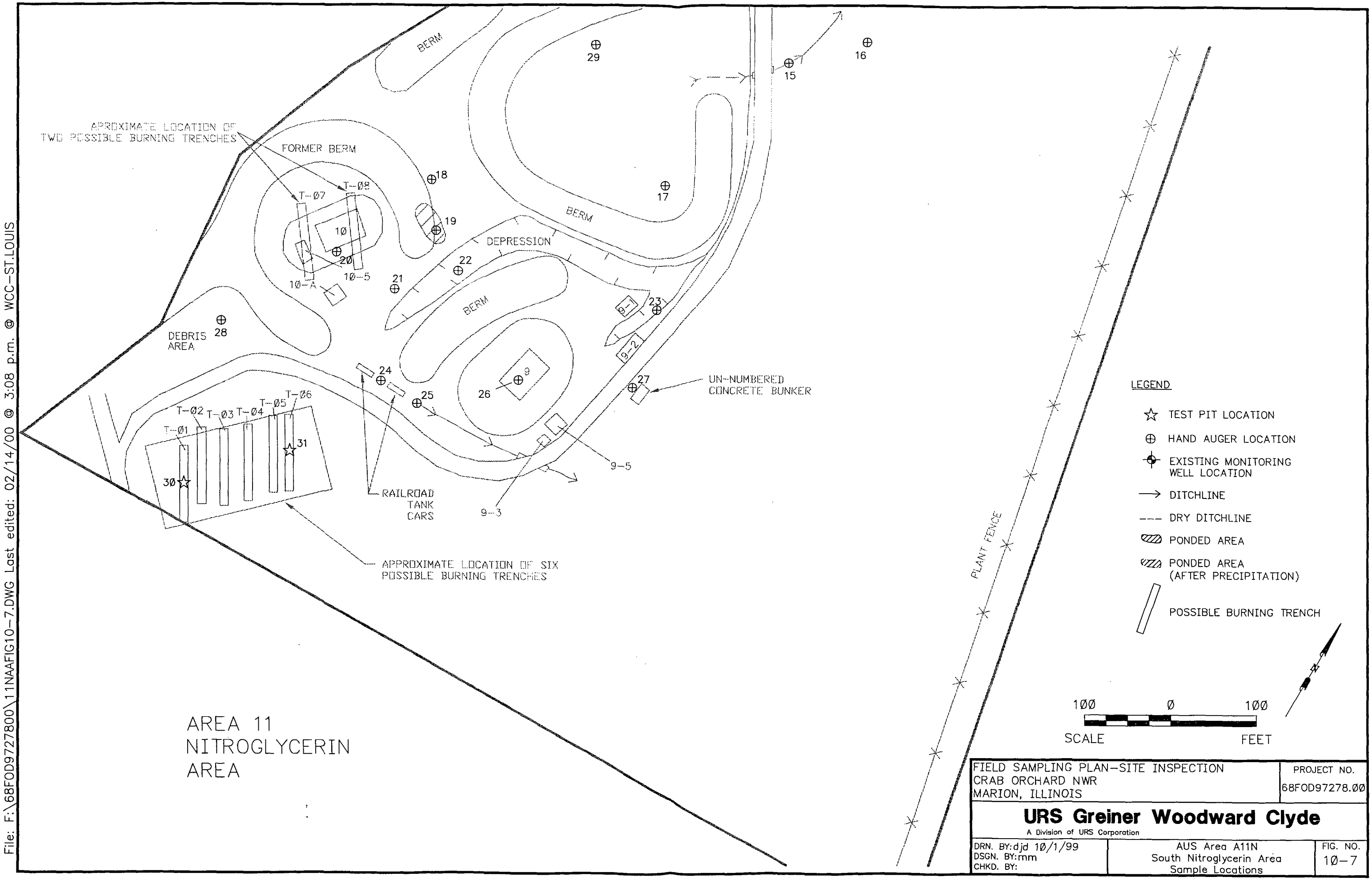
AUS Area A11H – High Explosives Area Sample Locations

☐ **Other:**



File: F:\68FOD9727800\11NAFIG10-6.DWG Last edited: 02/24/00 @ 3:23 p.m. @ WCC-ST.LOUIS



FIELD SAMPLING PLAN–SITE INSPECTION CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

URS Greiner Woodward Clyde
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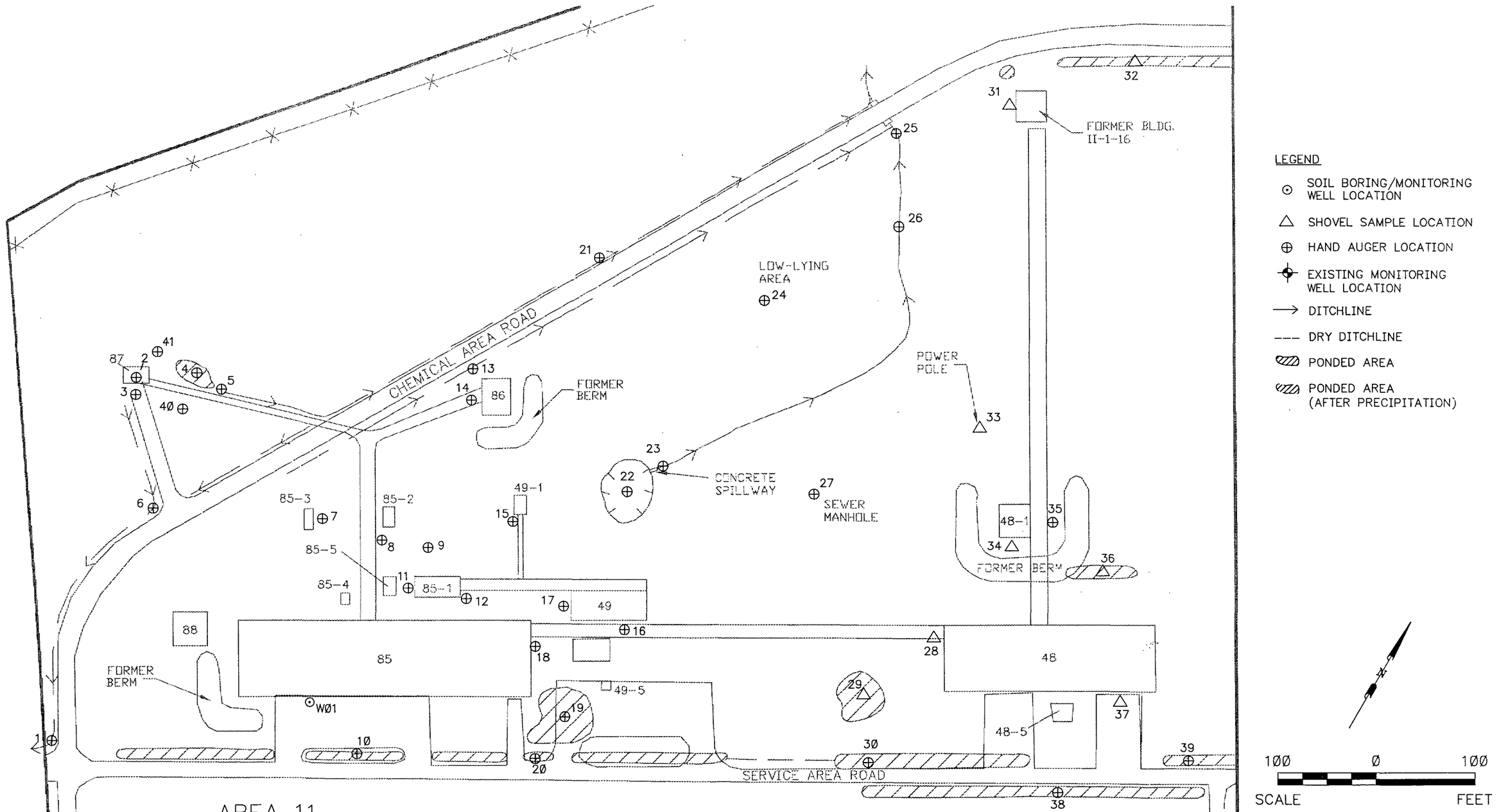
DRN. BY: djd 1Ø/1/99 DSGN. BY: mm CHKD. BY:	AUS Area A11N South Nitroglycerin Area Sample Locations	FIG. NO. 1Ø–7

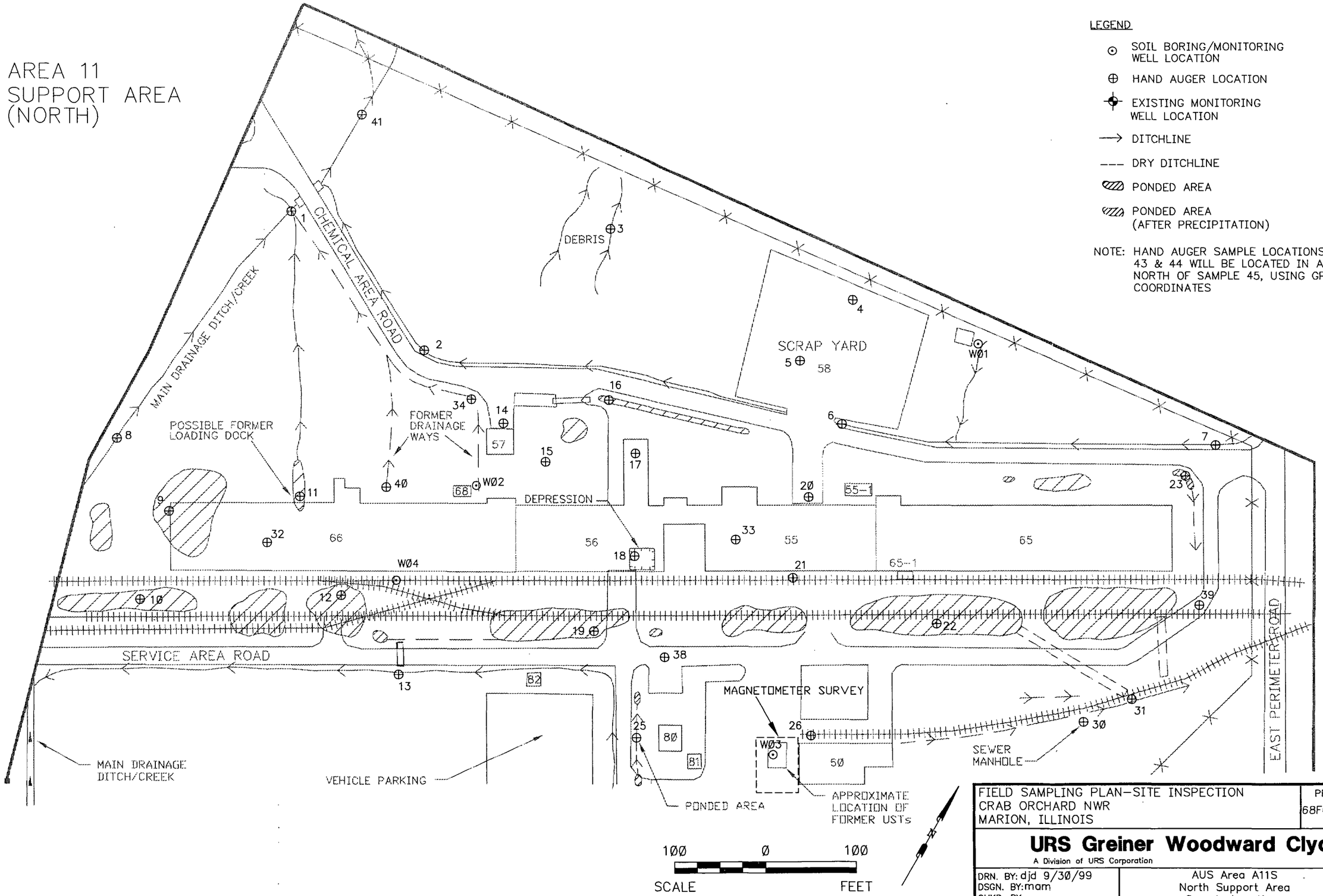
File: F:\68FOD9727800\11NAAFIG10-7.DWG Last edited: 02/14/00 @ 3:08 p.m. @ WCC-ST.LOUIS



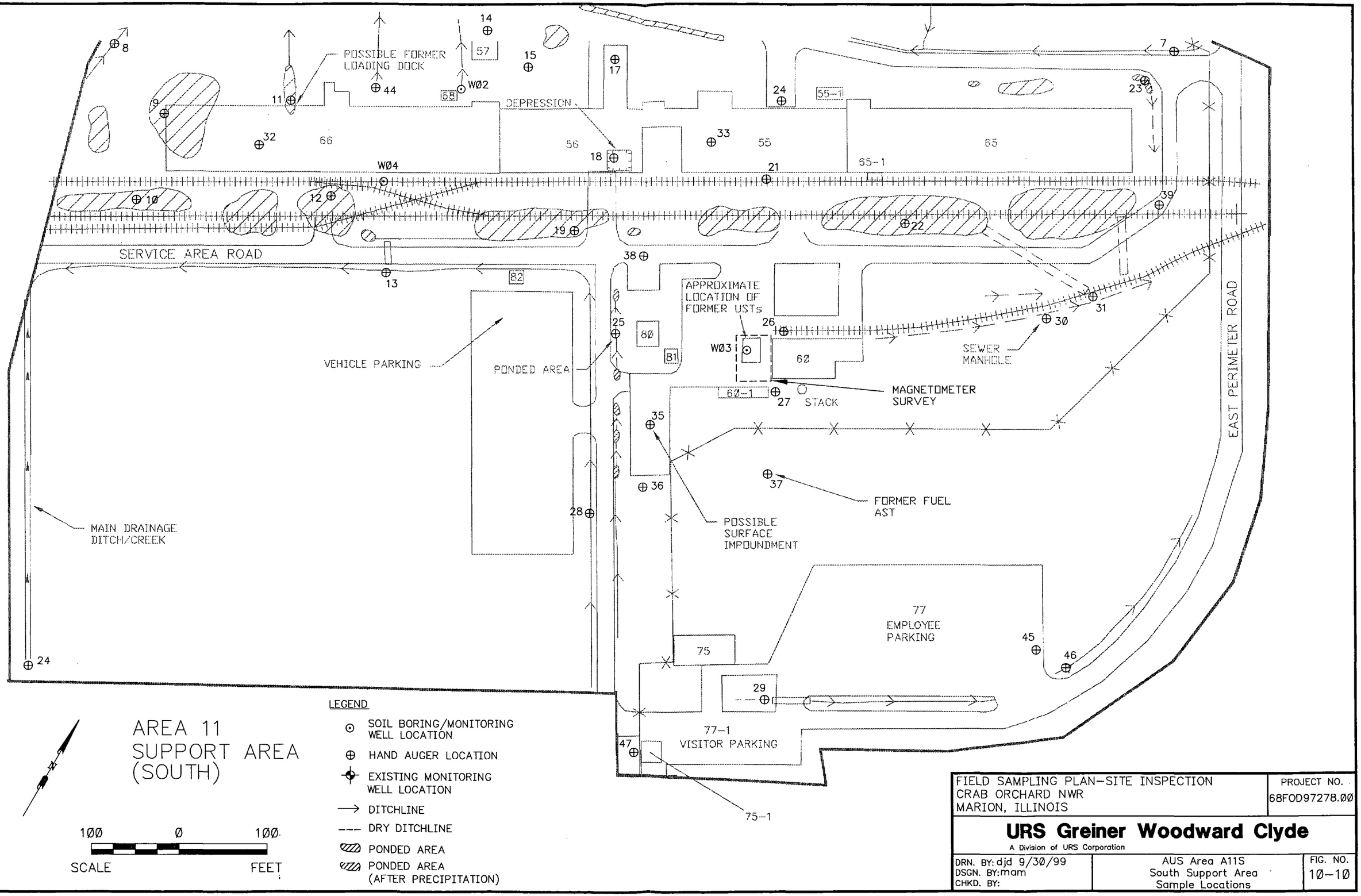
AREA 11
PILOT PROPELLANT
PLANT/CAP
PRODUCTION AREA

FIELD SAMPLING PLAN-SITE INSPECTION CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68F0D97278.00
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 9/30/99 DSGN. BY: mm CHKD. BY:	AUS Area A11P Pilot Propellant Plant/Cap Production Area Sample Locations
	FIG. NO. 10-8

File: F:\68F0D9727800\11PPFIG10-8.DWG Last edited: 02/24/00 @ 3:20 p.m. @ WCC-ST.LOUIS



File: F:\68FOD9727800\11SSAFIG10-9.DWG Last edited: 02/24/00 @ 2:33 p.m. @ WCC-ST.LOUIS



FIELD SAMPLING PLAN–SITE INSPECTION
CRAB ORCHARD NWR
MARION, ILLINOIS

PROJECT NO. 68FOD97278.00

URS Greiner Woodward Clyde
A Division of URS Corporation

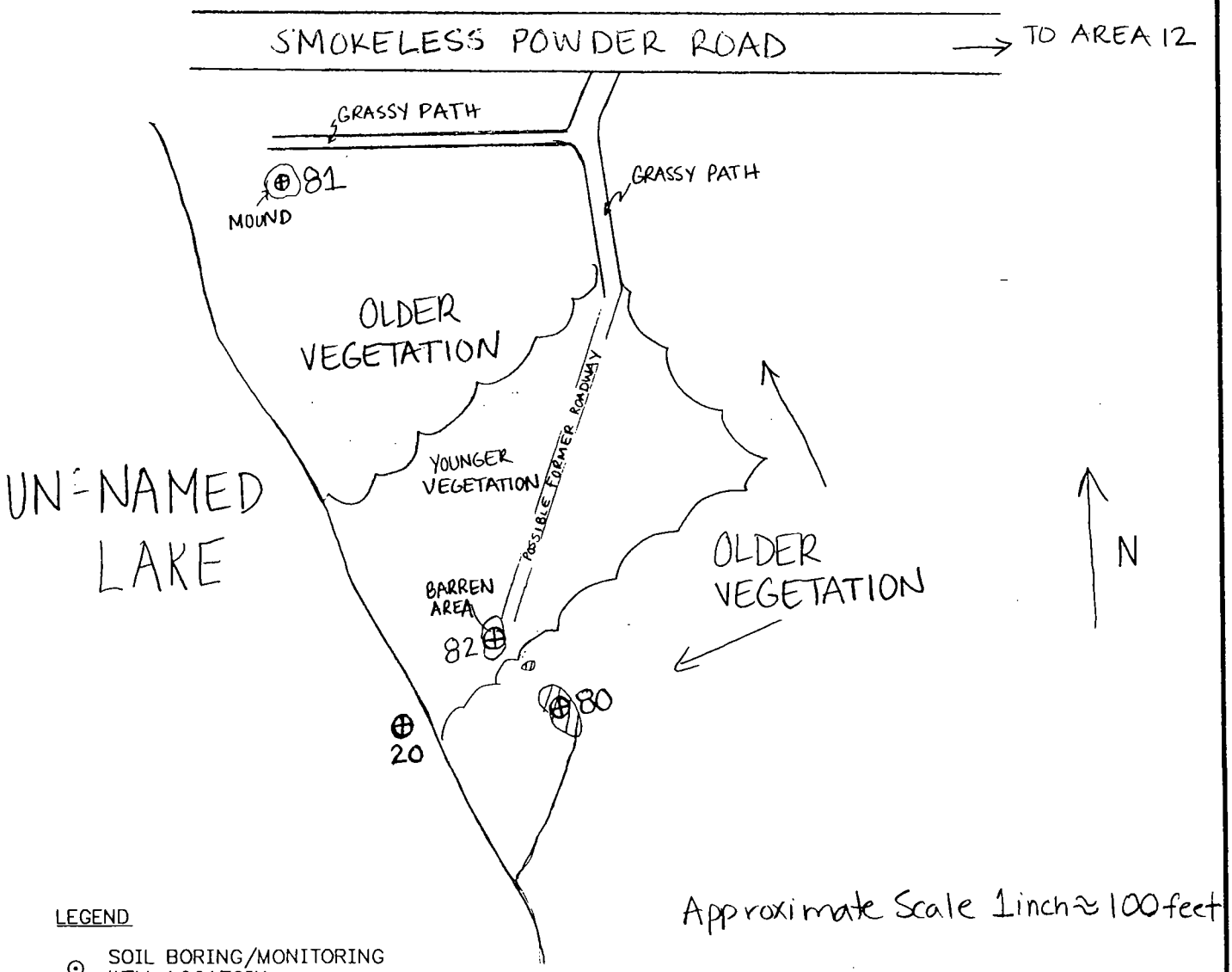
DRN. BY: djd 9/30/99
DSGN. BY: mam
CHKD. BY:

AUS Area A11S
South Support Area
Sample Locations

FIG. NO. 10–10

File: F:\68FOD9727800\11SSFIG10-10.DWG Last edited: 02/24/00 @ 3:12 p.m. @ WCC-ST.LOUIS

NOTE: Test pit location #18 will be located in the field at the former trench location.



Approximate Scale 1 inch ≈ 100 feet

LEGEND

- ⊙ SOIL BORING/MONITORING WELL LOCATOIN
- ⊕ HAND AUGER LOCATION
- EXISTING MONITORING WELL LOCATION
- → DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

FIELD SAMPLING PLAN–SITE INSPECTION CRAB ORCHARD NATIONAL WILDLIFE REFUGE MARION, ILLINOIS	PROJECT NO. 68F0D97278.00
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 9/30/99 DSGN. BY: mam CHKD. BY:	AUS Area A12 Area West of Area 12 Sample Locations
	FIG. NO. 10–12

11.1 AUS-0A13 – IOP FINISHED AMMUNITION IGLOOS

Site Location and Boundaries

The location of Area 13 is shown on Figure 2-1.The site is located west of Highway 148 and west of the intersection of Ogden Road and Wolf Creek Road. To get to the site travel west on Ogden road from Highway 148 for 2.1 miles. This road leads to Area 13. The site is bound on all sides by woodlands.

Site History

The site was formerly a group of storage magazines for finished ammunition. Since World War II the igloos have been used by various manufacturers to store their raw materials and products. A large number of the igloos have been leased by ordnance manufacturers for their safe storage needs. Each igloo has a truck loading dock for material transfers. In addition, one row of igloos had an additional dock adjacent to the railroad line running through the site.

Sampling Information Specific to Area 13

Because of the large amounts of explosives and other materials stored in the igloos spills in the igloos and on the docks are likely. Sampling at randomly selected igloos will provide a good overall picture of the likelihood of contamination at any of the loading dock areas. Samples will be taken in the soils directly beneath the loading areas in front of the igloo doorways. Sampling in this manner will be more likely to identify loading docks affected by spills. Therefore the igloo loading docks in Area 13 were numbered from 1 to 102 (including the east and west railroad loading docks) and 31 random numbers were chosen using a random number generator (30% sampling rate). The random numbers chosen are shown on Table 11-1. Igloos represented by those random numbers will have their loading docks sampled according to the sample outlines in Table 11-2. The loading docks to be sampled are circled on Figure 11-1.

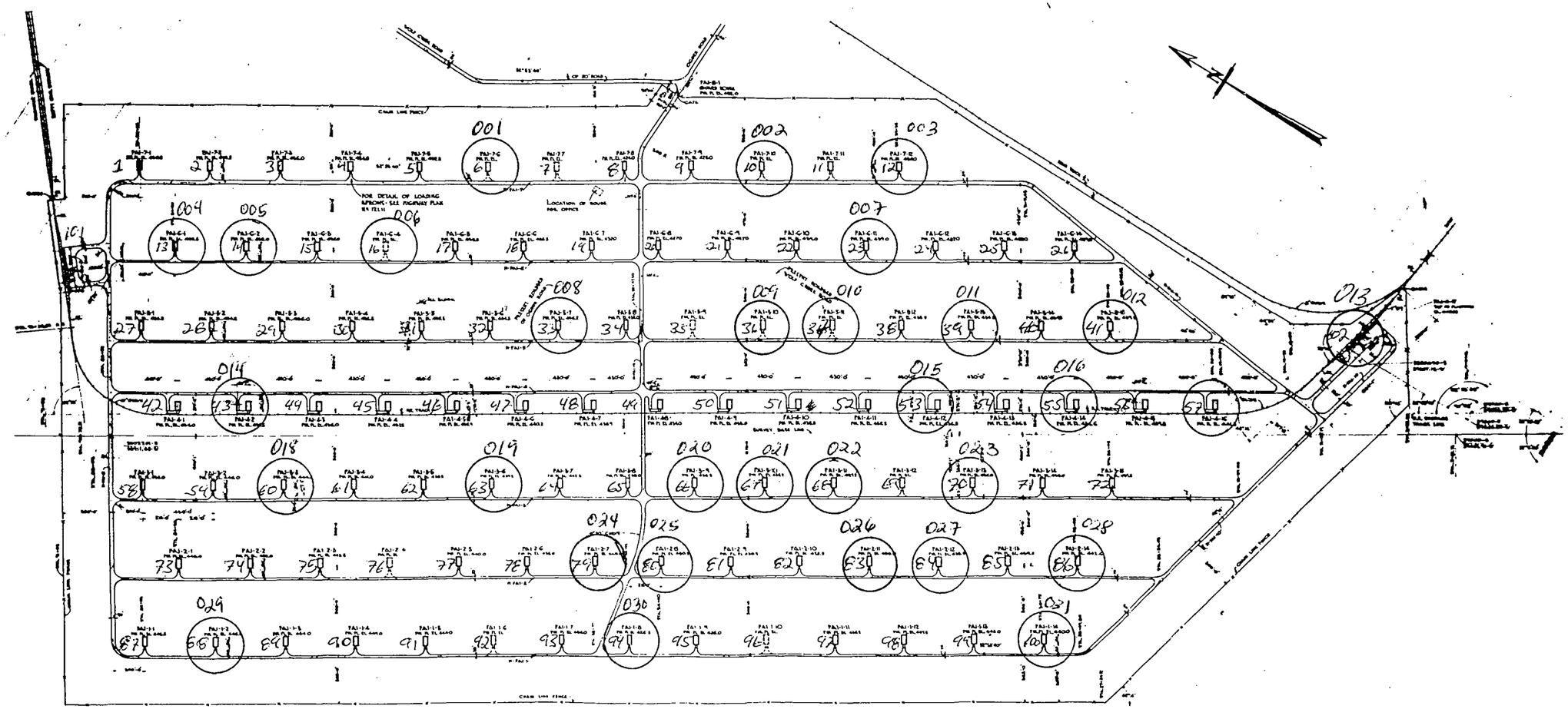
TABLE 11-1
RANDOMLY GENERATED AREA 13 IGLOOS TO BE SAMPLED

Sample Number	Igloo Number
1	12
2	86
3	10
4	13
5	88
6	80
7	84
8	102
9	57
10	16
11	23
12	63
13	53
14	6
15	14
16	67
17	39
18	33
19	66
20	60
21	55
22	68
23	70
24	37
25	94
26	43
27	100
28	79
29	41
30	36
31	83

TABLE 11-2
SAMPLE ANALYSES FOR AUS 0A13 – IOP FINISHED AMMUNITION IGLOOS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
A13-001 Through A13-031	AUS-0A13-001-SS-0X through AUS-0A13-031-SS-0X	Loading dock area of the Igloo number chosen by random number generator	Shovel sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives + Nitroglycerin (8330)	Samples taken by O'brien & Gere in 1988 showed elevated levels of BNAs, explosive (RDX), and metals at one loading dock. All Igloos loading docks have an equal probability of having some contamination. Thirty percent of the loading docks will be selected randomly and sampled for the listed analysis.

Note: Sample at igloo number 66 will have a TOC sample at that location.
This sample will be labeled 0A013-020.



750 0 750

SCALE FEET

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.00

URS Greiner Woodward Clyde

A Division of URS Corporation

DRN. BY: djd 11/2/99 DSGN. BY: mh CHKD. BY:	Area 13 Sample Locations	FIG. NO. 11–1

12.1 AUS-0062 to AUS-0069 and AUS-0109 COC AREA SITES

Site Location and Boundaries

The locations of the AUS sites in the Crab Orchard Cemetery (COC) area are shown on Figure 2-1. The COC area is located in an area south of Crab Orchard Lake near Hampton Cemetery. To get to the sites you must go south on Wolf Creek Road across the causeway. Site AUS-0069 is located to the east of Wolf Creek Road north of the first road past the causeway. And the rest of the sites are to the west of Wolf Creek Road on the first road past the causeway. The sites are all in remote areas. Some of the sites are near the Lake (AUS-0069 and AUS-0066) while others border open fields or woodlands.

Site History

The original COC sites were identified as having been impacted by ordnance disposal activities in a 1998 UXO investigation by Parsons Engineering. The AUS sites in the COC Area consist of dumpsites identified by Parsons, and other sites which because of their location may be connected to ordnance disposal activities.

Ordnance scrap was identified on all of the COC sites that are part of this investigation except for AUS-0066 and AUS-0109. AUS-0066 was not investigated during Parsons' 1998 UXO investigation. AUS-0109 is a previously unidentified site. AUS-0109 was identified by aerial photo interpretations as resembling other ordnance disposal sites previously identified and characterized at the site.

UXO removal activities have occurred at some sites in the COC area and are a real concern at all COC area sites. No investigation into chemical contamination in the COC area has been performed.

Sample locations and sample descriptions for each of the AUS sites in the COC area are in the figures and tables identified below.

AUS Site Number	Sample Location Figure Number	Sample Summary Table Number
AUS-0062	Figure 12-1	Table 12-1
AUS-0063	Figure 12-2	Table 12-2
AUS-0065	Figure 12-3	Table 12-3
AUS-0066	Figure 12-4	Table 12-4
AUS-0067	Figure 12-5	Table 12-5
AUS-0069	Figure 12-6	Table 12-6
AUS-0109	Figure 2-1	Table 12-7

The remaining sites are not in close proximity to or share similar functions with any of the other areas of IOP. All of these sites are shown on Figure 2-1 in various areas of the Refuge. Each of the AUS sites is described below.

TABLE 12-1
SAMPLE LOCATIONS FOR AUS 0062 – COC 11
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0062-001	AUS-0062-001-SS-0X	Soil pile on the south east side of the site	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Soil pile is not a normal feature and may have resulted from either UXO investigation or dumping.
	AUS-0062-001-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0062-001-SS-04			3-4ft.	TAL Metals (6010/7000) SW846 Explosives (8330) TCL Volatiles (8260B)	
0062-002	AUS-0062-002-SS-0X	Eastern side of grassy area just south of site drainage	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This is the area of the UXO investigation and previous sampling had Metals results above SSLs.
	AUS-0062-002-SS-02			1-2 ft	TCL Volatiles (8260B)	
0062-003	AUS-0062-003-SS-0X	Western side of grassy area just south of site drainage	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This is the area of the UXO investigation and previous sampling had Metals results above SSLs.
	AUS-0062-003-SS-02			1-2 ft	TCL Volatiles (8260B)	
0062-004	AUS-0062-004-SW-00	Western end of drainage ditch running through the site	Surface water	NA	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from the entire site.
	AUS-0062-004-SD-0X		Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	
0062-005	AUS-0062-005-SD-0X	Pit located on the southeast side of the site with ponding.	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Pit is an unnatural feature which is holding water and may have resulted from either UXO investigation or dumping.
0062-006	AUS-0062-006-SS-0X	East side of site near culvert in soils beneath decayed drum	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Abandoned drum is decayed and laying on ground. Original contents of drum are unknown.
	AUS-0062-006-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 12-1
SAMPLE LOCATIONS FOR AUS 0062 – COC 11
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0062-007	AUS-0062-007-SW-00	Eastern end of drainage ditch running through the site in ponded area	Surface water	NA	TAL Metals (6010/7000) SW846 Explosives (8330) TCL Volatiles (8260B)	Drainage ditch at the site ponds at this point. Contaminants entering the drainage ditch upstream of this point are likely to settle out at this point.
	AUS-0062-007-SD-0X		Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	
0062-008	AUS-0062-008-Sd-0X	Soil pile on the northwest side of the site near the abandoned road	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Soil pile is not a normal feature and may have resulted from either UXO investigation or dumping.
	AUS-0062-008-SD-02			1-2 ft	TCL Volatiles (8260B)	
				3-4 ft.	TAL Metals (6010/7000) SW846 Explosives (8330) TCL Volatiles (8260B)	

TABLE 12-2
SAMPLE LOCATIONS FOR AUS 0063 – COC 12
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0063-001	AUS-0063-001-SS-0X	South of fenced area designated as COC-12	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	EPA samples in nearby creek contained elevated levels of some Metals and site was found to contain ordnance scrap during UXO investigation.
0063-002	AUS-0063-002-SS-0X	Inside fenced area designated as COC-12	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	EPA samples in nearby creek contained elevated levels of some Metals and site was found to contain ordnance scrap during UXO investigation. Fenced area may be a source of contamination,
	AUS-0063-002-SS-02			1-2 ft.	TAL Metals (6010/7000) SW846 Explosives (8330)	
0063-003	AUS-0063-003-SD-0X	Drainage ditch on north side of the site adjacent to abandoned road near culvert	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from the entire site.
0063-004	AUS-0063-004-SD-0X	Drainage ditch on north side of the site	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from the entire site.
0063-005	AUS-0063-005-SD-0X	Drainage ditch north of the site 200' east of location number 003	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from the entire site.
0063-006	AUS-0063-006-SS-0X	North of fenced area designated as COC-12 600 north of fence	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	EPA samples in nearby creek contained elevated levels of some Metals and site was found to contain ordnance scrap during UXO investigation. Fenced area may be a source of contamination,
	AUS-0063-006-SS-02			1-2 ft.	TAL Metals (6010/7000) SW846 Explosives (8330)	
0063-007	AUS-0063-007-SS-0X	North of fenced area designated as COC-12 400 north of fence	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	EPA samples in nearby creek contained elevated levels of some Metals and site was found to contain ordnance scrap during UXO investigation. Fenced area may be a source of contamination,
0063-008	AUS-0063-008-SL-0X	North of fenced area designated as COC-12 200 north of fence	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	EPA samples in nearby creek contained elevated levels of some Metals and site was found to contain ordnance scrap during UXO investigation. Fenced area may be a source of contamination,

TABLE 12-3
SAMPLE LOCATIONS FOR AUS 0065 – FOUNDATIONS NORTHEAST OF COC-1
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0065-001	AUS-0065-001-SS-0X	Depression furthest to the north at the site containing a large concrete pad	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Depression is an unnatural feature in the area possibly created by ordnance disposal activities. EPA samples at the site contained elevated levels of BNAs and Metals.
0065-002	AUS-0065-002-SS-0X	Depression furthest to the west at the site in the area of the construction debris	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TOC (9060)	Depression is an unnatural feature in the area possibly created by ordnance disposal activities. EPA samples at the site contained elevated levels of BNAs and Metals.
0065-003	AUS-0065-003-SS-0X	Depression furthest to the east inside of the crumbling foundation	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Depression is an unnatural feature in the area possibly created by ordnance disposal activities. EPA samples at the site contained elevated levels of BNAs and Metals.
0065-004	AUS-0065-004-SS-0X	Large mound of soil just south of the eastern foundation	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Mounds of dirt are unnatural features and may have been affected by industrial operations at the refuge.
	AUS-0065-004-SS-04			3-4 ft.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	
0065-005	AUS-0065-005-SS-0X	Depression furthest to the north at the site containing a large concrete pad	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Depression is an unnatural feature in the area possibly created by ordnance disposal activities. EPA samples at the site contained elevated levels of BNAs and Metals.
0065-006	AUS-0065-006-SS-0X	Depression furthest to the west at the site in the area of the construction debris	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Depression is an unnatural feature in the area possibly created by ordnance disposal activities. EPA samples at the site contained elevated levels of BNAs and Metals.

TABLE 12-3
SAMPLE LOCATIONS FOR AUS 0065 – FOUNDATIONS NORTHEAST OF COC-1
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0065-007	AUS-0065-007-SS-0X	Depression furthest to the east inside of the crumbling foundation	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Depression is an unnatural feature in the area possibly created by ordnance disposal activities. EPA samples at the site contained elevated levels of BNAs and Metals.
0065-008	AUS-0065-008-SS-0X	Mound of soil in the middle of depressions.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Mounds of dirt are unnatural features and may have been affected by industrial operations at the refuge.
	AUS-0065-008-SS-03			2-3 ft.	TAL Metals (6010/7000) TCL BNAs (8270c)	
0065-009	AUS-0065-009-SS-0X	Mound of soil in the middle of depressions.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Mounds of dirt are unnatural features and may have been affected by industrial operations at the refuge.
	AUS-0065-009-SS-03			2-3 ft.	TAL Metals (6010/7000) TCL BNAs (8270c)	

TABLE 12-4
SAMPLE LOCATIONS FOR AUS 0066
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0066-001	AUS-0066-001-SS-0X	On hillside north of contaminated area sign half way between fence and the creek	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	The contaminated area sign indicates that prior dumping in this area may have occurred. The creek has a reddish tint indicating the possibility of contamination.
	AUS-0066-001-SS-02			1-2 ft.	TCL Volatiles (8260B) SW846 Explosives (8330)	
	AUS-0066-001-SS-04			3-4 ft.	SW846 Explosives (8330)	
0066-002	AUS-0066-002-SS-0X	On the hillside northeast of the contaminated area sign half way between fence and the creek	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	The contaminated area sign indicates that prior dumping in this area may have occurred. The creek has a reddish tint indicating the possibility of contamination.
	AUS-0066-002-SS-02			1-2 ft.	TCL Volatiles (8260B) SW846 Explosives (8330)	
	AUS-0066-002-SS-04			3-4 ft.	SW846 Explosives (8330)	
0066-003	AUS-0066-003-SD-0X	In the center of the creek half way from the abandoned road to the lake	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	The contaminated area sign indicates that prior dumping in this area may have occurred. The creek has a reddish tint indicating the possibility of contamination.
	AUS-0066-003-SW-00		Surface water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B) Ammonia as N; Nitrate + Nitrites; Alkalinity	

TABLE 12-4
SAMPLE LOCATIONS FOR AUS 0066
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0066-004	AUS-0066-004-SD-0X	In the center of the creek near the berm of red clay bricks	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	The contaminated area sign indicates that prior dumping in this area may have occurred. The creek has a reddish tint indicating the possibility of contamination.
	AUS-0066-004-SW-00		Surface water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B) Ammonia as N, Nitrate + Nitrites, Alkalinity	
0066-005	AUS-0066-005-SS-0X	North of the creek and northeast of the berm	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	The contaminated area sign indicates that prior dumping in this area may have occurred. The creek has a reddish tint indicating the possibility of contamination.
	AUS-0066-005-SS-02			1-2 ft.	TCL Volatiles (8260B)	
0066-006	AUS-0066-006-SD-0X	West side of the pond created by the berm	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	The contaminated area sign indicates that prior dumping in this area may have occurred. The creek has a reddish tint indicating the possibility of contamination.
	AUS-0066-006-SW-00		Surface water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B)	

TABLE 12-4
SAMPLE LOCATIONS FOR AUS 0066
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0066-007	AUS-0066-007-SL-0X	East side of the pond created by the berm	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	The contaminated area sign indicates that prior dumping in this area may have occurred. The creek has a reddish tint indicating the possibility of contamination.
	AUS-0066-007-SW-00		Surface water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B)	
0066-008	AUS-0066-008-SS-0X	On hillside north of contaminated area sign approximately 25 ft. from the fence	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	The contaminated area sign indicates that prior dumping in this area may have occurred. The creek has a reddish tint indicating the possibility of contamination.
	AUS-0066-008-SS-02			1-2 ft	TCL Volatiles (8260B)	

NA = Not applicable

TABLE 12-5
SAMPLE LOCATIONS FOR AUS 0067
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0067-001	AUS-0067-001-SS-0X	Soil pile just south of the entrance to the site	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Contaminated Area sign at entrance to sight indicates possible presence of contaminants. Soil pile is an unnatural feature in the area possibly created by ordnance disposal activities.
	AUS-0067-001-SS-02			1-2 ft	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B)	
0067-002	AUS-0067-002-GW-00	Cistern southeast of entrance to the site.	Water from cistern	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B)	Contaminated Area sign at entrance to sight indicates possible presence of contaminants. Dumping activities occurring at the site may have included dumping into the cistern.
0067-003	AUS-0067-003-SS-0X	Depression furthest to the south at the site inside of the crumbling foundation	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Contaminated Area sign at entrance to sight indicates possible presence of contaminants. Depression is an unnatural feature in the area possibly created by ordnance disposal activities
	AUS-0067-003-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 12-6
SAMPLE LOCATIONS FOR AUS 0069 – COC 15
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0069-001	AUS-0069-001-SS-0X	Southwest end of the site near debris and drums nearest tree line	Trench samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-001-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0069-001-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0069-001-GW-00		Trench water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330)	
0069-002	AUS-0069-002-SS-0X	Southwest end of site in the center of the swale descending the hillside near drums	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-002-SS-02			1-2 ft	TCL Volatiles (8260B)	
0069-003	AUS-0069-003-SS-0X	On the western side of the stand of trees in the western drainage swale just north of drums	Hand auger	0-6 in.	TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-003-SS-02			1-2 ft	TCL Volatiles (8260B)	
0069-004	AUS-0069-004-SS-0X	On northeast portion of site on the southeastern most soil pile	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-004-SS-02			1-2 ft	TCL Volatiles (8260B)	
0069-005	AUS-0069-005-SS-0X	Near the shore line of the lake in the area of construction debris	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-005-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 12-6
SAMPLE LOCATIONS FOR AUS 0069 – COC 15
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0069-006	AUS-0069-006-SS-0X	On the eastern portion of the site to the south of the bulk of the debris in an area of abandoned drums	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-006-SS-02			1-2 ft	TCL Volatiles (8260B)	
0069-007	AUS-0069-007-SS-0X	On northeast portion of site on the northern most soil pile	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-007-SS-02			1-2 ft	TCL Volatiles (8260B)	
0069-008	AUS-0069-008-SS-0X	On northeast portion of site on the south side of the northern most soil pile	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-008-SS-02			1-2 ft	TCL Volatiles (8260B)	
0069-009	AUS-0069-009-SS-0X	Eastern portion of the site just west of the creek near drums	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-009-SS-02			1-2 ft	TCL Volatiles (8260B)	
0069-010	AUS-0069-010-SD-0X	Eastern portion of the site north end of the creek	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TOC (9060)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-010-SW-00		Surface water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B)	

TABLE 12-6
SAMPLE LOCATIONS FOR AUS 0069 – COC 15
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0069-011	AUS-0069-011-SD-0X	Eastern portion of the site on the south end of the creek	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-011-SW-00		Surface water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B)	
0069-012	AUS-0069-012-SS-0X	On northeast portion of site on the south side of the northern most soil pile	Trench samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-012-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0069-012-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0069-012-GW-00		Trench water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330)	
0069-013	AUS-0069-013-SS-0X	Northwest end of the site near lake between lake and drums	Trench samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site was used as a dumping ground for industrial wastes. The dumping activities may have affected the soils and groundwater in the area.
	AUS-0069-013-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0069-013-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0069-013-GW-00		Trench water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330)	

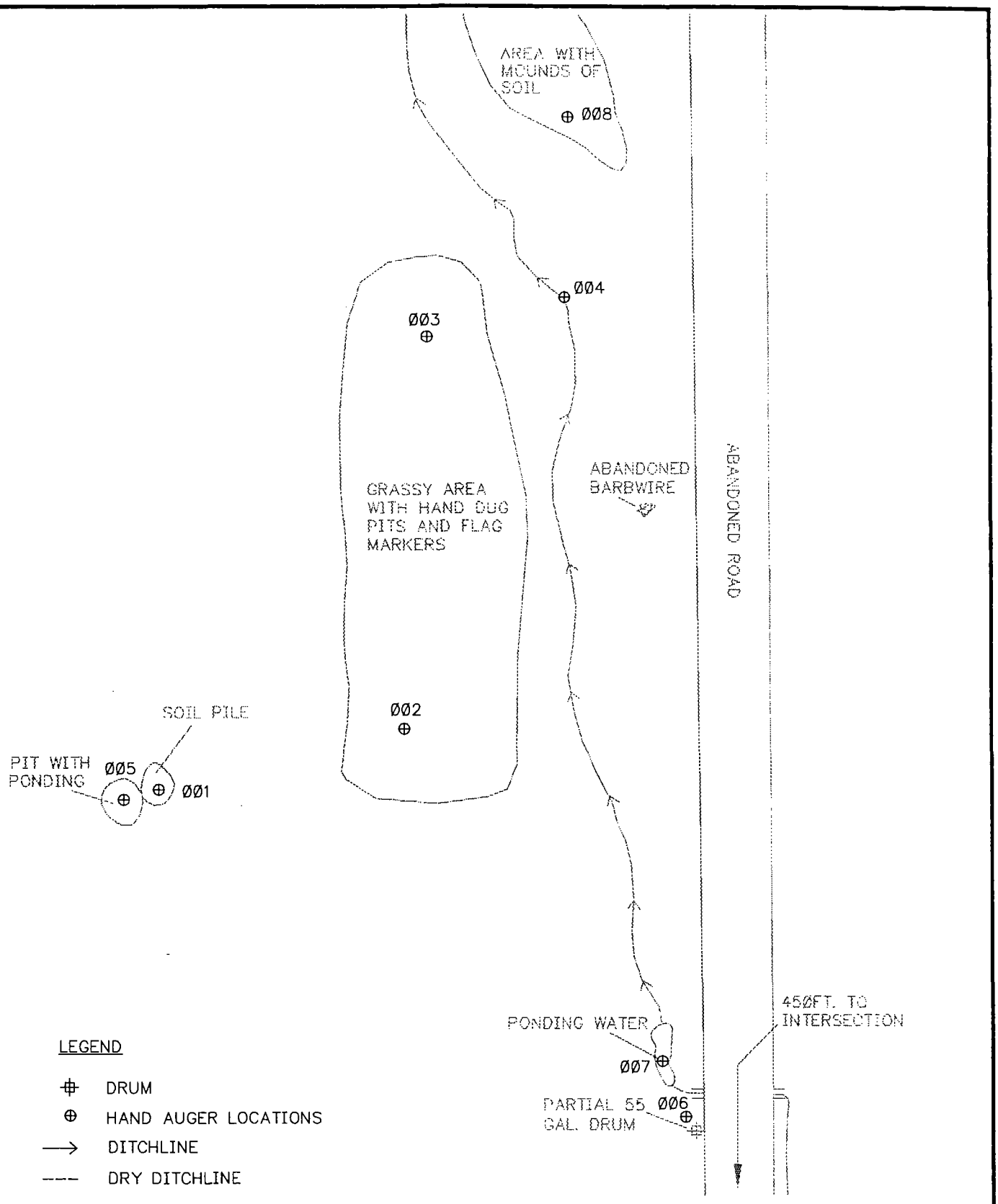
BWT = Below water table

NA = Not applicable

TABLE 12-7
SAMPLE LOCATIONS FOR AUS 109 – COC AREA SITE IDENTIFIED BY AERIAL PHOTO INTERPRETATION
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0109-001	AUS-0109-001-SS-0X	South-southeast of COC 1 approximately 1,188 feet at GIS coordinates:	Trench samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site identified by aerial photo interpretation as having several craters densely clustered together. The area as a whole appears similar in appearance to COC 9 which was previously identified as a UXO detonation area.
	AUS-0109-001-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0109-001-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0109-001-GW-00		Trench water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330)	
0109-002	AUS-0109-002-SS-0X	South-southeast of COC 1 approximately 1,188 feet at GIS coordinates:	Trench samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site identified by aerial photo interpretation as having several craters densely clustered together. The area as a whole appears similar in appearance to COC 9 which was previously identified as a UXO detonation area.
	AUS-0109-002-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0109-002-SS-??			BWT	TCL Volatiles (8260B)	
	AUS-0109-002-GW-00		Trench water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330)	

BWT = Below water table
NA = Not applicable



LEGEND

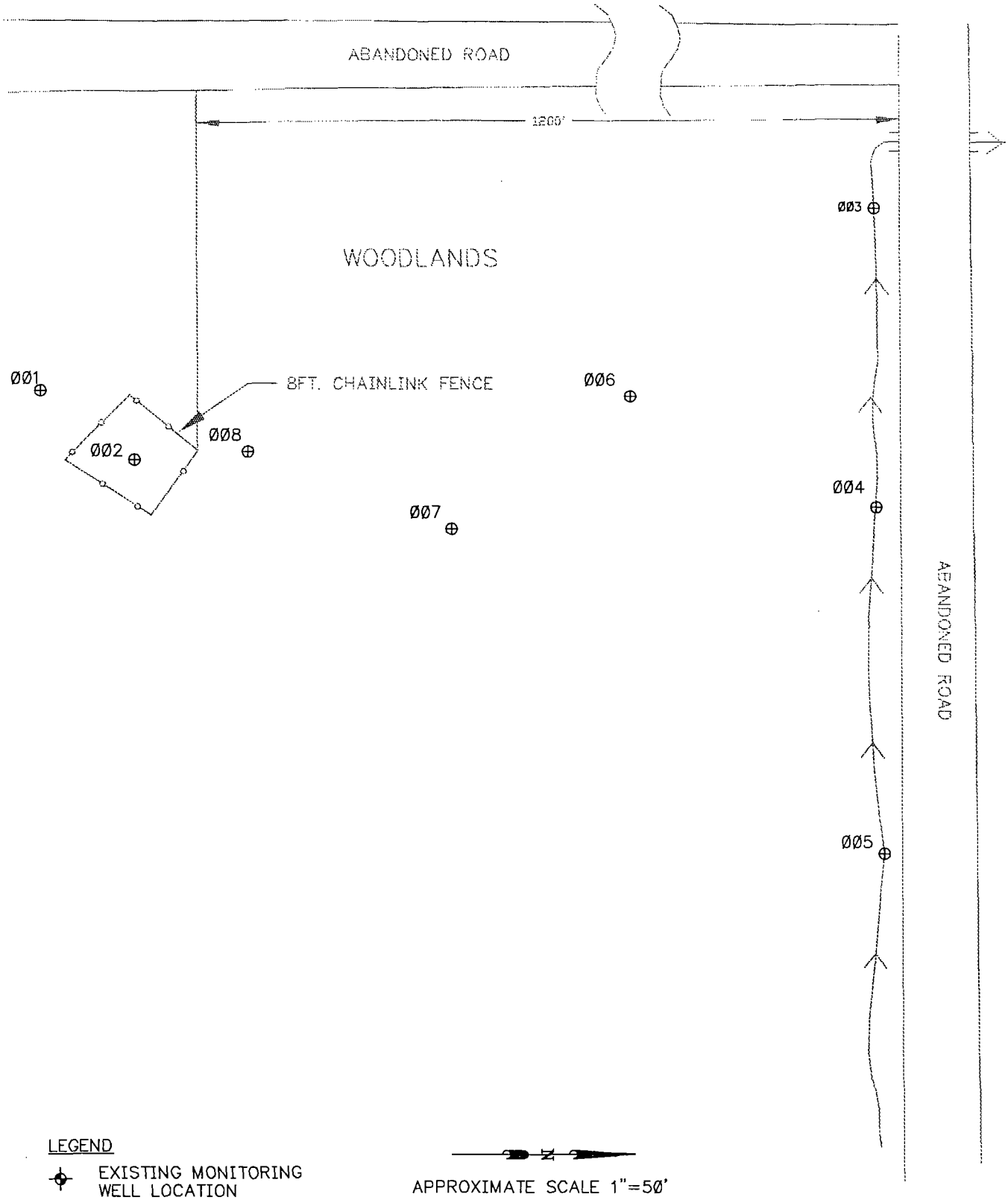
- DRUM
- HAND AUGER LOCATIONS
- DITCHLINE
- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

Ø 4Ø

SCALE FEET

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 1Ø/5/99 DSGN. BY: mjh CHKD. BY:	AUS–ØØ62–COC–II Sample Locations
FIG. NO. 12–1	

File: G:\68FOD9727800\FWSAUS\FWSAUS62FIG12-1.DWG Last edited: 02/10/00 @ 4:15 p.m. WC-ST.LOUIS, MO



LEGEND

- EXISTING MONITORING WELL LOCATION
- HAND AUGER LOCATIONS
- DITCHLINE
- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

APPROXIMATE SCALE 1"=50'

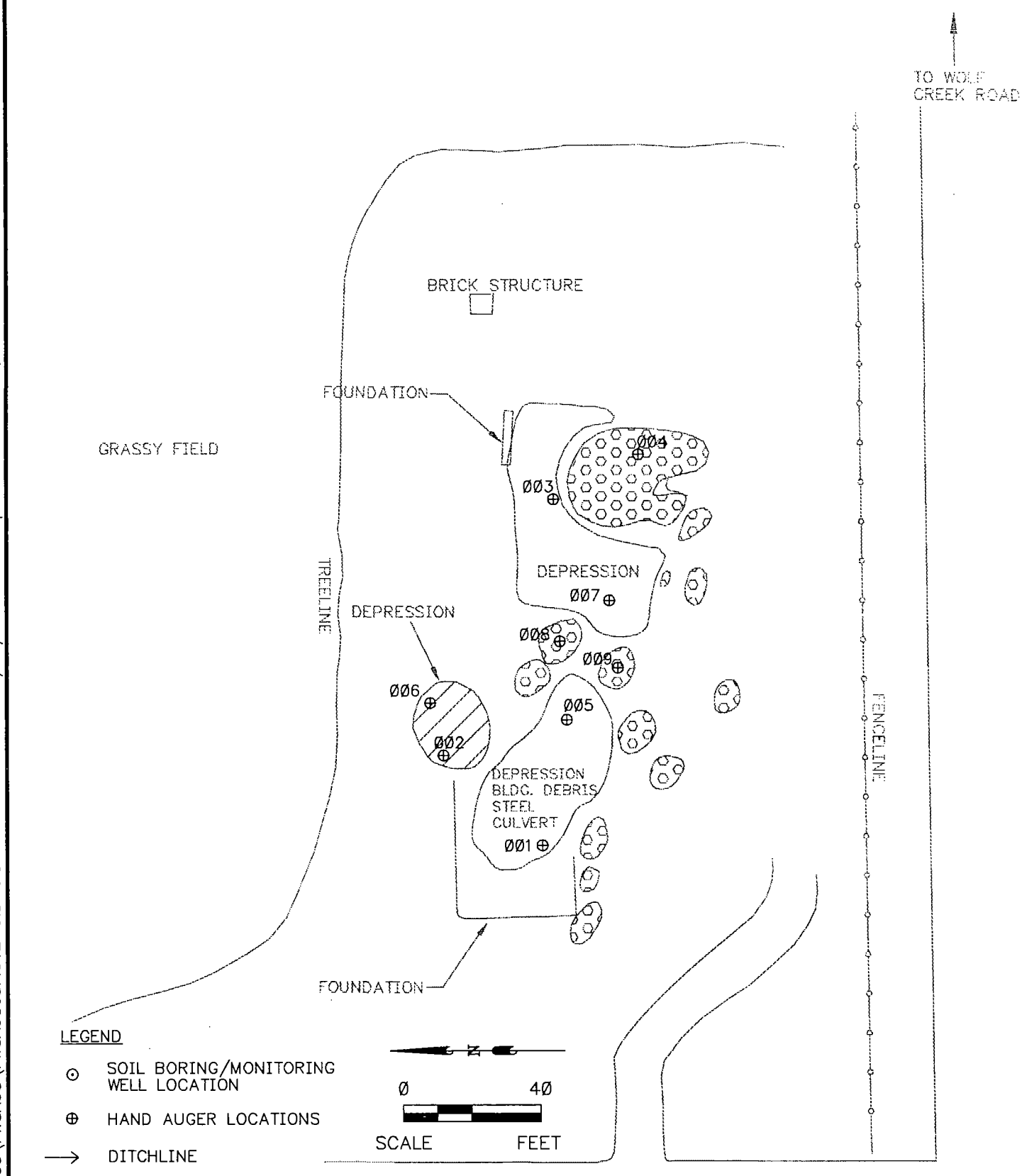
FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

URS Greiner Woodward Clyde

A Division of URS Corporation

DRN. BY:djd 1Ø/5/99 DSGN. BY:mjh CHKD. BY:	AUS–ØØ63–COC–12 Sample Locations	FIG. NO. 12–2

File: G:\68FOD9727800\FWSAUS\FWSAUS63FIG12-2.DWG Last edited: 10/29/99 @ 10:43 a.m. WC-ST.LOUIS, MO

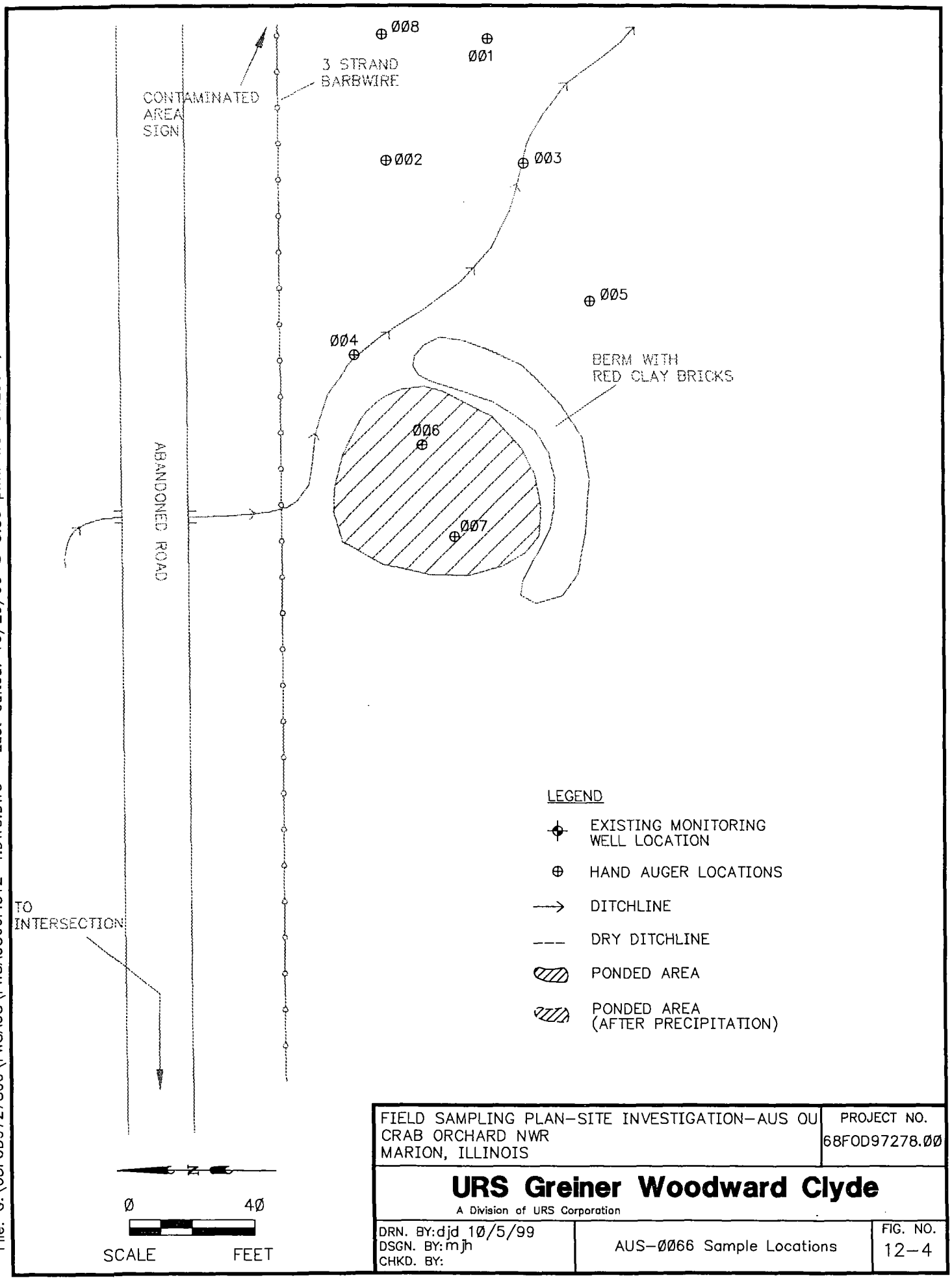


LEGEND

- ⊙ SOIL BORING/MONITORING WELL LOCATION
- ⊕ HAND AUGER LOCATIONS
- ⟶ DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)
- MOUNDS OF SOIL

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 1Ø/5/99 DSGN. BY: mjh CHKD. BY:	AUS–ØØ65 Sample Locations FIG. NO. 12–3

File: G:\68FOD9727800\FWSAUS\FWSAUS65FIG12-3.DWG Last edited: 11/01/99 @ 12:46 p.m. WC-ST.LOUIS, MO



FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

PROJECT NO. 68FOD97278.ØØ

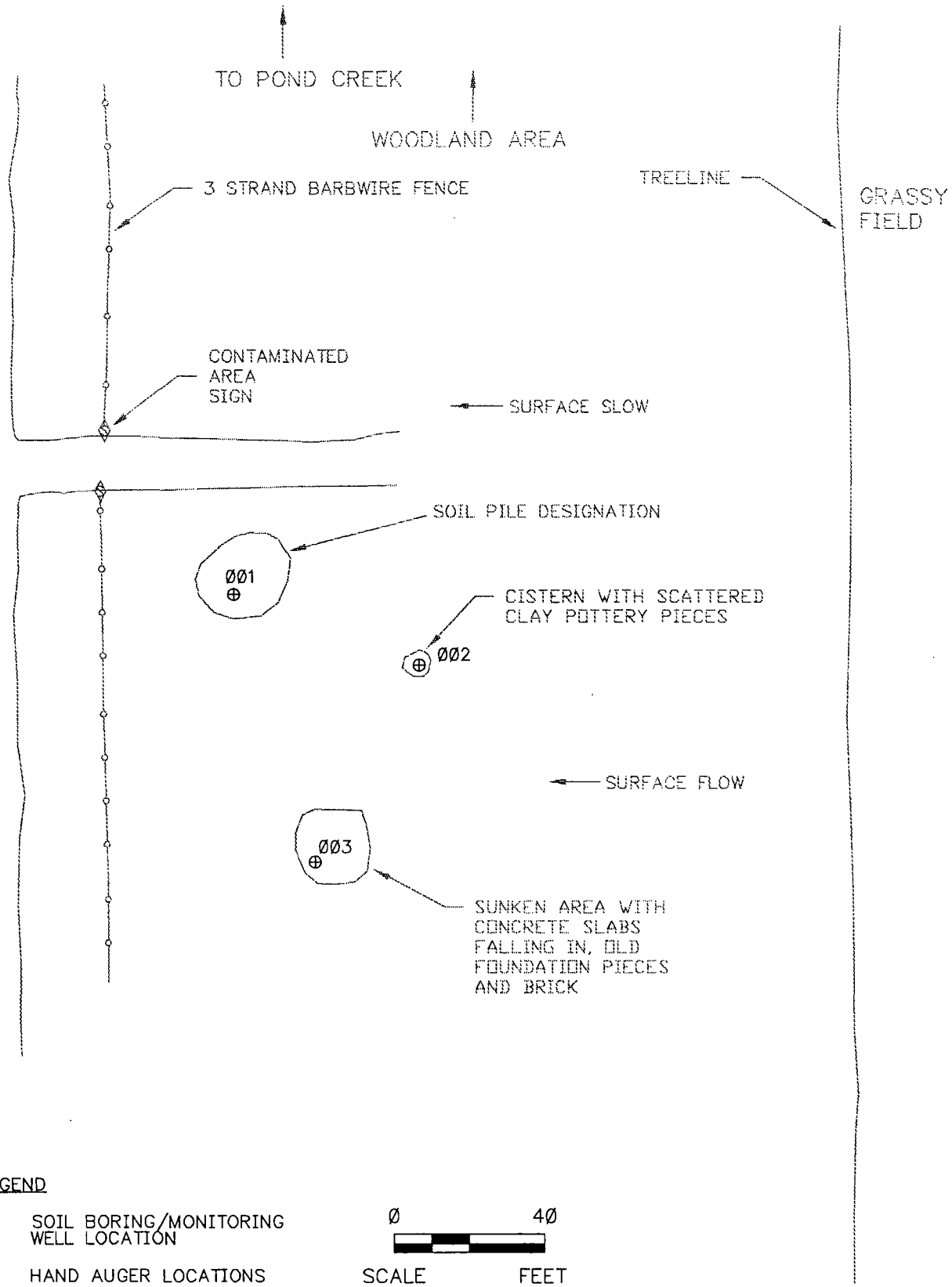
URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 1Ø/5/99
DSGN. BY: mjh
CHKD. BY:

AUS–ØØ66 Sample Locations

FIG. NO. 12–4

File: G:\68FOD972780Ø\FWSAUS\FWSAUS66FIG12–4.DWG Last edited: 10/29/99 @ 3:39 p.m. WC–ST.LOUIS, MO



LEGEND

- ⊙ SOIL BORING/MONITORING WELL LOCATION
- ⊕ HAND AUGER LOCATIONS
- ⟶ DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

Ø 4Ø
SCALE FEET

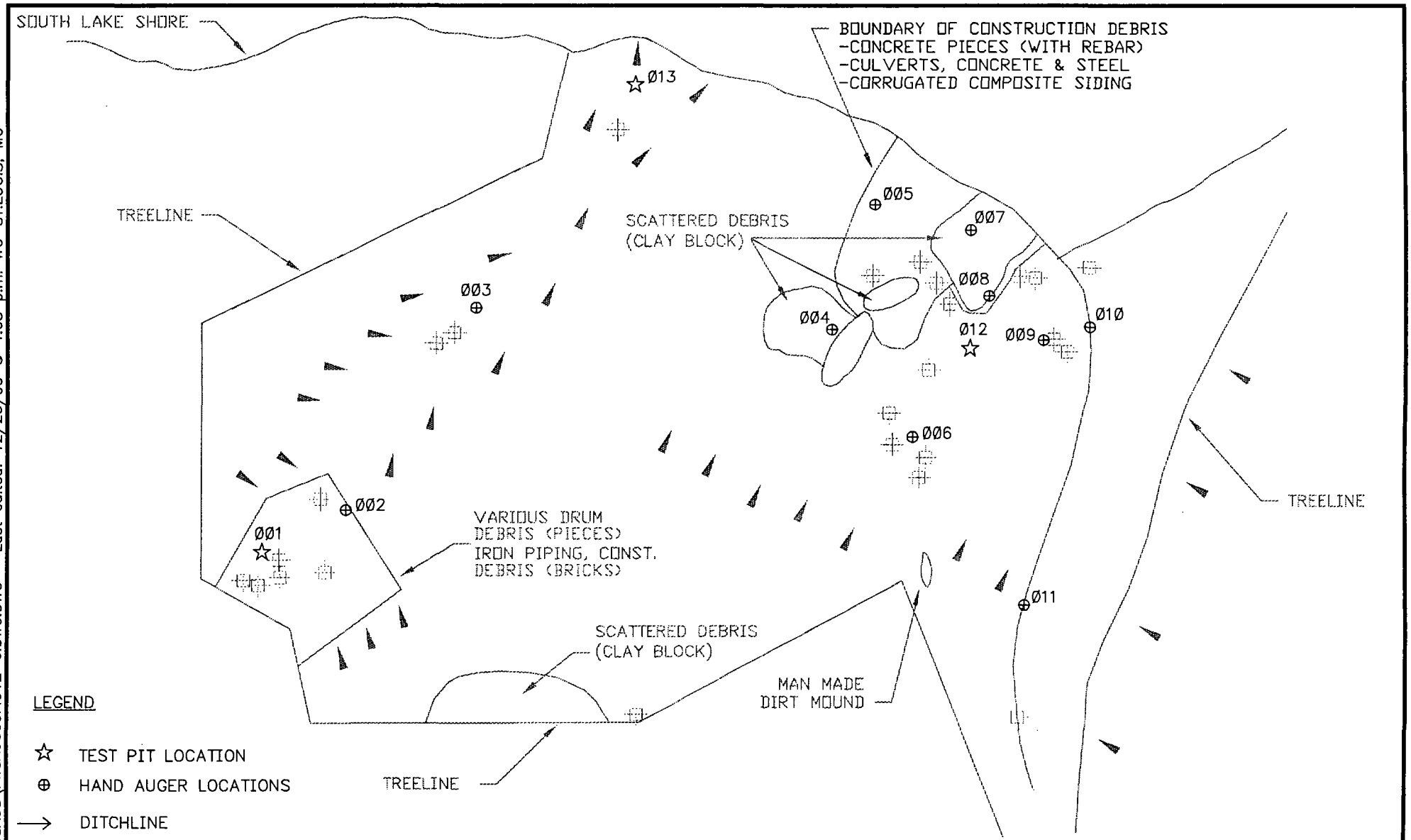
N

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 1Ø/5/99 DSGN. BY: mjh CHKD. BY:	AUS–ØØ67 Sample Locations	FIG. NO. 12–5

File: G:\68FOD9727800\FWSAUS\FWSAUS67FIG12-5.DWG Last edited: 12/23/99 @ 3:41 p.m. WC-ST.LOUIS, MO



FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

PROJECT NO.
68FOD97278.ØØ

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 1Ø/5/99
DSGN. BY: mjh
CHKD. BY:

AUS–ØØ69–COC–15 Sample Locations

FIG. NO.
12–6

File: G:\68FOD9727800\FWSAUS\FWSAUS69FIG12-6.DWG Last edited: 12/23/99 @ 4:03 p.m. WC-ST.LOUIS, MO

13.1 AUS-0001 – IOP FIRE AND POLICE HEADQUARTERS

Site Location and Boundaries

The site is located on the western side of Wolf Creek Road 0.4 miles south of Old Highway 13. The foundation of the former firehouse is approximately 120 feet west of Wolf Creek Road. No buildings remain from the Headquarters but the foundations are visible. The site is bounded on the east by Wolf Creek Road. The site is bounded on the remaining sides by woodlands, which are beginning to overtake the foundations of the former buildings. AUS-0001 is shown on Figure 13-1 with sample locations. Information on each sample is contained in Table 13-1.

Site History

This site formerly housed the Fire and Police Headquarters for the Illinois Ordnance Plant and later the Refuge. The Headquarters included an administration building, and a fire station as well as a small boiler house. To the west of these buildings was a long structure with a trough running through it for which a purpose has not yet been identified. All of the buildings at the site were razed however their foundations remain. In addition, evidence of underground storage tanks at the site was observed near the former boiler house.

Sampling Information Specific to AUS-0001

A magnetometer survey is planned in the area of the suspected location of the underground storage tanks. The magnetometer survey should provide a clear indication of the presence of underground storage tanks if they are still at the site.

13.2 AUS-0002 – IOP WASTEWATER TREATMENT PLANT

Site Location and Boundaries

The site is located on the western side of Wolf Creek Road approximately 0.1 miles south of Old Highway 13. The site is in a stand of trees just west of a pond. The site is bounded on the east by the pond and on the north, south and west by cropland. AUS-0002 is shown on Figure 13-2 with sample locations. Information on each sample is contained in Table 13-2.

Site History

This site is the former location of the Wastewater Treatment Plant for the Illinois Ordnance Plant's administration area and may have served portions of Area 2. The building was razed, however the settlement lagoons still exist. Dense vegetation now exists all around the area of the settlement lagoons.

13.3 AUS-0018 – IOP RAILROAD CLASSIFICATION YARD

Site Location and Boundaries

The site is located on the eastern side of Highway 148 approximately 1.0 miles south of Illinois Route 13. The former IOP railroad classification yard is just south of an unnamed road which is located just south of Old Highway 13. The site is bound on the north by the unnamed access road and on the south by woodlands. AUS-0018 is shown on Figure 13-3 with sample locations. Information on each sample is contained in Table 13-3.

Site History

This site was formerly the railroad classification yard for the Illinois Ordnance Plant. Railroad cars were ordered at the site for efficient transport to their final destinations. The site was not used for long-term storage, however, train cars may have waited at the yard for a few days awaiting dispensation. According to an engineering drawing contained in the War Departments' 1944 Facilities Inventory of the Illinois Ordnance Plant, the classification yard had a fuel oil column which may have been used for refueling of locomotives. The tracks at the site were removed along with the ballast and railroad ties. One building still stands at the site. However, it has been abandoned since its post World War II tenant, the Williamson County Emergency Management Agency, moved to a new location. Previous sampling at the site revealed the presence of elevated levels of cadmium, mercury, lead, and zinc.

13.4 AUS-0021 – IOP FIRE STATION FOR AREA 7

Site Location and Boundaries

The site is located east of Highway 148 and north of the PCB OU landfill. To get to the site travel east on Ogden road from Highway 148 and then take Chamness Road north to the entrance to the PCB OU landfill. AUS-0021 is located just north of the landfill. The site is bound on the south by the landfill and on the east by Chamness Road. To the north and west are woodlands. AUS-0021 is shown on Figure 13-4 with sample locations. Information on each sample is contained in Table 13-4.

Site History

This site formerly housed a fire station that serviced Area 7 and other nearby IOP facilities. The building has been razed and only parts of the foundation are visible. A walkover survey of the site revealed ordnance/explosive waste at the site to the north of the former fire station building.

13.5 AUS-0043 – AREAS 11 AND 12 FIRE STATION

Site Location and Boundaries

The site is located west of Highway 148 on the north side of Ogden Road. To get to the site travel west on Ogden road from Highway 148 for 1.2 miles. AUS-0043 is across Ogden Road from the entrance road to Areas 11 and 12. The site is bound on the south by Ogden Road and on the east and west by woodlands. To the north is an open field. AUS-0043 is shown on Figure 13-5 with sample locations. Information on each sample is contained in Table 13-5.

Site History

This site formerly housed a fire station that serviced Areas 11 and 12 as well as other nearby IOP facilities. The building has been razed and only the foundation and debris remain at the site. A walkover survey of the site revealed sumps and a burner stack as well as abandoned farm equipment.

13.6 AUS-0060 – IOP FULMINATE STORAGE IGLOOS

Site Location and Boundaries

The site is located on the western side of Wolf Creek Road 1.4 miles south of Old Highway 13. The igloos are in a fenced compound approximately 0.1 miles west of Wolf Creek Road. All of the igloos are intact and accessible, however, overgrowth in the area of the compound's fence gate limits access through the gate. The lake is west of the compound and open fields surround the compound on the north south and east. AUS-0060 is shown on Figure 13-6 with sample locations. Information on each sample is contained in Table 13-6.

Site History

This site was originally designed, built and used for the storage of mercury fulminate for use in detonators. After World War II the storage igloos were used to store other compounds including lead azide, TNT, tetryl, and nitrocellulose. The storage igloos have been unoccupied for approximately 30 years. In 1996 igloo number FS 2-2 was found to contain boxes with some nitrocellulose. The igloo was decontaminated subsequent to this discovery. Previous sampling at the site showed elevated levels of metals at the site. Visual inspection of the site revealed the presence of numerous drums abandoned at the site.

13.7 AUS-0061 – CONCRETE STRUCTURES WEST OF WOLF CREEK ROAD

Site Location and Boundaries

The site is located on the western side of Wolf Creek Road 1.0 miles south of Old Highway 13. The concrete structures are approximately 0.1 miles west of Wolf Creek Road in a thin row of

trees. The site is overgrown and difficult to see from Wolf Creek Road. The site has woodlands on the east and west and open fields on the north and south. AUS-0061 is shown on Figure 13-7 with sample locations. Information on each sample is contained in Table 13-7.

Site History

This site was built for the testing of ordnance and propellant systems. The site contains two structures that were used as test pits and one structure used to initiate the testing. Previous sampling at the site showed elevated levels of BNAs.

13.8 AUS-106A – DRUM DISPOSAL AREA IDENTIFIED DURING SITE RECONNAISSANCE EAST OF AREA 11

Site Location and Boundaries

AUS-106A is located east of the former Nitroglycerin Area (A11N). The site is shown on Figure 10-1. There is a former roadway (which is now impassable to vehicular traffic) that heads east from the roadway just east of former Building 9. The site is located on the northern side of the former roadway, approximately 1000 feet east of the roadway that is just east of former Building 9. There is a fence line crossing the former roadway, approximately 500 feet west of the site. The site is made up of a mounded area that is covering up drums. This area covers approximately 3,000 square feet. There is also an oven hood and two former smoke stacks located near this soil mound.

Sample locations at this site are shown on Figure 13-8. Sample analysis information for each sample location is contained in Table 13-8.

Site History

The history of this site is unknown. There appeared to be a road leading to this disposal area as seen in 1951 aerial photographs, which did not appear in the 1960 aerial photograph. This would indicate that either the IOP (1942 through 1945), Hoosier Cardinal (1948 through 1954) or Silas Mason (1947 through 1950) could possibly be responsible for these drums.

During the site reconnaissance, it was estimated that there could be anywhere from 50 to 100 drums that were disposed of in this area. These drums are partially buried and are located along a creek bed which contains water usually only during precipitation events. There is a grayish-bluish solid substance present in several of the exposed drums. It is speculated by USFWS that this may be old paint, however there is no evidence to support this speculation. USFWS discovered this site during the site reconnaissance.

Sampling Information Specific to AUS-106A

There are twelve samples to be collected from this site. Seven hand auger samples will be collected from the soil mound covering the drums. Three samples of the materials found inside

the drums will be collected. Two samples will be collected from the nearby creek beds that likely receive runoff from this drum disposal area.

13.9 AUS-0107 – POSSIBLE DISPOSAL AREA IDENTIFIED BY AERIAL PHOTO INTERPRETATIONS

Site Location and Boundaries

This site is located north of Area 8 and just south of Ogden Rd. It was identified by aerial photography interpretations as a possible disposal area. Sample locations will be determined using coordinates determined using the aerial photos. The investigation at Site 107 will include a trench pit and should reveal the presence of a dump site if it exists. Sample analyses are shown on Table 13-9 and the location of Site 107 is shown on Figure 2-1.

13.10 AUS-0108 –POSSIBLE SURFACE DISPOSAL AREA IDENTIFIED BY AERIAL PHOTO INTERPRETATIONS

Site Location and Boundaries

This site is located north of Ogden Rd. and north of Area 11. It was identified by aerial photography interpretations as a possible surface disposal area near COC 10. Sample locations will be determined using coordinates determined using the aerial photos. The investigation at Site 108 will include two shovel samples. Sample analyses are shown on Table 13-9 and the location of Site 108 is shown on Figure 2-1.

TABLE 13-1
SAMPLE LOCATIONS FOR AUS-0001-FIRE AND POLICE HEADQUARTERS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0001-001	AUS-0001-001-SS-0X	Outfall of trough	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Trough was designed to carry fluids from the building and discharge them to the ground.
	AUS-0001-001-SS-02			1-2 ft	TCL Volatiles (8260B)	
0001-002	AUS-0001-002-SS-0X	Discharge location of the sump pit in the western portion of main building.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	EPA sample location showing contamination above SSLs.
	AUS-0001-002-SS-01			6-12 in.	TCL Volatiles (8260B)	
0001-003	AUS-0001-003-SS-0X	Area of suspected fuel oil UST	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	This is the suspected fill location of a fuel oil UST used to fuel the boiler for the buildings.
	AUS-0001-003-SS-02			1-2 ft	TCL Volatiles (8260B)	
0001-004	AUS-0001-004-SS-0X	Base of former stack near the south end of former boiler house	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Fuel spills would have ultimately ended up in this drainage way.
	AUS-0001-004-SS-02			1-2 ft	TCL Volatiles (8260B)	
0001-005	AUS-0001-005-SD-0X	Drainage ditch near outfall location to the southwest of former building foundation	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Fuel spills would have ultimately ended up in this drainage way.
	AUS-0001-005-SD-02			1-2 ft	TCL Volatiles (8260B)	
0001-W01	AUS-0001-W01-SS-05	Southwest of any USTs identified by the magnetometer survey in the area west of the building foundation	Soil boring	4-5 ft	TCL Volatiles (8260B) PAHs (8310)	If the USTs are located by the magnetometer survey, then this soil boring will be placed next to the USTs. If the USTs can not be located then this soil boring will be placed in the most likely area of the former USTs. This boring is to determine the potential for subsurface contamination associated with the USTs.
	AUS-0001-W01-SS-??			BWT	TCL Volatiles (8260B) PAHs (8310)	
	AUS-0001-W01-GW-00		Monit. Well	NA	TAL Metals (6010/7000) PAHs (8310) TCL Volatiles (8260b)	

BWT = Below water table
NA = Not Applicable

TABLE 13-2
SAMPLE LOCATIONS FOR AUS 0002-IOP WASTEWATER TREATMENT PLANT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0002-001	AUS-0002-001-SS-0X	Outlet of discharge pipe between lagoons	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Contamination discharged to the lagoons would have to have flowed over this point.
	ÁUS-0002-001-SS-02			1-2 ft	TCL Volatiles (8260B)	
0002-002	AUS-0002-002-SD-0X	North lagoon	Hand auger	6-12 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	The lagoons are used for the settlement of solids. It is possible the lagoons were the recipients of contamination from IOP operations.
	AUS-0002-002-SW-00		Surface water	NA	TAL Metals (6010/7000) SW846 Explosives (8330) TCL Volatiles (8260B) Ammonia as N, Nitrates + Nitrites, Alkalinity	
0002-003	AUS-0002-003-SD-0X	South lagoon	Hand auger	6-12 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	The lagoons are used for the settlement of solids. It is possible the lagoons were the recipients of contamination from IOP operations.
	AUS-0002-003-SW-00		Surface water	NA	TAL Metals (6010/7000) SW846 Explosives (8330) TCL Volatiles (8260B) Ammonia as N, Nitrates + Nitrites, Alkalinity	
0002-004	AUS-0002-004-SD-0X	Drainage way to the west of the treatment plant buildings.	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage way would have received any treatment plant overflows or lagoon bypass discharges.
	AUS-0002-004-SW-00		Surface water	NA	TAL Metals (6010/7000) SW846 Explosives (8330)	
0002-005	AUS-0002-004-SD-0X	Drainage way to the west of treatment lagoons	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage way would have received any treatment plant overflows or lagoon bypass discharges.
	AUS-0002-004-SW-00		Surface water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	

NA = Not applicable

TABLE 13-3
SAMPLE LOCATIONS FOR AUS 0018 – IOP RAILROAD CLASSIFICATION YARD
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0018-001	AUS-0018-001-SS-0X	North of the former IOP sand house	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This track may have been used for the fueling of locomotive engines.
	AUS-0018-001-SS-02			1-2 ft	TCL Volatiles (8260B)	
0018-002	AUS-0018-002-SS-0X	West of the former IOP sand house	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This was the area where the fuel oil loading column was located.
	AUS-0018-002-SS-02			1-2 ft	TCL Volatiles (8260B)	
0018-003	AUS-0018-003-SS-0X	South of the former IOP sand house	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This track may have been used for the fueling of locomotive engines.
	AUS-0018-003-SS-02			1-2 ft	TCL Volatiles (8260B)	
0018-004	AUS-0018-004-SS-0X	Area of the IOP receiving yards east of the former office building	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This track used for the staging of train cars loaded with raw materials for the production operations during WWII.
	AUS-0018-004-SS-02			1-2 ft	TCL Volatiles (8260B)	
0018-005	AUS-0018-005-SS-0X	Area of the IOP classification ladder east of the former office building	Hand auger	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This track used for the staging of train cars loaded with raw materials for the production operations during WWII.
	AUS-0018-005-SS-02			1-2 ft	TCL Volatiles (8260B)	

TABLE 13-4
SAMPLE LOCATIONS FOR AUS 0021 – IOP AREA 7 FIRE STATION
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0021-001	AUS-0021-001-SD-0X	Drainage ditch west of the observed location of abandoned, used ordnance	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Ordnance items were observed in this area. Drainage from the area flows through this ditch. Ordnance appears pyrotechnic in nature and COPCs include Metals, plastic binders, and Explosives.
0021-002	AUS-0021-002-SD-0X	Drainage ditch draining the observed location of abandoned, used ordnance	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Ordnance items were observed in this area. Drainage from the area flows through this ditch. Ordnance appears pyrotechnic in nature and COPCs include Metals, plastic binders, and Explosives.
0021-003	AUS-0021-003-SL-0X	Area around observed location of abandoned, used ordnance	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Ordnance items were observed in this area. Ordnance appears pyrotechnic in nature and COPCs include Metals, plastic binders, and Explosives.

TABLE 13-5
SAMPLE LOCATIONS FOR AUS 0043 – IOP AREAS 11 AND 12 FIRE STATION
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0043-001	AUS-0043-001-SS-0X	Near steel burner on the west side of former building	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	Residues from burning activities were observed on the ground near the stack. Volatiles and Explosives would have burned off. Metals and semi-volaitles remain.
0043-002	AUS-0043-002-SS-0X	Drainage ditch north of former building in the area of the large sump	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Sump cleaning activities likely resulted in discharges to the drainage ditch in the immediate vicinity of the sump. COPCs include Metals, Explosives, and semi Volatiles.
0043-003	AUS-0043-003-SW-0X	Large sump at the north west corner of the former building	Surface water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330) TCL Volatiles (8260B)	Large sump was identified during site walkover which may have contained hazardous materials. COPCs include Metals, Explosives, volatile solvents and semi Volatiles.
0043-004	AUS-0043-004-SD-0X	Drainage ditch east of former building near Ogden road.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	This ditch collects runoff from the entire site.
	AUS-0043-004-SD-02			1-2 ft	TCL Volatiles (8260B)	
0043-005	AUS-0043-005-SD-0X	Drainage ditch north of former building near Ogden road.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c)	This ditch collects runoff from the entire site.
	AUS-0043-005-SD-02			1-2 ft	TCL Volatiles (8260B)	

NA = Not applicable

TABLE 13-6
SAMPLE LOCATIONS FOR AUS 0060 – IOP FULMINATE STORAGE IGLOOS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0060-001	AUS-0060-001-SD-0X	Drainage ditch on south west side of storage area	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from the entire storage area.
0060-002	AUS-0060-002-SD-0X	Drainage ditch on south side of storage area between igloos FS 1-1 and 1-2	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from the area between igloos FS 1-1 and FS 1-2.
	AUS-0060-002-SD-01			6-12 in.	TCL Volatiles (8260b)	
0060-003	AUS-0060-003-SD-0X	Drainage ditch on west side of storage igloo FS 1-2	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from the west side of igloo FS 1-2.
	AUS-0060-003-SD-01			6-12 in.	TCL Volatiles (8260b)	
0060-004	AUS-0060-004-SD-0X	Drainage ditch on east side of storage igloo FS 2-2	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	This drainage ditch receives runoff from between storage igloos FS 2-1 and FS 2-2.
0060-005	AUS-0060-005-SD-0X	West side of storage igloo FS 2-2 in area where drums were abandoned	Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	Several drums were abandoned in this area and the former contents of the drums are unknown.
	AUS-0060-005-SD-01			6-12 in.	TCL Volatiles (8260b)	
0060-006	AUS-0060-006-SW-00	West side of storage site road in area where water ponds.	Surface water	NA	TAL Metals (6010/7000) SW846 Explosives (8330)	This ponded area receives runoff from the entire storage area.
	AUS-0060-006-SD-0X		Shovel sample	0-6 in.	TAL Metals (6010/7000) SW846 Explosives (8330)	

NA = Not applicable

TABLE 13-7
SAMPLE LOCATIONS FOR AUS 0061 – CONCRETE STRUCTURES SOUTH OF JOB CORP LANDFILL
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0061-001	AUS-0061-001-SL-0X	Interior of southern detonation pit.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Detonation pits used to test Explosives. BNAs and Metals found at the site above SSLs.
0061-002	AUS-0061-002-SL-0X	Interior of northern detonation pit.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Detonation pits used to test Explosives. BNAs and Metals found at the site above SSLs.
0061-003	AUS-0061-003-SD-0X	Drainage ditch between detonation pits and firing pit	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives runoff from the entire site interior. Detonation pits used to test Explosives. BNAs and Metals found at the site above SSLs.
0061-004	AUS-0061-004-SD-0X	Drainage ditch on north side of north detonation pit	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	This drainage ditch receives runoff from the western side of the detonation pits. Detonation pits used to test Explosives. BNAs and Metals found at the site above SSLs.
0061-005	AUS-0061-005-SD-0X	Ponded area to the south of southern detonation pit.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Detonation pits used to test Explosives. BNAs and Metals found at the site above SSLs. Ponded area likely to receive contaminants from runoff.
0061-006	AUS-0061-006-SD-0X	Ponded area to the south of southern detonation pit nearest to tree line.	Hand auger	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Detonation pits used to test Explosives. BNAs and Metals found at the site above SSLs. Ponded area is not a natural feature. It may have been used for the storage of Explosives during testing.

TABLE 13-8
SAMPLE LOCATIONS FOR AUS 106A– DRUM STORAGE AREA IDENTIFIED DURING SITE RECONNAISSANCE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
106A-001	AUS-106A-001-SS-02	Soil beneath drum disposal area	Hand auger	1-2 ft	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance – it is speculated that this substance might have been paint – COPCs: unknown
106A-002	AUS-106A-002-SS-02	Soil beneath drum disposal area	Hand auger	1-2 ft	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance – it is speculated that this substance might have been paint – COPCs: unknown
106A-003	AUS-106A-003-SS-02	Soil beneath drum disposal area	Hand auger	1-2 ft	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance – it is speculated that this substance might have been paint – COPCs: unknown
106A-004	AUS-106A-004-SS-02	Soil beneath drum disposal area	Hand auger	1-2 ft	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance – it is speculated that this substance might have been paint – COPCs: unknown
106A-005	AUS-106A-005-SS-02	Soil beneath drum disposal area	Hand auger	1-2 ft	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance – it is speculated that this substance might have been paint – COPCs: unknown

TABLE 13-8
SAMPLE LOCATIONS FOR AUS 106A– DRUM STORAGE AREA IDENTIFIED DURING SITE RECONNAISSANCE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

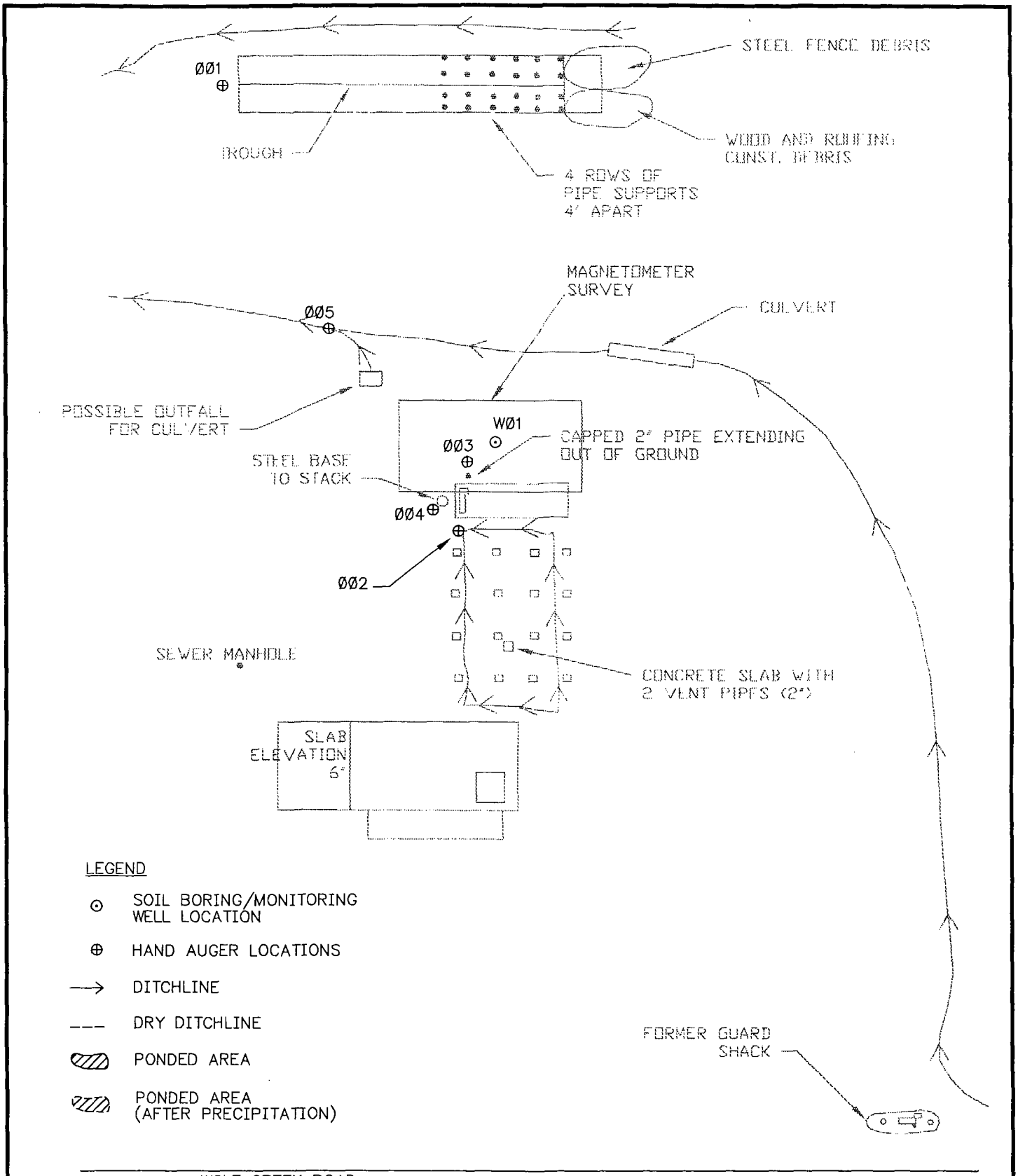
LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
106A-006	AUS-106A-006-SS-02	Soil beneath drum disposal area	Hand auger	1-2 ft	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance – it is speculated that this substance might have been paint – COPCs: unknown
106A-007	AUS-106A-007-SS-02	Soil beneath drum disposal area	Hand auger	1-2 ft	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance – it is speculated that this substance might have been paint – COPCs: unknown
106A-008	AUS-106A-008-DRUN	Inside one of the drums containing solid material	Hand auger or trowel	0-6 in.	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance which will be sampled – it is speculated that this substance might have been paint – COPCs: unknown
106A-009	AUS-106A-009-DRUM	Inside one of the drums containing solid material	Hand auger or trowel	0-6 in.	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance which will be sampled – it is speculated that this substance might have been paint – COPCs: unknown
106A-010	AUS-106A-010-DRUM	Inside one of the drums containing solid material	Hand auger or trowel	0-6 in.	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in this mounded area and about one quarter of them contain a whitish-bluish-greyish solid substance which will be sampled – it is speculated that this substance might have been paint – COPCs: unknown

TABLE 13-8
SAMPLE LOCATIONS FOR AUS 106A– DRUM STORAGE AREA IDENTIFIED DURING SITE RECONNAISSANCE
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
106A-011	AUS-106A-011-SS-0X	Dry creek bed running along north side of drum disposal area	Hand auger	0-6 in.	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in the mounded area just south of this creek bed and the creek bed may have received runoff from this area during precipitation events – possible COPCs: unknown
106A-012	AUS-106A-012-SS-0X	Dry creek bed running east from drum disposal area	Hand auger	0-6 in.	TCL Volatiles (8260B) TCL BNAs (8270c) TAL Metals (6010/7000) SW846 Explosives (8330)	Approximately 50 to 100 drums may be disposed of in the mounded area just upstream (west) of this creek bed and the creek bed may have received runoff from this area during precipitation events – possible COPCs: unknown

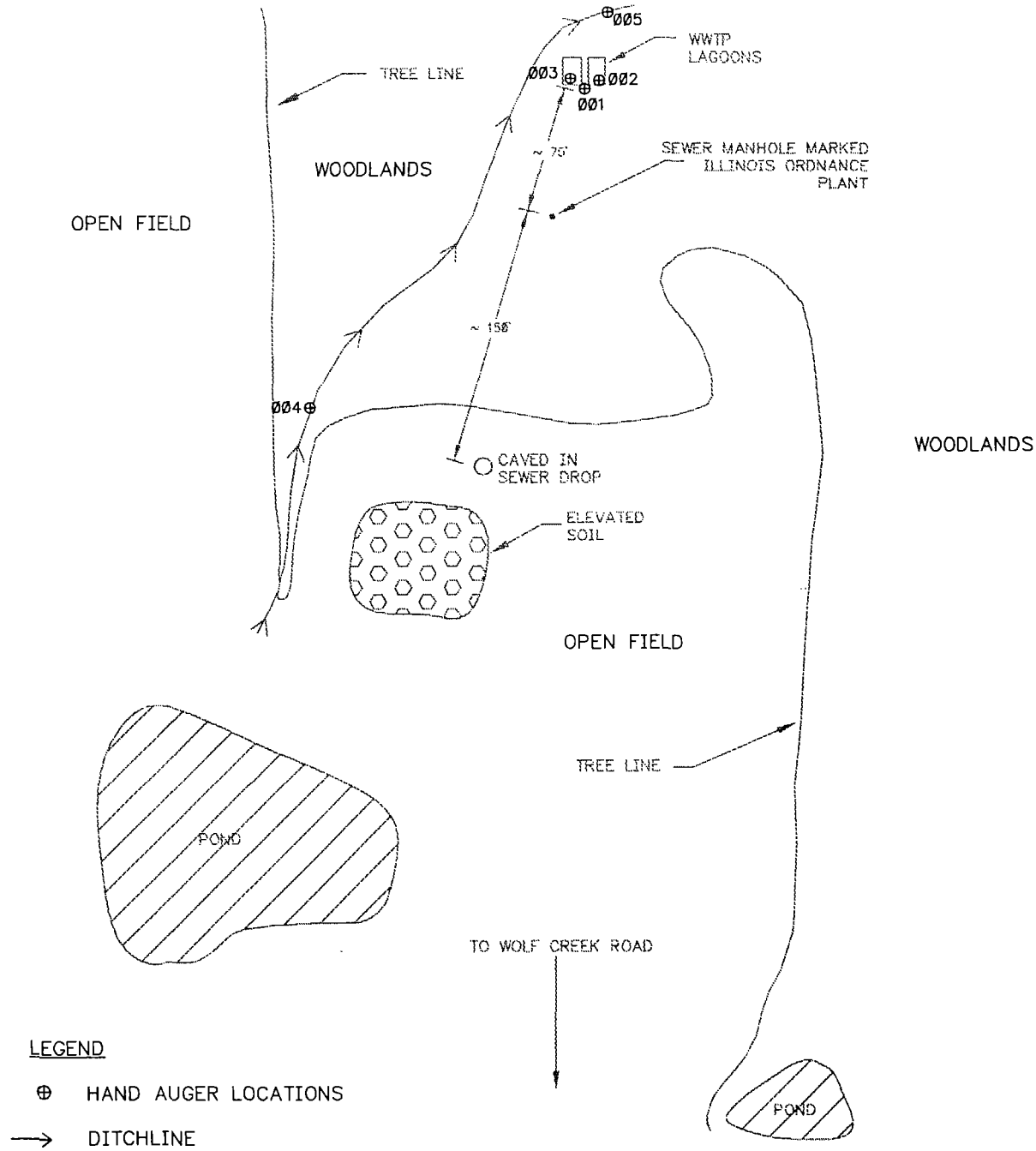
TABLE 13-9
SAMPLE LOCATIONS FOR AUS 0107 AND 108– POSSIBLE DISPOSAL AREAS IDENTIFIED BY AERIAL PHOTO INTERPRETATIONS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS

LOCATION NUMBER	SAMPLE DESIGNATION	LOCATION DESCRIPTION	TYPE	DEPTH	ANALYSIS	RATIONALE
0107-001	AUS-0107-001-SS-0X	North of Area 8 and south of Ogden Rd. at GIS Coordinates:	Test pit samples	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site identified by aerial photo interpretation as an open trench possibly used for solid waste disposal.
	AUS-0107-001-SS-02			1-2 ft	TCL Volatiles (8260B)	
	AUS-0107-001-SS-05			4-5 ft	TCL Volatiles (8260B)	
	AUS-0107-001-SS-??			Below trench	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	
	AUS-0107-001-GW-00		Test pit water	NA	TAL Metals (6010/7000) TCL BNAs (8270c) TCL Volatiles (8260b) SW846 Explosives (8330)	
0108-001	AUS-0108-001-SS-0X	North of Area 11, north of Ogden Rd. and east of COC 10, at GIS Coordinates:	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site identified by aerial photo interpretation as a possible surface disposal area and is located near COC 10.
	AUS-0108-001-SS-01			6-12 in.	TCL Volatiles (8260B)	
0108-002	AUS-0108-002-SS-0X	North of Area 11, north of Ogden Rd. and east of COC 10, at GIS Coordinates:	Shovel Sample	0-6 in.	TAL Metals (6010/7000) TCL BNAs (8270c) SW846 Explosives (8330)	Site identified by aerial photo interpretation as a possible surface disposal area and is located near COC 10.
	AUS-0108-002-SS-01			6-12 in.	TCL Volatiles (8260B)	



FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD CENTER MARION, ILLINOIS	PROJECT NO. 68FOD97872.ØØ
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY:djd 9/21/99 DSGN. BY:mh CHKD. BY:	AUS–ØØØ1 Fire & Police Headquaters Sample Locations
	FIG. NO. 13–1

File: F:\68FOD9727800\FWSAUS13-1.DWG Last edited: 02/24/00 @ 1:49 p.m. @ WCC-ST.LOUIS



LEGEND

- ⊕ HAND AUGER LOCATIONS
- ⟶ DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)
- ELEVATED SOIL

N

APPROXIMATE SCALE 1"=100'

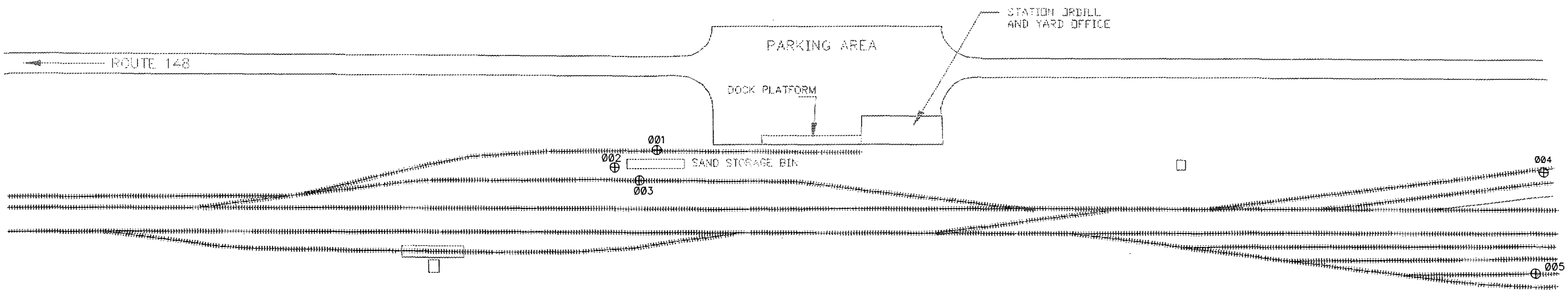
FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD CERCLA MARION, ILLINOIS	PROJECT NO. 68F0D97872.00

URS Greiner Woodward Clyde

A Division of URS Corporation

DRN. BY: djd 9/21/99 DSGN. BY: mh CHKD. BY:	AUS–0002–WWTP Sample Locations	FIG. NO. 13–2

File: F:\68F0D9727800\FWSAUSFIG13-2.DWG.DWG Last edited: 11/02/99 @ 5:55 p.m. WC-ST.LOUIS, MO



LEGEND

- ⊙ SOIL BORING/MONITORING WELL LOCATION
- ⊕ HAND AUGER LOCATIONS
- ⟶ DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

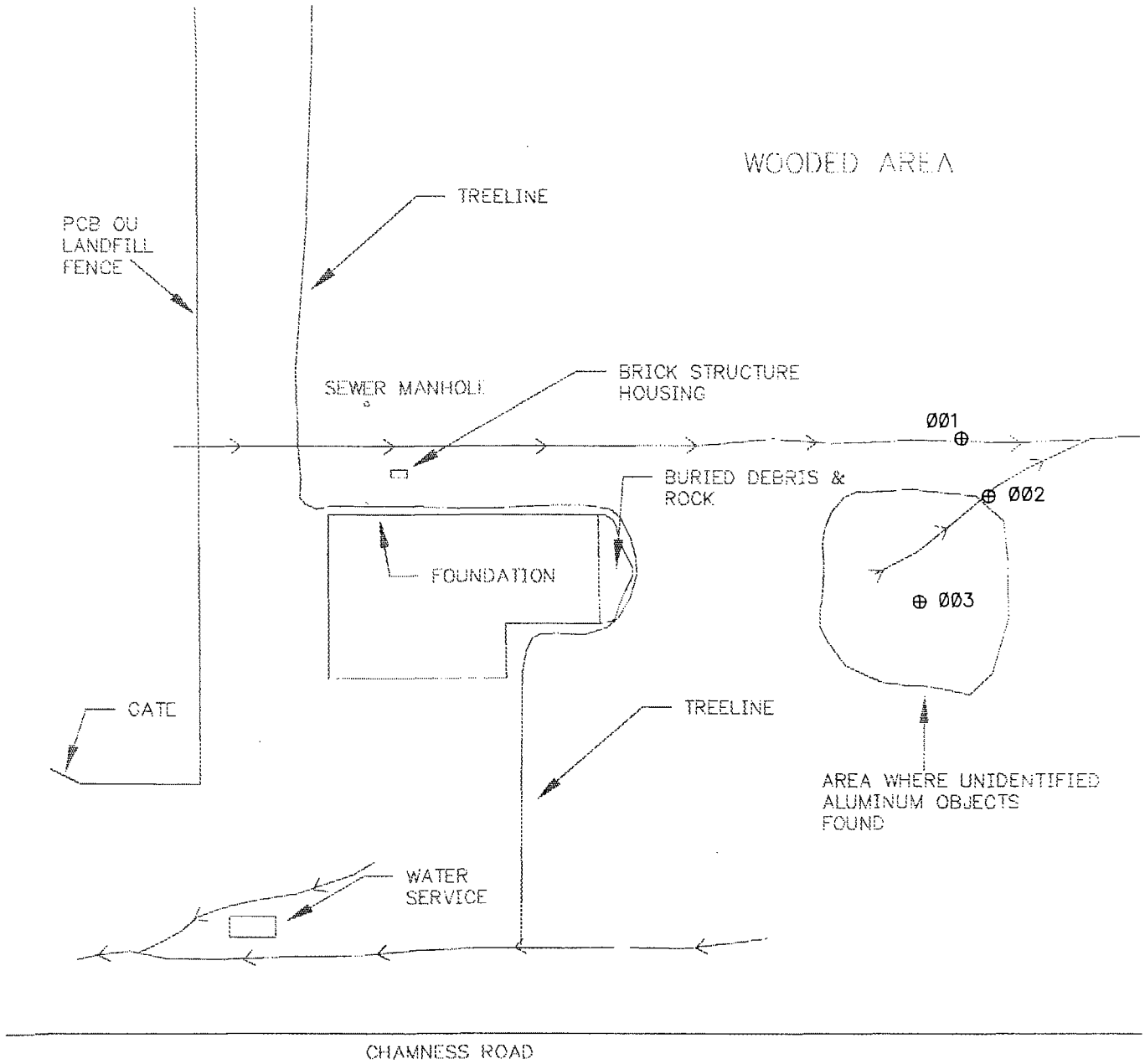
APPROXIMATE SCALE 1"=100'

FIELD SAMPLING PLAN-SITE INVESTIGATION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68F0D97278.00

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 10/5/99 DSGN. BY: mjh CHKD. BY:	AUS-0018 Railroad Classification Yard Sample Location	FIG. NO. 13-3

File: F:\68F0D9727800\CRABAUS18FIG13-3.DWG Last edited: 11/02/99 @ 5:47 p.m. WC-ST.LOUIS, MO



LEGEND

- EXISTING MONITORING WELL LOCATION
- HAND AUGER LOCATIONS
- DITCHLINE
- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

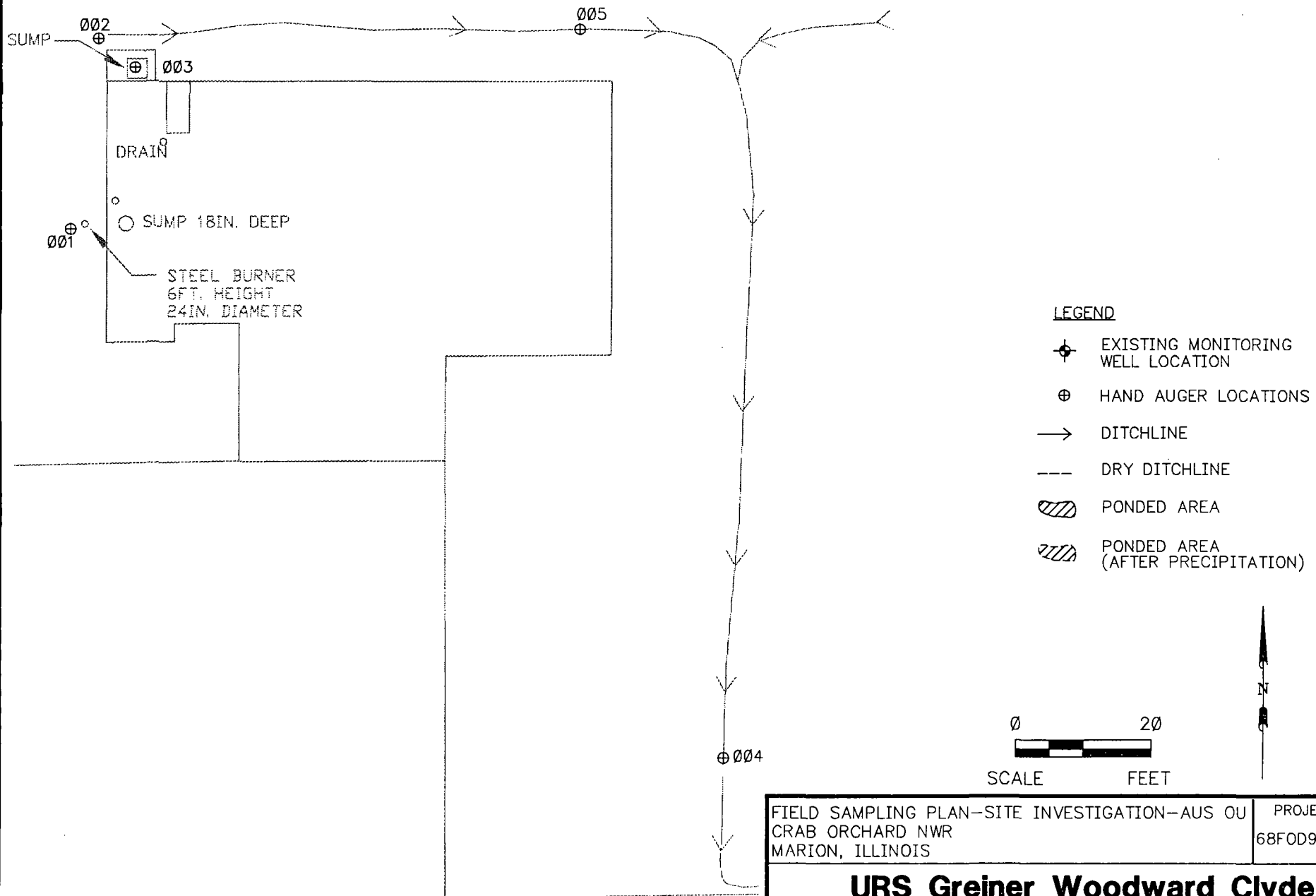
N

Ø 5Ø

SCALE FEET

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: djd 1Ø/5/99 DSGN. BY: mjh CHKD. BY:	AUS–ØØ21 Area 7 Fire Station Sample Locations
	FIG. NO. 13–4

File: G:\68FOD9727800\FWSAUS\FWSAUS21FIG13-4.DWG.DWG Last edited: 11/02/99 @ 3:26 p.m. WC-ST.LOUIS, MO



FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU
CRAB ORCHARD NWR
MARION, ILLINOIS

PROJECT NO. 68FOD97278.ØØ

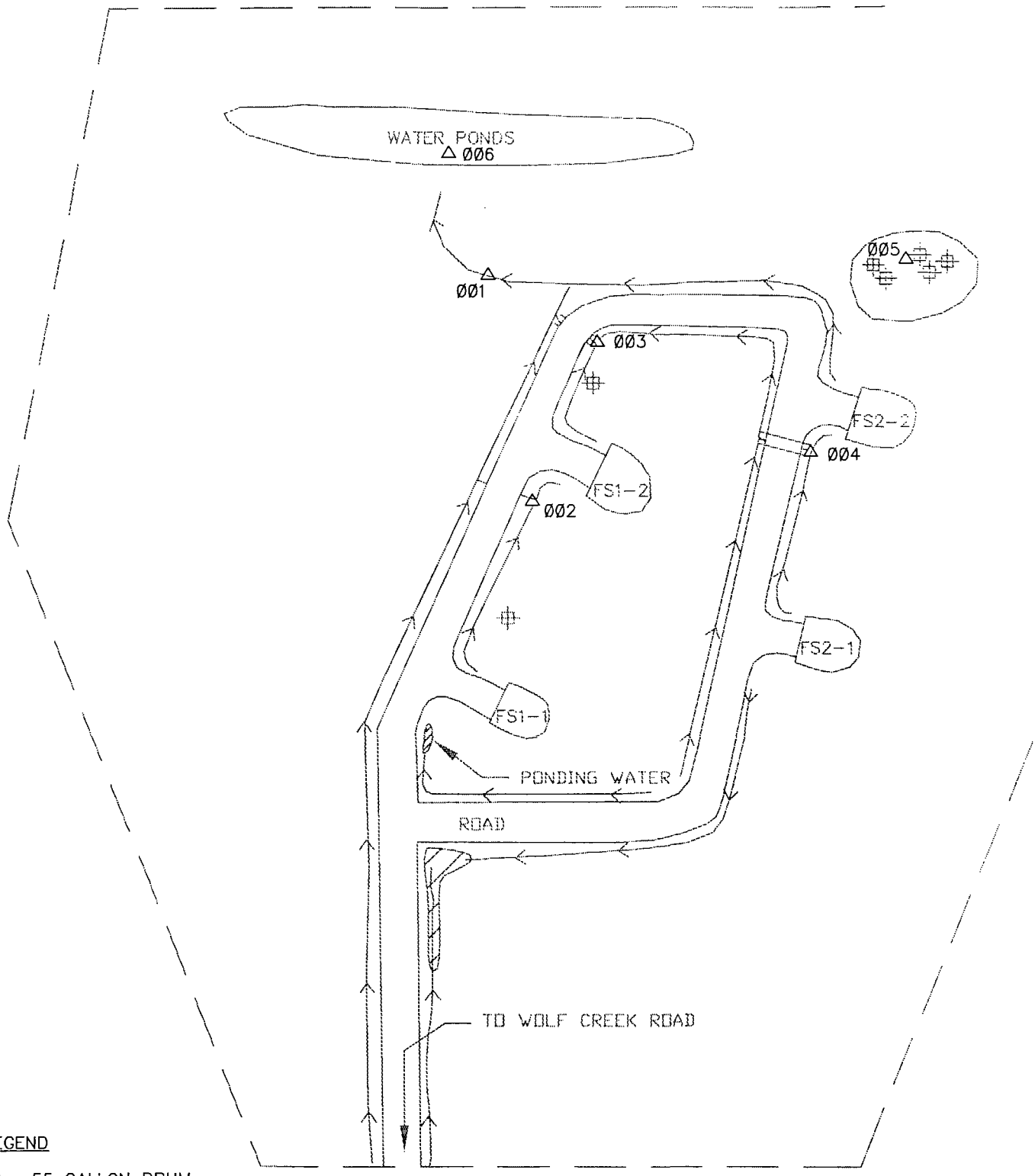
URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY: djd 1Ø/5/99
DSGN. BY: mjh
CHKD. BY:

AUS–ØØ43 Area 11/12 Fire Station Sample Locations

FIG. NO. 13–5

File: G:\68FOD9727800\FWSAUS\FWSAUS43FIG13-5.DWG Last edited: 11/02/99 @ 3:04 p.m. WC-ST.LOUIS, MO



LEGEND

- 55 GALLON DRUM
- EXISTING MONITORING WELL LOCATION
- SHOVEL SAMPLE LOCATIONS
- DITCHLINE
- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

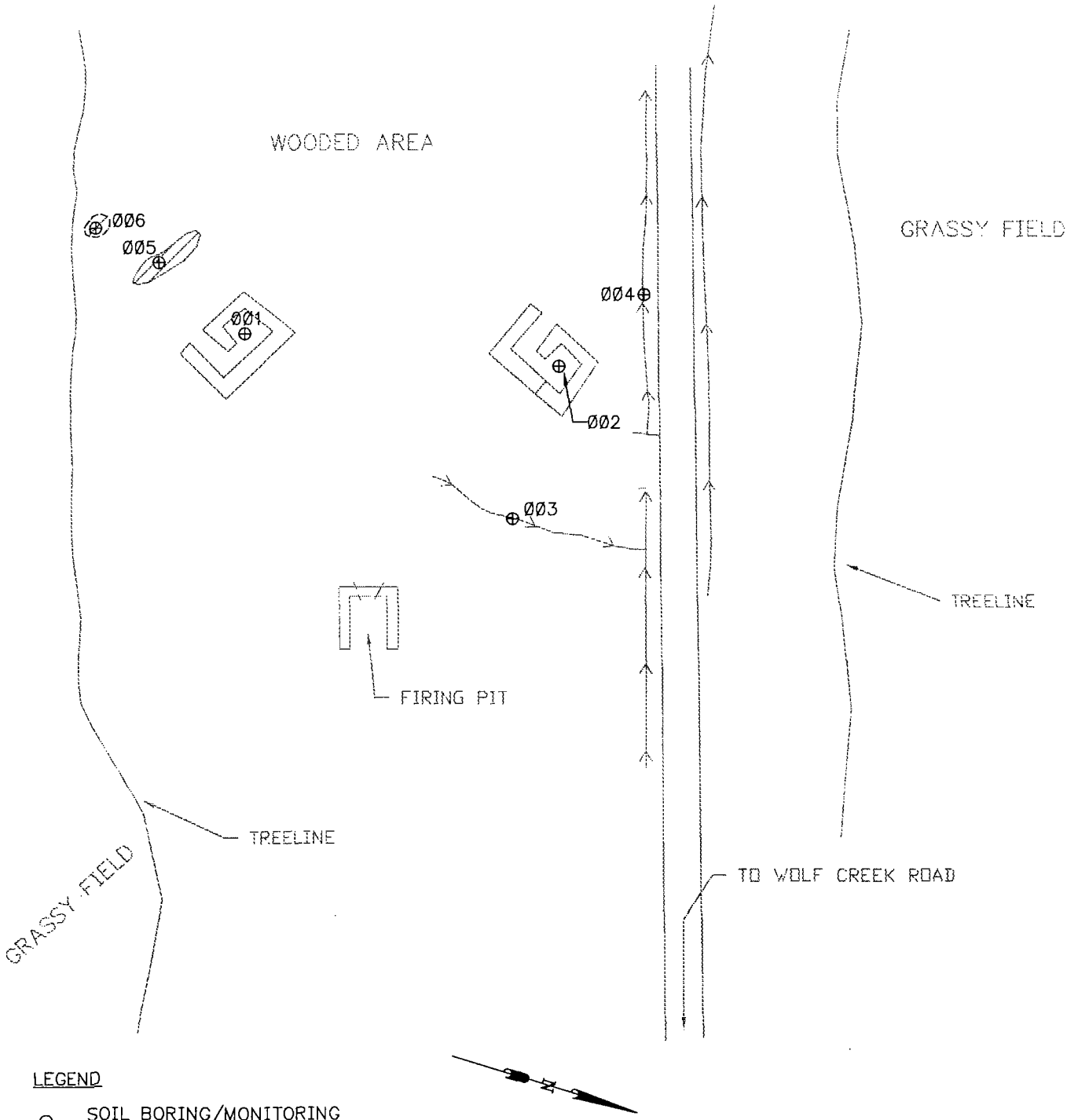
Ø 1ØØ
SCALE FEET

FIELD SAMPLING PLAN-SITE INVESTIGATION-AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY:djd 1Ø/5/99 DSGN. BY:mjh CHKD. BY:	AUS-ØØ6Ø Fulminate Storage Area Site map Sample Locations	FIG. NO. 13-6

File: G:\68FOD9727800\FWSAUS\FWSAUS60FIG13-6.DWG Last edited: 11/02/99 @ 3:04 p.m. WC-ST.LOUIS, MO



LEGEND

- ⊙ SOIL BORING/MONITORING WELL LOCATION
- ⊕ HAND AUGER LOCATIONS
- ⟶ DITCHLINE
- --- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)

APPROXIMATE SCALE 1"=3Ø'

FIELD SAMPLING PLAN–SITE INVESTIGATION–AUS OU CRAB ORCHARD NWR MARION, ILLINOIS	PROJECT NO. 68FOD97278.ØØ

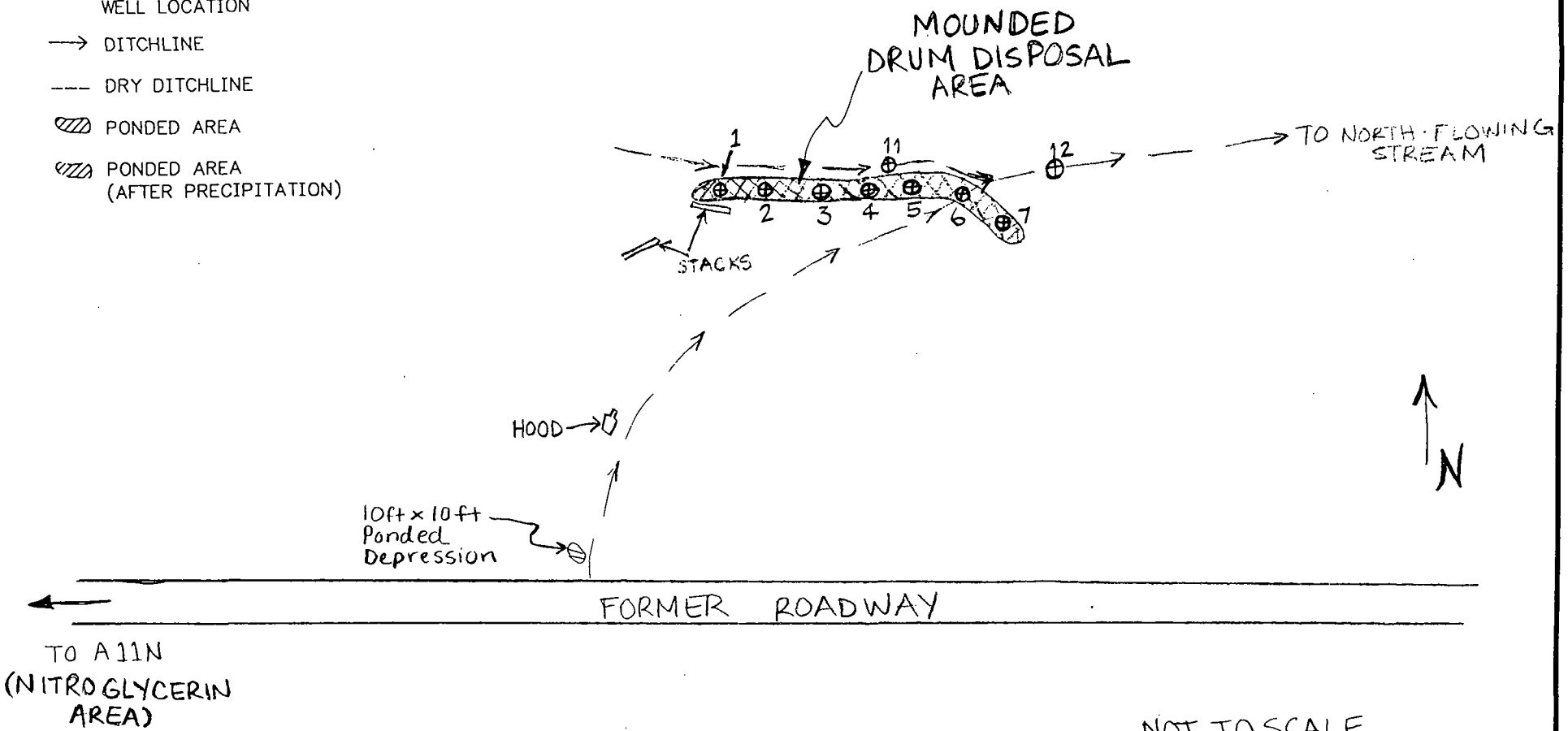
URS Greiner Woodward Clyde
A Division of URS Corporation

DRN. BY:djd 1Ø/5/99 DSGN. BY:mjh CHKD. BY:	AUS–ØØ61 Sample Locations	FIG. NO. 13–7

File: G:\68FOD9727800\FWSAUS\FWSAUS61FIG13-7.DWG.DWG Last edited: 11/02/99 @ 2:56 p.m. WC-ST.LOUIS, MO

LEGEND

- SOIL BORING/MONITORING WELL LOCATOIN
- HAND AUGER LOCATION
- EXISTING MONITORING WELL LOCATION
- DITCHLINE
- DRY DITCHLINE
- PONDED AREA
- PONDED AREA (AFTER PRECIPITATION)



NOT TO SCALE

NOTE: Sample numbers 8, 9 + 10 will be located in the field. They will be collected from the material inside the drums.

FIELD SAMPLING PLAN–SITE INSPECTION CRAB ORCHARD NATIONAL WILDLIFE REFUGE MARION, ILLINOIS	PROJECT NO. 68F0D97278.00
URS Greiner Woodward Clyde A Division of URS Corporation	
DRN. BY: MAM 2-14-00 DSGN. BY: TJA 2-14-00 CHKD. BY: TJA 2-14-00	AUS-106A SAMPLE LOCATIONS
	FIG. NO. 13-8

Standard operating procedures (SOPs) for sample collection, sample handling, shipping, documentation, and decontamination, are included in Appendix A. Samples, preservations, and holding times are summarized in Table 14-1.

14.1 QUALITY CONTROL

The frequency of quality control samples is specified in the QAPP. The proposed number of field splits, rinse blanks, trip blanks and quality control samples are outlined in Table 14-2. Some of the analytes are not included in this sampling plan, but are a contingency.

14.2 SAMPLE NUMBERING

An example of the sample numbering is as follows, and is described below:

AUS-0A2B-004-SL-05

- AUS-____-___-__-__: All samples will have the "AUS" prefix.
- ___-0A2B-___-__-__: The second part of the number identifies the AUS OU Site. This designation is for Area 2B.
- ___-____-004-__-__: The third part of the number identifies the sample location within that site.
- ___-____-___-SL-__: The fourth part of the number identifies the media. SS = soil. SD = sediment. GW = groundwater. SW = surface water. SL = sludge.
- ___-____-___-__-05: The last part of the number identifies the sample depth in feet, to the nearest foot of the bottom of the sample interval. "0X" in this position indicates a sample taken from the surface to a depth of 6 inches.

For samples of waste material and samples taken from drums, the fourth and fifth positions will be replaced by a four-digit descriptor such as "drum" for a drum sample.

Duplicate samples locations will be numbered sequentially starting with 500. This will ensure that duplicate samples cannot be distinguished from the original sample at the laboratory. The notes taken in the field log will detail the original sample for which it is a duplicate.

TABLE 14-1
SAMPLE CONTAINTERS, PRESERVATION, AND HOLDING TIMES

	Parameter	Container	Preservative	Holding Time
Aqueous	Metals	1 liter, HDPE bottle	4°C, HNO_3 to pH < 2.0	6 Months, 28 days for Hg
Samples	Cyanide	500 ml HDPE bottle	4°C, NAOH to pH>12	14 days
	VOCs	3, 40-ml VOA vials	4°C, HCL to pH < 2.0	14 days
	SVOCs + MOCA	2, 1-liter amber bottles	4°C	7 days extract, 40 days analysis
	PAHs	2, 1-liter amber bottles	4°C	7 days extract, 40 days analysis
	PCBs	2, 1-liter amber bottles	4°C	7 days extract, 40 days analysis
	Pesticides	2, 1-liter amber bottles	4°C	7 days extract, 40 days analysis
	Explosives	2, 1-liter amber bottles	4°C	7 days extract, 40 days analysis
	Ammonia, Nitrogen	500 ml HDPE	4°C, H_2SO_4 to pH < 2.0	28 days
	Nitrate-Nitrite, Nitrogen	1-liter HDPE bottle	4°C, H_2SO_4 to pH < 2.0	28 days
	Phosphates	1-liter HDPE bottle	4°C	48 hours
	Alkalinity	500 ml HDPE bottle	4°C	14 days
	TOC	500 ml, amber bottle	4°C, H_2SO_4 to pH < 2.0	28 days
	TDS	1-liter HDPE bottle	4°C	7 days
	Perchlorate	1-liter HDPE bottle	4°C	28 days
	TSS	1-liter HDPE bottle	4°C	7 days
	Picric Acid	2, 1-liter amber bottles	4°C	7 days extract, 40 days analysis
Soil/Sediment	Metals	4 oz. glass jar, teflon lined lid	4°C	6 Months, 28 days for Hg
Samples	Cyanide	8 oz. glass jar, teflon lined lid	4°C	14 Days
	VOCs	3 Encore™ samplers, 2 oz. glass jar	4°C	48 hours extract, 14 days analysis
	SVOCs + MOCA	8 oz. glass jar, teflon lined lid	4°C	14 days extract, 40 days analysis
	PAHs	8 oz. glass jar, teflon lined lid	4°C	14 days extract, 40 days analysis
	PCBs	8 oz. glass jar, teflon lined lid	4°C	14 days extract, 40 days analysis
	Pesticides	8 oz. glass jar, teflon lined lid	4°C	14 days extract, 40 days analysis
	Explosives	8 oz. glass jar, teflon lined lid	4°C	14 days extract, 40 days analysis
	Ammonia, Nitrogen	8 oz. glass jar, teflon lined lid	4°C	28 days
	Nitrate-Nitrite, Nitrogen	8 oz. glass jar, teflon lined lid	4°C	28 days
	Phosphates	8 oz. glass jar, teflon lined lid	4°C	48 hours
	TOC	8 oz. glass jar, teflon lined lid	4°C	28 days
	Grain Size	8 oz. glass jar, teflon lined lid	--	

Note: Sample containers can be combined for many parameters.
HCL - Hydrochloric Acid
HDPE - High-density polyethylene
H_2SO_4 - Sulfuric acid
HNO_3 - Nitric acid
PCBs - Polychlorinated Biphenyls
PAHs - Polynuclear Aromatic Hydrocarbons
TOC - Total Organic Carbon
TDS - Total Dissolved Solids
TSS - Total Suspended Solids

TABLE 14-2
SAMPLE QUANTITES
AUS FIELD SAMPLING PLAN

Parameter	Analyte List	Method No. (SW846 or Stand. Meth)	Field Samples	Field Replicates	Field Blanks	Trip Blanks	MS/MSD Samples MS	MS/MSD Samples MSD	QA Samples	Total
Water										
Metals	TAL + Boron	6010C/7000	199	20	20		10	10	0	239
Metals	TAL	6010C/7000							10	10
Volatiles	TCL + Hexane	8260b	132	14	14	14	7	7	0	188
Volatiles	TCL	8260b							7	7
BNAs	TCL	8270	135	14	14		7	7	0	177
BNAs	TCL	8270							7	7
BNAs	TCL BNAs + MOCA	8270C	2	1	1		1	1	0	6
Picric Acid	Picric Acid	STL - SOP - PICRIC - REV.0	4	1	1		1	1	0	8
PAH		8310	21	3	3		2	2	0	31
PAH		8310							2	2
Explosives	SW-846 (14 compounds)	8330	134	14	14		7	7	0	176
Explosives	SW-846 (14 compounds + PETN and NG)	8330	61	7	7		4	4	0	83
Ammonia	Ammonia as N	350.1	90	9	9		5	5	0	118
Nitrate-nitrite	Nitrate/Nitrite as N	353.2	103	11	11		6	6	0	137
Phosphates	Phosphate as P	365.3	48	5	5		3	3	0	64
Alkalinity	Carbonate/bicarbonate	310.1	57	6	6		3	3	0	75
Total dissolved solids	TDS	160.1	74	8	8		4	4	0	98
Perchlorate	Perchlorate	STL-M-C104	79	8	8		4	4	0	103
Total suspended sol.	TSS	160.2	38	4	4		2	2	0	50
Sulfate	Sulfate	300	55	6	6		3	3	0	73
Dioxin	SE-846 (17 compounds)	8290	2	1	1		1	1	0	6

TABLE 14-2
SAMPLE QUANTITES
AUS FIELD SAMPLING PLAN

Parameter	Analyte List	Method No. (SW846 or Stand. Meth)	Field Samples	Field Replicates	Field Blanks	Trip Blanks	MS/MSD Samples MS	MS/MSD Samples MSD	QA Samples	Total
Soil/Sediments										
Metals	TAL + Boron	6010C/7000	786	79	79		40	40	0	1024
Metals	TAL	6010C/7000							40	40
Volatiles	TCL + Hexane	8260b	452	46	46	46	23	23	0	636
Volatiles	TCL	8260b							23	23
BNAs	TCL	8270	493	50	50		25	25	0	643
BNAs	TCL	8270							25	25
BNAs	TCL BNAs + MOCA	8270C	8	1	1		1	1	0	12
Picric Acid	Picric Acid	STL - SOP - PICRIC - REV.0	5	1	1		1	1	0	9
PAH		8310	64	7	7		4	4	0	86
PAH		8310							4	4
PCBs	7 Aroclors (total)	8082	13	2	2		1	1	0	19
PCBs	7 Aroclors (total)	8082							1	1
Pesticides	SW-846 (28 compounds)	8081A	11	2	2		1	1	0	17
Pesticides	SW-846 (28 compounds)	8081A							1	1
Explosives	SW-846 (14 compounds)	8330	481	49	49		25	25	0	629
Explosives	SW-846 (14 compounds + PETN and NG)	8330	205	21	21		11	11	0	269
Ammonia	Ammonia as N	350.1	6	1	1		1	1	0	10
Nitrate-nitrite	Nitrate/Nitrite as N	353.2	4	1	1		1	1	0	8
Total organic carbon	TOC	9060	48	5	5		3	3	0	64
Perchlorate	Perchlorate	STL-M-C104	64	7	7		4	4	0	86
Cyanide	free or total cyanide	4500-CN I/9012A	30	3	3		2	2	0	40
Dioxin	SE-846 (17 compounds)	8290	36	4	4		2	2	0	48

APPENDIX A Standard Operating Procedures

SOP No. 1 – Hand Auger Sampling
SOP No. 2 – Monitoring Well Installation
SOP No. 3 – Groundwater Sampling (Monitoring Well)
SOP No. 4 – Water Level Measurements
SOP No. 5 – Slug Testing
SOP No. 6 – Decontamination
SOP No. 7 – Sample Handling, Documentation and Tracking
SOP No. 8 – Headspace Analysis
SOP No. 9 – Identifying Underground Storage Tanks Using a Magnetometer Survey
SOP No. 10 – Surface Water Sampling
SOP No. 11 – Sediment Sampling
SOP No. 12 – Drum Sampling
SOP No. 13 – Water Quality Monitoring Equipment

SOP NO. 1 – HAND AUGER SAMPLING

1. PURPOSE AND SCOPE

This document defines the standard procedure for collection of soil and/or sediment samples. This procedure gives descriptions of equipment and field procedures necessary to collect soil and/or sediment samples. The sample locations and frequency of collection are specified in the Work Plan.

This SOP serves as a supplement to the Work Plan and is intended to be used together with other SOPs. Other related SOPs are listed below:

- SOP No. 6 - Decontamination
- SOP No. 7 - Sample Identification, Handling, and Documentation
- SOP No. 8 - Headspace Analysis

Health and safety procedures and equipment that will be required during the investigation are detailed in the HSP.

2. SOIL SAMPLING PROCEDURES

2.1 EQUIPMENT LIST

Equipment used during hand auger sampling:
- Stainless steel hand auger
- Sampling assembly and extension poles
- Decontamination buckets and brushes
- Alconox
- Disposable latex gloves
- Stainless steel bowls
- Stainless steel spoons
- Sampling containers
- Cooler and ice packs
- Chain of custody
- Custody Seal
- Photo ionization detector (PID) if applicable
- First aid kit
- Aluminum foil

2.2 SAMPLING PROCEDURE

This section gives the step-by-step procedures for collecting soil samples in the field. Observations made during sample collection should be recorded in the field notebook and field data sheet as specified in Section 2.3.1 of this SOP.

2.2.1 Equipment Decontamination

Prior to entering the field it is necessary to decontaminate the augers. Clean augers will be wrapped in aluminum foil until they are used. The procedures presented in SOP No. 6 will be followed for decontamination of field equipment and for personnel decontamination.

2.2.2 Instrument Calibration

Electronic equipment used during soil sampling is a PID. Before going into the field, the sampler shall verify that these instruments are operating properly. Calibration times and readings will be recorded in a notebook to be kept by the field sampler. Specific instructions for calibrating the instruments are given in the instrument manuals.

2.2.3 Sample Collection

The auger is advanced into the soil using a rotating motion while applying pressure. After advancing the auger into the soil to the desired depth, the auger is removed and a sample can be obtained from the barrel. Note: VOC samples will be collected with the Encore™ sampler directly from the boring at the target depth to reduce the loss of volatile compounds. Latex gloves should be used to handle soil and should be changed prior to collecting the sample. After the sample has been taken, the auger should be decontaminated using Alconox soap and deionized water before collecting the next sample. The sample should be placed in the sample container and stored in the cooler with ice. On the soil sample collection field sheets, the general characteristics of the soil should be noted such as: stratigraphic description, moisture content, clay, silt, sand, gravel content, any distinct odors, PID readings (if applicable), color, and texture.

Other samples (Explosives, Metals, etc.) may be composited in stainless steel bowls using stainless steel spoons prior to placement in sample jars. Bowls and spoons will require decontamination prior to sampling also.

2.3 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled, and recorded as described in this SOP and in SOP No. 7.

2.3.1 Field Sampling Data Sheet

A field sampling data sheet for soil samples (Figure SOP 1-1) will be completed at each sampling location. The data sheet will be completely filled in. If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Location number
- Date and time of sampling
- Person performing sampling
- Depth of sample
- Number of samples taken
- Sample identification number
- Description of sample
- Record of any QC samples from site
- Headspace analysis (if taken)
- Any irregularities or problems which may have a bearing on sampling quality

2.3.2 DOCUMENTATION

Field Notes

Field notes shall be kept in a bound field book. The following information will be recorded using waterproof ink:

- Names of personnel
- Weather conditions
- Location and sample number
- Date and time of sampling
- Decontamination information
- Depth of sample
- Preservation of samples
- Record of any QC samples from site
- Analyses that will be performed by the laboratory
- Equipment calibration information
- Headspace analysis (if taken)
- Any irregularities or problems which may have a bearing on sampling quality

SAMPLE COLLECTION FIELD SHEET

SITE NAME _____ PROJECT NO. _____

SAMPLE NO. _____ WELL NO. _____

DATE/TIME COLLECTED _____ PERSONNEL _____

SAMPLE METHOD AND DEPTH _____ _____

SAMPLE MEDIA (Circle 1): Soil Sediment Sludge MS/MSD

SAMPLE SPLIT (Circle 1): Yes No SPLIT SAMPLE NUMBER _____

FIELD DUPLICATE (Circle 1): Yes No DUPLICATE SAMPLE NUMBER _____

Sample Container	Preservative	Analysis Requested

DESCRIPTION:

DEPTH: DESCRIPTION:

Comments _____

SOP NO. 2 - MONITORING WELL INSTALLATION AND DEVELOPMENT

1. PURPOSE AND SCOPE

The purpose of this document is to define the SOP and necessary equipment for installation and development of groundwater monitoring wells. The step-by-step procedures described herein are sufficiently detailed to allow field personnel to properly install and develop the planned groundwater monitoring wells.

This SOP serves as a supplement to the Work Plan and Sampling and Analysis Plan and is intended to be used together with several other SOPs. Other related SOPs are listed below:

- SOP No. 4 - Water Level Measurement
- SOP No. 6 - Decontamination
- SOP No. 7 - Sample Identification, Handling, and Documentation

2. PROCEDURES FOR DRILLING AND MONITORING WELL INSTALLATION

This section details the required equipment, drilling, well installation procedures, and documentation procedures for installation of groundwater monitoring wells (including piezometers).

2.1 EQUIPMENT LIST

The following is an equipment list for well installation:

- Well casing and well screen
- Stainless-steel centralizers (if required)
- Bentonite (pellets, powder, or chips)
- Filter pack sand
- Potable water
- Portland Type I or II Cement, powdered bentonite for grouting
- Traffic-rated man-hole with locking cap
- Dry premix concrete
- High-pressure steamer/cleanser
- Long-handled bristle brushes
- Wash/rinse tubs
- Alconox detergent

- Location map
- Drill rig capable of installing wells to the desired depth with the proper diameter in the expected formation materials and conditions
- Plastic bags (Ziploc-type) or 8 ounce glass jars
- Self-adhesive labels
- Weighted tape measure with 0.1-foot increments
- Water level probe with 0.01-foot increments
- Deionized water and pressure sprayer
- Appropriate health and safety equipment, as specified in the Health and Safety Plan
- Field Logbook
- Boring log sheets
- Well construction form
- Well Keys (keyed alike)

2.2 DRILLING AND WELL INSTALLATION PROCEDURES

This part of the site work includes two general work activities:

1. Completion of a soil boring to evaluate the subsurface conditions and to obtain soil samples for visual descriptions or geotechnical testing.

2. Installation of a groundwater monitoring well within the soil boring to allow water level measurements and collection of groundwater samples.

All monitoring wells are scheduled to be installed with hollow-stem augers, placing the well materials through the center of the augers.

2.2.1 Preparation for Drilling

Several activities must be completed prior to any drilling work including:

- Staking the boring position

- Confirming accessibility of the monitoring well location to the proposed drilling equipment

- Clearing underground utilities or structures at the boring site

All sites must be checked for access prior to mobilization of the drill crew. Remember to check for overhead utilities or obstructions.

2.2.2 Drilling Methods

Hollow-stem auger method and rotary wash boring are described in the following sections:

2.2.2.1 Hollow-Stem Auger Drilling

Subsurface auger borings will utilize 4-1/4-inch minimum inside-diameter hollow-stem augers (HSA) to accommodate a 3-inch outside-diameter, stainless-steel split spoon or 5-foot-long core sampler. Hollow-stem auger borings will be completed in accordance with ASTM D1452.

Hollow-stem auger methods are commonly used in cohesive soils or in granular soil formations, where the boring walls may be unstable, and the augers form a temporary casing to allow sampling of the "undisturbed soil" below the bit. The hollow-stem augers provide a casing that supports the borehole walls and provides clear access to the bottom of the boring. Samplers can be easily inserted into the central core of the augers to obtain soil samples with a reduced risk of contamination by contact with soil strata at higher elevations. In a similar manner the augers allow installation of the monitoring well materials through the central core greatly reducing the potential for contact with the surrounding soil formations and resulting contamination.

The hollow-stem augers were designed to be advanced with a center bit or plug attached to drill rods. This center bit is intended to prevent soil cuttings from entering the hollow-stem augers during drilling and is removed to allow soil sampling. Use of a center plug or a special retainer basket to keep the core of the augers free of soil is essential.

Significant problems can occur where hollow-stem augers are used to sample soils below the groundwater level. The unbalanced water pressure acting against the soil at the bottom of the boring can significantly disturb the soil, particularly in granular soils or soft clays. Often the soils will heave and plug the auger preventing the sampler from reaching the bottom of the boring. Where heave or disturbance occurs, the penetration resistance or strength of the sample can be significantly reduced and the augers can become contaminated. Use of a retainer basket or filling the center of the augers with water or drilling mud may be required in some soil formations. Any water introduced into the augers must be potable and the quantity used recorded in the logbook. If heaving occurs, contact the site manager for specific instructions to modify the drilling method.

Soil cuttings will be left at the location where they originated. **Note: Soil cuttings at Areas 2B, 2D, 2F, and 2P will be containerized and waste characterization will be determined pending analytical results.**

Resistance to soil penetration will be measured when using a split-spoon sampler in accordance with ASTM D1586. Penetration resistance (blow counts) for each 6-inch increment will be recorded on the boring log. The coupling head for the split-spoon sampler will be provided with a ball check valve and will have open vents. Where necessary for sample recovery, the sampler will also be equipped with a spring-type sample retainer.

When using the 5-foot-long continuous sampler, the tip of the sampler will proceed the HSA bit, and special care will be taken to ensure that maximum recovery is obtained on each section of soil core. Core runs will be limited to 5 feet or less to ensure acceptable core recovery. Runs of 1 or 2 feet may be required to obtain acceptable core recovery in soft or broken material. Grinding of the core after the core barrel has been blocked will not be permitted.

2.2.2.2 Rotary Wash Boring

Subsurface rotary borings will utilize 8-inch minimum drag or tri-cone drill bit. Rotary wash borings will be completed in accordance with ASTM D1452.

The rotary wash boring method is commonly used in soil formations below the groundwater level where the boring walls are unstable. The drilling fluid (bentonite) is used to stabilize the boring walls and to remove the drill cuttings from the boring. Drag bits are commonly used in soil formations, and roller bits are used to penetrate cemented zones and rock formations.

Examination of the cuttings suspended in the wash water provides an opportunity to identify changes in the soil conditions between sample locations. A strainer is held in the drill water discharge stream to catch the suspended material. In some instances the drill water will be lost or significantly reduced. Open joints, fissures, cavities, or highly permeable zones are indicated by this action and must be carefully noted on the logs.

The weight of the drilling fluid and the quantity of water pumped through the bit will determine the size of particles that can be removed from the boring with the circulating fluid. In formations containing gravel, cobbles, or larger particles, coarse material may be left in the bottom of the boring. In these instances, clearing the bottom of the boring with a large-diameter sampler (such as a 3-inch OD split barrel sampler) may be needed to obtain a representative sample of the formation. The level of the drilling fluid in the boring must be maintained at or above the ground surface while removing drilling rods or tools to maintain positive pressure on the soil formations. The driller must add water or drilling fluid as the drilling tools are removed.

2.2.2.3 Soil Sampling

Continuous soil samples are required for all monitoring wells to aid in the evaluation of the stratigraphic conditions. Where analytical or geotechnical testing is required, the soil samples will be obtained with stainless-steel split-barrel samplers, continuous soil sampling systems, thin-walled samplers, or core samplers. Soil samples will be described using the Unified Soil Classification System (USCS).

Note that VOC samples will be collected with the Encore™ sampler directly from the sampler. Other samples (Explosives, Metals, etc.) may be composited in stainless

steel bowls using stainless steel spoons prior to placement in sample jars. Bowls and spoons will require decontamination prior to sampling also.

The sample will be classified in the field and the description recorded on the boring log by the field geologist. The strength of the soil sample will be measured with visual methods, evaluation of the driving resistance, or a hand penetrometer test.

The procedure for collecting subsurface soil samples is described below:

- Collect the soil samples at the depths specified in the SAP Addendum.
- Open the soil sampler, scan the length of the sample with the FID/PID and record the readings, measure the recovery, and scrape off any soil smear zone from the recovered sample with a stainless-steel knife. If the soil is not cohesive or if the smear zone cannot be easily removed, an attempt will be made to remove soil from the portion of the sample that has not come in contact with the sampler.
- Determine and identify the use of the recovered sample. This will always be for soil classification and stratigraphic logging and may be for geotechnical analysis.
- If geotechnical analysis is required, retain and complete the analyses according to SOP No. 8.

  Samples collected for triaxial permeability will be collected using a thin-walled (Shelby) tube sampler (ASTM D 1587). Both ends of the sampler tube will be capped after sample collection with wax or rubber packer.

  Samples collected for dry unit weight will be collected using a thin-walled (Shelby) tube sampler (ASTM D 1587) or 3-inch-diameter ring-lined barrel sampler (ASTM D 3550) such as the California Modified Sampler.
- Complete the lithologic description of the recovered sample according to the Unified Soil Classification System using ASTM D 2488.

2.2.3 Stratigraphic Logging

The stratigraphy at the monitoring well location will be logged by examination of the soil cuttings, examination of geotechnical soil samples and an observation of the response of the drilling equipment. The data will be recorded on the field-boring log and in the field book and will include the following information:

- Project name and number
- Drilling company name
- Date drilling started and finished
- Type of bit and size
- Size of augers (inside and outside diameters)

- Well completion details
- Driller's name
- Field geologist's name
- Type of drill rig
- Boring number and location
- Surface elevation (if available)
- Ground surface condition (grass, pavement)
- Sample depths and times
- Sample characteristics with depth, such as lithology, grain size, sorting, texture, structure, bedding, strength, color, water content, soil type, the Unified Soil Classification Symbol (if in unconsolidated geologic material) and a description of the geologic origin
- Water levels
- Geophysical or video log run (if any)
- Drilling observations
- FID/PID headspace and breathing zone readings
- Other pertinent information

2.2.4 Well Materials Specifications

Well Casing

Well casing will consist of new, threaded, flush-joint, 2-inch ID, PVC piping. Teflon O-rings will be used at all joints. Heat-welded joints and/or gaskets will not be used. The tops of all well casings will be fitted with locking caps that can be easily removed by hand. All well casing will be free of foreign material and cleaned before use in accordance with SOP No. 6.

Well Screen

Well screen will consist of new 2-inch ID, PVC, continuous, wire-wrapped, screen. The screen slot size will be 0.010 inch. The screen length of the monitoring wells will be 10 feet. The screen length of monitoring wells will not exceed 10 feet in length. The screen depth will be determined in the field by a URSGWC geologist, based on the geologic conditions encountered in the boring. All well screens will have an inside diameter equal to or greater than that of the well casings. All well screen will be free of foreign material and cleaned before use in accordance with SOP No. 6.

Filter Pack

The filter pack material (16/30 Filter Pack or Morey #1) for the monitoring wells will consist of a clean, washed, well-rounded silica sand to form a filter between the natural formation material and the well screen. Constant probing of pack thickness will be done to prevent bridging. The filter pack will be placed from the bottom of the boring to about 3 feet above the top of the screen.

Bentonite Seal

A bentonite seal shall be installed above the filter pack sand in the monitoring wells. The seal will consist of a layer of commercially available bentonite pellets or chips that is approximately 3-feet thick as measured immediately after placement, without allowance for swelling. As the bentonite chips or pellets are placed, about one gallon of potable water per foot of chips or pellets will be added to initiate hydration of the bentonite.

Cement/Bentonite Grout

The annular space between the well casing and the boring in the wells will be filled with a cement/bentonite grout from the top of the bentonite seal to 3 feet below the ground surface. The grout mixture will consist of approximately nine parts Portland cement to one part bentonite (equivalent to one 94-pound bag of cement to about 10 pounds of bentonite powder) added to about 20 gallons of potable water. The grout will be prepared in an above-ground rigid container by first thoroughly mixing the bentonite powder with water and then mixing in the cement. Grout will be placed in the well annulus with a tremie pipe. The grout will be pumped through the tremie pipe until undiluted grout flows from the annular space at the ground surface.

Concrete Surface Seal

Following placement of the cement/bentonite grout, the remaining 3 feet of annular space will be filled with concrete. The concrete will consist of a sand/gravel premix or ready-mixed concrete.

Ground Surface (Flush) Completion

Following placement of the concrete surface seal, a minimum 12-inch outside-diameter (OD) traffic rated, water tight manhole will be imbedded in the concrete. Manholes installed on paved surfaces will be completed flush. Manholes installed in unpaved areas will be completed with a concrete pad extending a minimum of 1.5 feet (3-foot diameter) from the well casing and a minimum thickness of 6 inches with a slight mound above the ground surface. A locking water-tight security plug will be installed and locked with a padlock on top of the PVC riser.

Aboveground Completion

Following placement of the concrete surface seal, a minimum 6-inch ID, 5-foot-long, protective steel casing with a lockable steel cap shall be placed over the monitoring well casing projecting above the ground surface. The protective casing will be placed about 2.0 feet into the concrete surface seal, leaving about 3.0 feet above the ground surface. A concrete surface pad will be placed around the protective cover extending a

minimum of 1.5 feet (3-foot diameter) from the cover and a minimum of 6 inches thick with a slight mound above the ground surface.

Guard Posts

Three 3-inch-diameter steel posts will be installed around the wells with aboveground completions. The posts will be located radially from the well casing at a distance of about 4 feet. The guard posts will be placed about 2 feet below the ground surface and have a minimum of 3 feet aboveground exposure. The inside of each post will be filled with concrete.

2.2.5 Well Installation Procedure

The procedures for monitoring well installation using Hollow-Stem Augers is as follows:

1. Decontaminate all drilling equipment according to procedures outlined in SOP No. 6.

2. Advance the boring to the planned depth using hollow stem augers. Collect soil samples continuously with a split-barrel sampler or with a soil core barrel advanced with the hollow-stem augers.

3. Measure depth of completed boring using a weighted tape.

4. Decontaminate all well materials according to SOP No. 6. Following decontamination, all personnel that handle the well materials will don a clean pair of rubber or surgical gloves.

5. Measure the length of each section of well casing and screen to nearest 0.10 foot.

6. Assemble the well screen and casing as it is lowered into the boring inside the hollow stem augers.

7. Lower screen and casing until the bottom cap is about 6 inches above the bottom of the boring.

8. Record level of top of casing and calculate screened interval. Adjust screen interval by raising the assembly to the desired interval, if necessary, and add sand to raise the bottom of the boring to the base of the casing.

9. Calculate and record the volume of the filter pack, bentonite seal, and grout/bentonite chips required for existing boring conditions. (Annular Space Calculation: $V_H = \pi r^2 h$; $V_C = \pi r^2 h$; $V_A = V_H - V_C$, where V_H = Volume of borehole, V_C = Volume of casing, V_A = Volume of annulus, r = Radius of borehole, and h = Vertical length of borehole.)

10. Installation of monitoring well filter pack sand, seal, and backfill.

    a. Begin adding filter pack sand around the annulus of the casing by tremie pipe in 5-foot increments. Repeated depth soundings shall be taken to monitor the level of the sand.

    b. Allow sufficient time for the filter pack sand to settle through any water column outside the casing before measuring the sand level.

    c. Extend the filter pack sand to about 3 feet above the top of the well screen.

    d. Following filter pack sand placement, install a 3-foot-thick annular seal of bentonite chips or pellets on top of the filter pack sand. Slowly add the bentonite chips or pellets through the Hollow-Stem Augers to avoid bridging. Add one gallon of potable water per one foot lift of chips or pellets to initiate swelling of the bentonite chips or pellets if annular seal is above the water table. The bentonite seal will be allowed to hydrate for 30 minutes prior to placement of the cement/bentonite grout.

    e. Add cement/bentonite grout to the remaining annulus from the top of the bentonite seal to 3 feet below the surface. The grout will be tremied into the borehole until the annulus is completely filled. The base of the tremie pipe should be placed approximately 3 feet above the filter pack sand when grouting begins.

    f. After the column of grout has set for at least 24 hours it will be checked for settlement. If necessary, additional grout will be added to accommodate any settlement.

11. After the monitoring well backfill grout sets, the 3-foot-thick concrete surface seal will be installed. The excavation will be filled with concrete. A protective cover or manhole will be centered on the well casing riser and inserted into the concrete. The well number, depth, and installation date will be inscribed on the well casing cap.

2.3 DOCUMENTATION

Observations and field data acquired during drilling and installation of the monitoring wells will be recorded to provide a permanent record. These observations will be recorded with waterproof ink in a bound weatherproof field book with consecutively numbered pages. Notes will be recorded daily when in the field. The information in the field book will include the following as a minimum:

- Project name and number
- Observer's name
- Drilling and well installation observations as described in Section 2.2 of this SOP
- Decontamination observations as described in SOP No. 6

- Weather conditions
- Other pertinent information

A boring log (Figure SOP 2-1) will be completed for each boring. The observations made during the boring will also be recorded in the field book. The well installation details will be shown in a diagram which will be completed in the field book and on the monitoring well construction log (Figure SOP 2-2). Each well diagram will consist of the following (denoted in order of decreasing depth from ground surface):

- Bottom of the boring
- Casing depth
- Casing and screen type
- Screen location(s)
- Filter pack
- Bentonite seal
- Well backfill material (chips or grout)
- Cave-in locations
- Depth of riser without cap (below ground surface)
- Concrete surface seal and protective manhole details

Additional documentation for well construction noted in the field book include the following:

- Grout, sand, and bentonite volume calculations prior to well installation.
- The quantity and composition of the grout, seals, and filter pack actually used during construction.
- Screen slot size (in inches), slot configuration, outside diameter, nominal inside diameter, schedule/thickness, composition, and manufacturer.
- Coupling/joint design and composition.
- Protective man hole composition and nominal inside diameter.
- Start and completion dates.
- Discussion of all procedures and any problems encountered during drilling and well construction.
- Need to add water during well installation. Note the depth that water was added and the quantity.

2.4 WELL ACCEPTANCE CRITERIA

Well acceptance will be on a case-by-case basis. The following criteria will be used along with individual circumstances in the evaluation process.

a. The well and material placement will meet the specifications of the Work Plan unless modified by any amendments.

b. Wells will not contain portions of drill casing or augers unless they are specified in the Work Plan as permanent casing.

c. All well casing and screen materials will be free of any unsecured couplings, ruptures, or other physical breakage/defects before and after installation.

d. The annular material (filter pack, bentonite, and grout) of the installed well will form a continuous and uniform structure, free of any detectable fractures, cracks, or voids.

e. Any casing or screen deformation or bending will be minimal to the point of allowing the insertion and retrieval of the pump and/or bailer optimally designed for that size casing.

f. All joints will be constructed to provide a straight, nonconstricting, and watertight fit.

g. Completed wells will be free of extraneous objects or materials; e.g., tools, pumps, bailers, packers, excessive sediment thickness, grout, etc. This prohibition should not apply to intentionally installed equipment per the Work Plan.

h. All boring logs, well diagrams, development records, well completion reports, and related photographs and negatives will have been completed per the Work Plan and received by the Field Manager.

i. Keys to the padlocks securing the well covers will be in the possession of the Field Manager prior to well acceptance. All padlocks will be keyed alike.

Wells not meeting these criteria are subject to rejection and will be abandoned.

3. WELL DEVELOPMENT PROCEDURE

The purpose of well development is to remove well drilling fluids, solids, or other particulates which may have been introduced or deposited on the boring wall in a recently installed well during drilling and construction activities. This restores the hydraulic conductivity of the aquifer material surrounding the well to near pre-well

installation conditions. Properly developed monitoring wells allow for the collection of ground water samples that are chemically and physically representative of the aquifer of concern. The procedure is also applicable to older or improperly developed wells that are suspected of not providing representative groundwater samples.

This section describes the equipment, methods, and documentation that shall be used for developing groundwater monitoring wells.

3.1 EQUIPMENT LIST

The following items are required to properly develop groundwater monitoring wells:

- Well keys
- Water level probe with 0.01-foot increments
- Weighted tape measure with 0.1-foot increments
- Calculator
- Field notebook and well development log
- Waterproof pen
- PVC hand pump or submersible pump
- PVC, Teflon or stainless-steel bailer (sized appropriately for well)
- Nylon rope or wire line for bailing
- Surge block (sized appropriately for well)
- PVC or stainless-steel pipe for operating surge block (sized appropriately for well)
- Thermometer
- pH meter (with automatic temperature compensation)
- Calibration pH buffer solutions
- Conductivity meter
- Polyethylene or glass container (for field parameter measurements)
- Plastic squeeze bottle filled with deionized water
- 5-gallon bucket
- Drums or other large container for development water
- Appropriate health and safety equipment
- Alconox soap (or equivalent)
- Potable tap water
- Distilled or deionized water
- Decontamination buckets/pails
- Large sponges
- Plastic brushes
- Well completion information

3.2 PROCEDURE

The development of a newly installed monitoring well will proceed only after the cement/bentonite grout or hydrated bentonite chips have been allowed to set for a

minimum of 24 hours. Monitoring well development activities shall be completed prior to purging and groundwater sampling for analytical testing. Before development begins, the development equipment will be decontaminated according to the procedures described in SOP No. 6. Equipment coming in contact with the well will also be decontaminated between wells.

Before development begins, the field personnel will verify that the temperature, pH and conductivity meter, and water level probe are operating properly. The conductivity meter requires daily calibration prior to use and must be recalibrated if it has been turned off. The pH meter must be calibrated each day before taking any readings of samples and must be recalibrated during the day if it has been turned off after the initial calibration. Calibration times and readings will be recorded in the field notebook. Specific instructions for calibrating the meters are given in the manufacturer's manual.

Monitoring well development is accomplished using a surge block and/or a bailer, hand pump, or submersible pump to flush the screen, sand pack material, and borehole wall of drilling fluids and fine sediment resulting from well drilling and installation activities. This procedure also allows for the removal of fine sediment that may have accumulated within the inner well casing.

Development consists of removing a minimum of five well casing volumes of water during repeated surging and well evacuation episodes. This volume is in addition to three times the volume of water used during drilling and installation activities.

Well surging is the process of causing water to move through the screen and into and out of the sand pack and aquifer formation. This will be accomplished by gently surging the entire length of well screen either mechanically using a surge block or hydraulically utilizing a bailer or pump. **Note: Surging will be done only on wells screened within sand formations.** This allows for the proper packing of the sand pack material. Well evacuation is the process of removing water from throughout the entire water column by periodically lowering and raising the pump intake or the point to which the bailer is lowered. Development water will be disposed of on site in a manner that will prevent the water from flowing into drainage ditches.

Development of monitoring wells installed in formations with a relative high hydraulic conductivity (e.g. sand or silty sand) will be completed by alternating between surging and extraction methods with either a hand or submersible pump.

Development of monitoring wells installed in formations with a relatively low hydraulic conductivity (e.g. clay or silt) will be completed with either a bailer, hand or submersible pump. The initial development will attempt to remove highly turbid water from the well. Subsequent development will be completed slowly to minimize any surging. Water will be evacuated slowly to allow the filter pack to trap the fine suspended sediment and allow the introduction of lower turbidity formation water into the well. A submersible or

hand pump or a bailer will be used on the monitoring wells. Development, purge, and decontamination water will be left at the site where it originated.

The volume of water required for removal during development is calculated using the following method:

1. Measure the depth to water in the well from the measuring point. This is usually a notched point on the top of the riser pipe which has been surveyed.

2. Measure the total depth of the well from the same measuring point used for measuring the depth to water.

3. Calculate the height of water in the well casing by subtracting the depth of water from the total well depth.

4. Calculate the number of gallons of water corresponding to one well volume. This is done by multiplying the height of water in the well casing by the conversion factor corresponding to the inside diameter of the well casing.

The following equation shall be used to calculate the volume of water to be removed during well evacuation:

For 2-inch wells:

One Evacuation Volume (gal) = (Total Well Depth [ft]) - Water Level Depth [ft]) x 0.16 gal/ft

Multiply the volume of one well casing volume by five to obtain the minimum volume of water to be evacuated. Note: if water was added during installation or drilling, at least three times this volume must be removed before well development evacuation begins.

During the well development activities, field parameters (temperature, pH, and specific conductivity) are measured and the clarity, color, any presence of odors, and other comments regarding water quality are noted in the field notebook and on the well development log (Figure SOP 2-3). The date, time, and volume of water removed is also recorded at this time. A sample of water will be collected for measurement of field parameters at the beginning of well development in order to establish a baseline for comparison with the water quality as well development proceeds. Measurements of field parameters along with observations will be recorded after a minimum of one well casing volume of water is removed.

Monitoring well development will continue until measurements of the field parameters have stabilized to within ten percent of the previous measurements and the water removed from the well is as clear of sediment as is practical. Regardless of the clarity of the water removed, a minimum of five well volumes of water will be removed. If the well is pumped or bailed dry, it will be allowed to recover. Development will continue until a minimum of five well volumes are removed. If water was added to the well

during drilling or construction activities, at least three times the volume of water added will be removed in excess of the five well volumes of water to be removed for development. No agents or additives will be used or introduced into the well during development or at any other time.

3.3 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on well development and also provide a permanent record. These observations and field data will be recorded with waterproof ink in a bound weatherproof field book with consecutively numbered pages and on the well development log shown on Figure SOP 2-3. As part of the development process, the following information will be recorded:

- Well designation
- Well location
- Date(s) and time of well development
- Static water level from top of well casing before and after development
- Volume of water in well prior to development
- Volume of water removed and time of removal
- Depth from top of well casing to bottom of well
- Screen length
- Depth from top of well casing to top of sediment inside well, if present, before and after development
- Field measurements of pH, conductivity, and temperature taken during and after development
- Physical character of removed water throughout development (color, odor, and turbidity)
- Type and size/capacity of pump and/or bailer
- Description of development technique
- Decontamination observations
- Instrument calibration record

HTRW DRILLING LOG	DISTRICT	HOLE NUMBER
1. COMPANY NAME	2. DRILLING SUBCONTRACTOR	SHEET SHEETS OF

3. PROJECT	4 LOCATION
5. NAME OF DRILLER	6. MANUFACTURE'S DESIGNATION OF DRILL
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED / 11. DATE COMPLETED
12 OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13 DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING
14. TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE

20. SAMPLES FOR CHEMICAL	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR

LOCATION SKETCH/COMMENTS SCALE:

PROJECT	HOLE

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

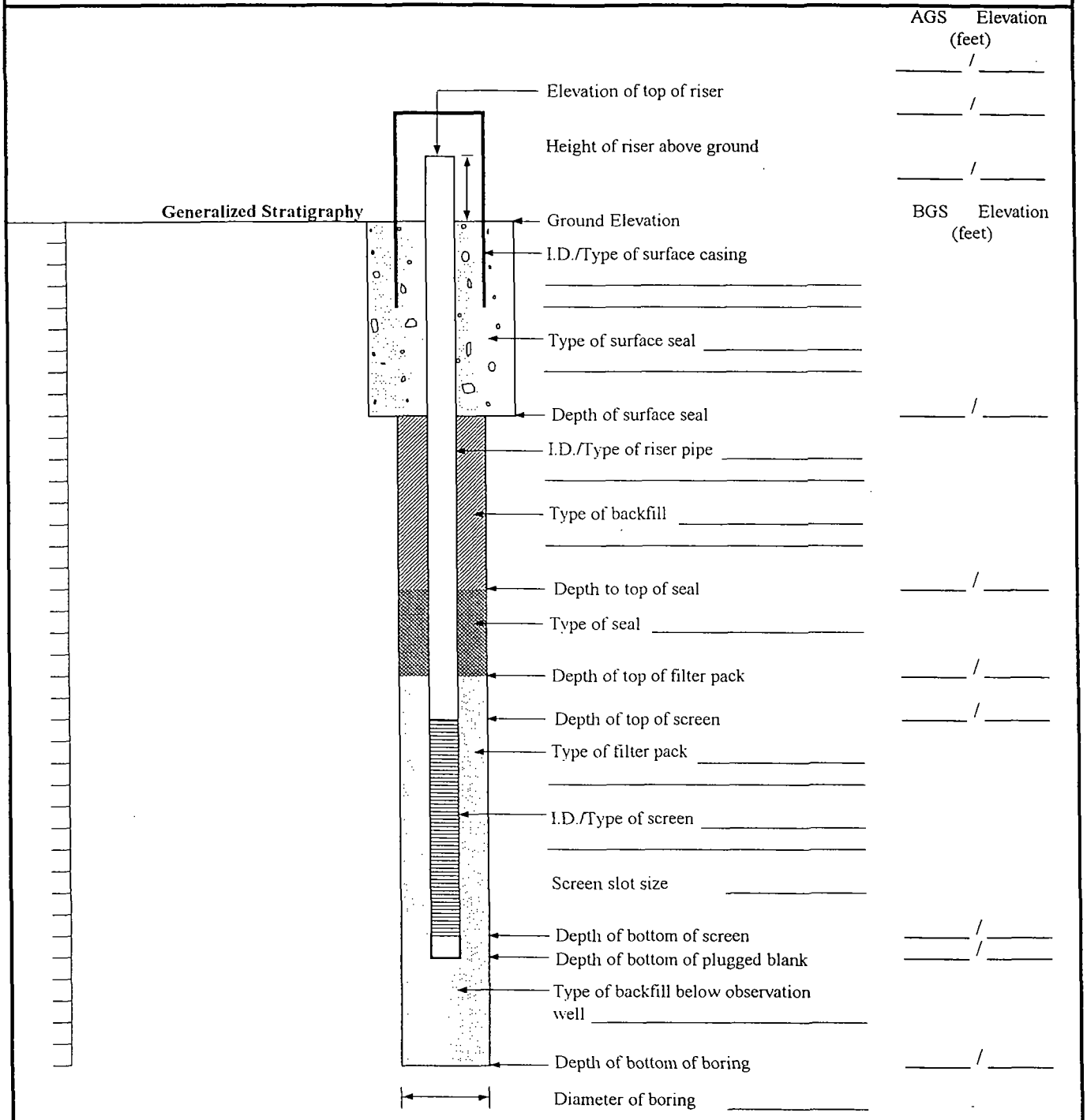
HOLE NO.	
PROJECT	INSPECTOR
SHEET	OF SHEETS

ELEV a	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.

PROJECT	HOLE NO.

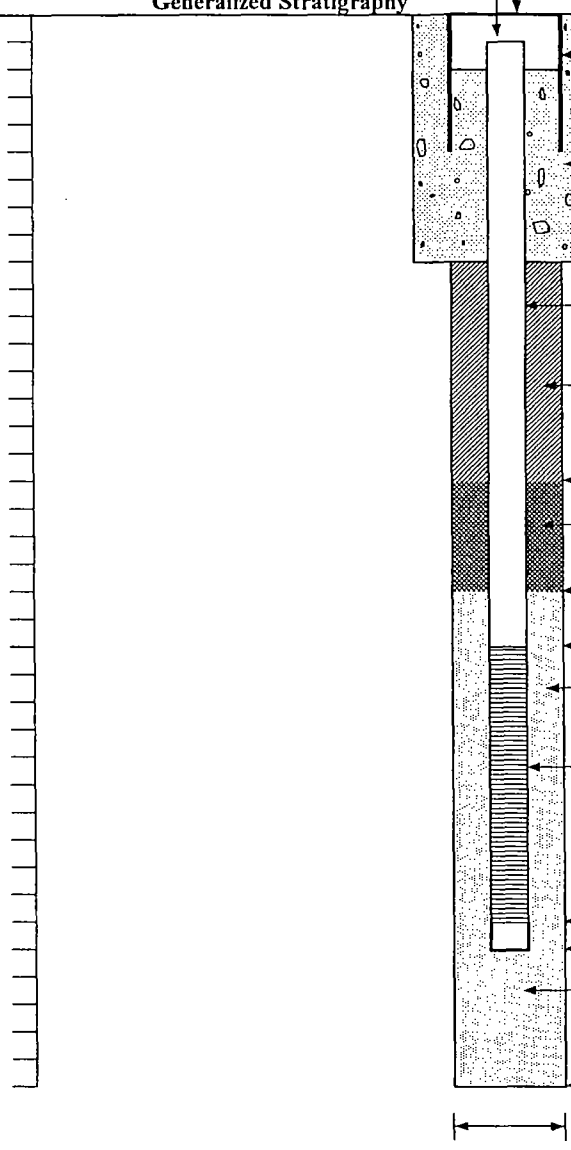
MONITORING WELL CONSTRUCTION LOG

Project Name _____ **Piez./Well No.** _____
Location _____ **Project No.** _____
Installed By _____ **Date** _____ **Time** _____
Inspected By _____
Method of Installation _____
Remarks _____



MONITORING WELL CONSTRUCTION LOG

Project Name _____ **Piez./Well No.** _____
Location _____ **Project No.** _____
Installed By _____ **Date** _____ **Time** _____
Inspected By _____
Method of Installation _____
Remarks _____



	BGS / Elevation (feet)
Elevation of top of riser	_____ / _____
Depth of riser below ground	_____ / _____
Ground Elevation	_____ / _____
I.D./Type of surface casing _____	BGS / Elevation (feet)
Type of surface seal _____	
Depth of surface seal	_____ / _____
I.D./Type of riser pipe _____	
Type of backfill _____	
Depth to top of seal	_____ / _____
Type of seal _____	
Depth of top of filter pack	_____ / _____
Depth of top of screen	_____ / _____
Type of filter pack _____	
I.D./Type of screen _____	
Screen slot size _____	
Depth of bottom of screen	_____ / _____
Depth of bottom of plugged blank	_____ / _____
Type of backfill below observation well _____	
Depth of bottom of boring	_____ / _____
Diameter of boring _____	

WELL DEVELOPMENT LOG

Project _____ Well No. _____
Project No. _____ Date _____

WELL MEASUREMENTS

Well Inside Diameter _____ ft.
Depth of well casing _____ ft.
Initial water level: _____ ft. Below MP
Measuring Point: (MP) _____
Fluid well casing volume: _____ gal.
Air temperature: _____
Weather conditions: _____

SAMPLING MEASUREMENTS

DISCHARGE

Water Level (ft BMP)								
Time								
Discharge (Gal.)								

WATER QUALITY DATA

pH								
Conductivity mS/cm)								
Temperature (°C)								
Color								
Odors								
Turbidity								

Total Discharge: _____ Casing volumes removed: _____
Method of Water Disposal: _____

QUALITY ASSURANCE

Sampling Method: _____
Method to measure water level: _____
Bailer ropes new or cleaned? _____
pH Meter _____ Calibrated _____
Conductivity Meter _____ Calibrated _____
Comments: _____

SOP NO. 3 - GROUNDWATER SAMPLING (MONITORING WELLS)

1. PURPOSE AND SCOPE

This document defines the standard procedure for collection of groundwater samples. This procedure gives descriptions of equipment and field procedures necessary to collect groundwater samples. The sample locations and frequency of collection are specified in the Sampling and Analysis Plan Addendum.

This SOP serves as a supplement to the Work Plan Addendum and the Sampling and Analysis Plan Addendum and is intended to be used together with several other SOPs. Other related SOPs are listed below:

- SOP No. 4 - Water Level Measurement
- SOP No. 6 - Decontamination
- SOP No. 7 - Sample Handling, Documentation, and Tracking
- SOP No. 13 - Water Quality Monitoring Equipment

Health and safety procedures and equipment that will be required during the investigation are detailed in the HSP.

2. GROUNDWATER SAMPLING PROCEDURES

2.1 EQUIPMENT LIST

Equipment used during well purging and sampling:

- Well keys
- Water level probe with 0.01-foot increments
- Oil-water interface probe
- Assorted tools (knife, screwdriver, etc.)
- Disposable Teflon™ bailers with VOC sampling tip
- Nylon rope
- Temperature meter
- Turbidity meter
- Dissolved oxygen meter
- pH meter (with automatic temperature compensation)

- Conductivity meter
- Calibration fluids
- Plastic squeeze or spray bottle filled with deionized water
- Polyethylene or glass container (for field parameter measurements)
- Paper towels or Kimwipes
- Calculator
- Field notebook
- Waterproof and permanent marker
- Plastic buckets or truck-mounted tank for holding purged water
- Plastic sheeting (for placing around well)
- Appropriate health and safety equipment
- Well completion information sheet
- Appropriate decontamination equipment
- Cooler with ice
- Field Sampling Data Sheet
- Sample jars and labels. Sample bottles with preservatives added will be obtained from the analytical laboratory. Several extra sample bottles will be obtained in case of breakage or other problems.

2.2 SAMPLING PROCEDURE

This section gives the step-by-step procedures for collecting groundwater samples in the field. Observations made during sample collection should be recorded in the field notebook and field data sheet as specified in Section 2.3.1.1 of this SOP.

2.2.1 Equipment Decontamination

Before any purging or sampling activities begin, all applicable sampling devices shall be decontaminated. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. Each piece of purging or sampling equipment shall be decontaminated before sampling operations and between each well. The decontamination solutions shall be replaced with clean solutions between each well. Used solutions will be placed in the container with purged well water for disposal as IDW. The procedures presented in SOP No. 6 will be followed for decontamination of field equipment and for personnel decontamination.

2.2.2 Instrument Calibration

Electronic equipment used during sampling includes a pH meter with temperature scale and automatic temperature compensation, a conductivity meter, a turbidity meter, a dissolved oxygen meter, and a water level measurement probe. Before going into the field, the sampler shall verify that these instruments are operating properly. The pH,

turbidity and conductivity meters require calibration prior to use every day and must be recalibrated if they have been turned off. Calibration times and readings will be recorded in a notebook to be kept by the field sampler. Specific instructions for calibrating the instruments are given in the instrument manuals.

2.2.3 Well Purging

The purpose of well purging is to remove stagnant water from the well and obtain representative water from the geologic formation being sampled while minimizing disturbance to the collected samples. Before a sample is taken, the well will be purged until a minimum of three well casing volumes have been removed and field parameters have stabilized or until the well is bailed dry. All wells shall be purged on the same day that samples are taken. Evacuated well water shall be contained for proper disposal in accordance with the Waste Management Plan, and necessary precautions shall be taken to prevent spilling of water.

Before well purging begins, the following procedures will be performed at each well:

- The condition of the outer well casing, concrete well pad, and any unusual conditions of the area around the well will be noted in the field logbook.
- Clean plastic sheeting will be placed around the well.
- The well will be opened.
- Appropriate readings will be taken in the breathing zone with a flame ionization detector (FID) or photoionization detector (PID) according to the HSP. The reading will be recorded in the field logbook.
- The condition of the inner well cap and casing will be noted.
- The depth of static water level will be measured (to nearest 0.01 foot) and recorded from a measuring point on the well casing, the measuring point should be identified, and time indicated in the field logbook.
- The presence of light nonaqueous-phase liquids (NAPL) will be determined using an oil-water interface probe or a clear bailer. If a light NAPL is identified, its thickness will be measured and a sample of the NAPL will be collected.
- The presence of dense NAPL will be determined using an oil-water interface probe or by slowly lowering a clear, double-check valve Teflon™ bailer to the approximate bottom of the well screen and obtaining a sample for visual inspection.

- If a dense NAPL is observed, a sample will be collected by slowly draining the bailer until the NAPL layer is reached.
- The presence of light or dense NAPLs will preclude sampling of the groundwater itself.
- The total depth of the well from the same measuring point on the casing will be measured and recorded.
- The volume of water in the well casing will be calculated in gallons based on feet of water and casing diameter. (See Section 2.3.4 for calculation of volumes.)
- From the above calculation, the three casing volumes to be evacuated will be calculated.
- An initial sample will be obtained from the bailer for field measurements of temperature, conductivity, and pH, and for observation of water quality. This sample will not be retained after these initial measurements are recorded. These measurements will also be used during the evaluation of chemical analytical data.
- Three volumes of water in the casing will be evacuated with the bailer and retained for later disposal. Temperature, conductivity, and pH measurements will be taken after evacuation of each well volume to determine whether the water chemistry has stabilized. Generally, pH values within ±0.1 pH unit, temperature within ±0.5°C, and conductivity within ±10 Tmhos/cm between consecutive readings indicate adequate stability of the water chemistry. If the chemistry is not stable, purging will continue, measuring pH, temperature, and conductivity after each one-half well volume.
- If the well is bailed dry during evacuation, it can and will be assumed that the purpose of removing 3 well volumes of water has been accomplished, that is, removing all stagnant water which had prolonged contact with the well casing or air. If recovery is very slow, samples may be obtained as soon as sufficient water is available.

2.2.4 Sample Collection

Samples for chemical analysis will be collected using a disposable Teflon™ bailer within eight hours after purging is completed. For slow recovering wells, the sample shall be collected immediately after a sufficient volume is available. The water quality samples shall be taken from within the well screen interval.

The following sampling procedure is to be used when using disposable bailers:

1. Decontaminated sampling equipment will be assembled. New nylon rope will be used for each well for each sampling event.

2. Identification labels for sample bottles will be filled out for each well.

3. The Teflon™ bailer will be lowered **slowly** and **gently** into contact with the water in the well. The Teflon™ bailer will be lowered to the same depth in the well each time.

4. The Teflon™ bailer will be retrieved **smoothly** and the water will be **slowly** drained into the sample containers through the bailer's bottom discharge control device.

5. The individual sample bottles should be filled in the order given below:

   - Volatile organic compounds (VOCs)
   - Semivolatiles organic compounds, pesticides and PCBs, and herbicides
   - Petroleum hydrocarbons
   - Total metals
   - Explosives

   VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles in the vial which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure until no air bubbles appear.

   Fill bottles for metals and general minerals almost full.

6. Time of sampling will be recorded.

7. The well cap will be replaced and locked.

8. Field documentation will be completed, including the chain-of-custody.

2.3 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled, and recorded as described in this SOP and in SOP No. 7.

2.3.1.1 DOCUMENTATION

2.3.2 Field Sampling Data Sheet

A field sampling data sheet for groundwater samples (Figure SOP 3-1) will be completed at each sampling location. The data sheet will be completely filled in. If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Well number
- Date and time of sampling
- Person performing sampling
- Volume of water purged before sampling
- Depth of sample
- Conductivity, temperature, turbidity, dissolved oxygen, and pH during evacuation (note number of well volumes)
- Number of samples taken
- Sample identification number
- Preservation of samples
- Record of any QC samples from site
- Headspace analysis (if taken)
- Any irregularities or problems which may have a bearing on sampling quality

2.3.3 Field Notes

Field notes shall be kept in a bound field book. The following information will be recorded using waterproof ink:

- Names of personnel
- Weather conditions
- Location and well number
- Date and time of sampling
- Condition of the well
- Decontamination information
- Initial static water level and total well depth
- Depth of sample
- Calculations (e.g., calculation of purged volume)
- Analyses that will be performed by the laboratory
- Equipment calibration information
- Headspace analysis (if taken)

2.3.4 Well Volume Calculations

The following equation shall be used to calculate the volume of water to be removed during well evacuation:

For 2-inch wells:

Evacuation Volume = (Total Well Depth - Water Level Depth) x 0.16 gal/ft = gallons/1 well casing volume
(gal) (ft) (ft)

Multiply the volume of one well casing volume by three (3) to obtain the minimum volume of water to be evacuated.

WATER SAMPLE COLLECTION FIELD SHEET

GENERAL INFORMATION

SITE NAME _____ PROJECT NO. _____

SAMPLE NO. _____ WELL NO. _____

DATE/TIME COLLECTED _____ PERSONNEL _____
SAMPLE METHOD _____ _____

SAMPLE MEDIA:	Groundwater	Surface Water	
SAMPLE QA SPLIT:	YES	NO	SPLIT SAMPLE NO. _____
SAMPLE QC DUPLICATE:	YES	NO	DUPLICATE SAMPLE NO. _____
MS/MSD REQUESTED	YES	NO	

SAMPLE CONTAINERS, PRESERVATIVES, ANALYSIS

Sample Container	Preservative	Analysis Requested

WELL PURGING DATA

Date	_____	Well Depth (ft. BTOC)	_____
Time Started	_____	Depth to Water (ft BTOC)	_____
Time Completed	_____	Water Column Length	_____
Hnu Measurements		Volume of Water in Well (gal)	_____
Background	_____	Casing Volumes to Purge	_____
Breathing Zone	_____	Minimum to Purge (gal)	_____
Well Head	_____	Actual Purge (gal)	_____

FIELD MEASUREMENTS

Time	Amount Purged (gal)	pH	Temperature (°C)	Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU's)	Color

FIELD EQUIPMENT AND CALIBRATION

	Model	Calibration
Water Level Probe		
Water Quality Meter		

GENERAL COMMENTS

_____

SOP NO. 4 - WATER LEVEL MEASUREMENTS

1. PURPOSE AND SCOPE

This document defines the standard procedure for measuring water levels in wells. This SOP serves as a supplement to the Work Plan Addendum and Sampling and Analysis Plan Addendum and is intended to be used together with other SOPs. Other related SOPs are listed below:

- SOP No. 3 - Groundwater Sampling (Monitoring Wells)
- SOP No. 6 - Decontamination

2. WATER LEVEL MEASUREMENT PROCEDURE

2.1 EQUIPMENT LIST

The equipment necessary to measure water levels includes:

- Water level probe with 0.01-foot increments
- Organic vapor analyzer
- Two 5-gal buckets (with lids) or equivalent for decontamination
- Decontamination brushes
- Alconox soap
- Deionized or distilled water
- Potable water
- Spray bottle
- Field data sheets
- Field notebook
- Appropriate health and safety equipment

2.2 MEASUREMENT PROCEDURE

Appropriate health and safety equipment, as described in the HSP should be worn during well opening, water level measurement, and decontamination. The following procedures will be completed when measuring water levels:

- The water level probe shall be decontaminated prior to use in each monitoring well. Decontamination procedures are discussed in SOP No. 6.

- The well will be approached from upwind, the well cap unlocked and removed, and the air quality monitored in the casing and breathing zone with an FID or PID. Air quality measurements will be recorded in the field notebook.

- Observations regarding the condition of the well, including the well pad, and surface or protective casing, will be documented in the field notebook.

- The static water level and the total well depth will be measured using an electronic water level meter. The measuring point for all the wells shall be the top of PVC or steel monitoring well casing. For standardization of measurements, all well readings will be referenced to the north rim of the monitoring well riser pipe or to a marked reference point on the casing rim.

- The static water level and the total depth of the well shall be measured with the probe, recorded on the water level data sheet, and then immediately rechecked before the probe is removed from the well.

- All columns of field data sheets shall be completed, including time of measurement. An example water level data sheet is shown as Figure SOP 4-1. If measurements are taken over a several-day period, the date of each measurement should be clearly indicated on the form. Section 2.4 describes the required documentation.

- Care shall be taken to verify the readings during each water level measurement period. Any significant changes in water level will be noted by comparing the most recent measurement with past measurements.

- After any measurement is taken, the water level probe shall be decontaminated as described in Section 2.3 of this SOP.

2.3 DECONTAMINATION

The water level indicator must be decontaminated before use, between wells, and at the conclusion of measurements. The probe will be decontaminated according to the procedure for decontamination of sampling equipment described in SOP No. 6.

2.4 DOCUMENTATION

The water level data sheet, shown as Figure SOP 4-1, shall be completed during each measuring event. Field data sheets will include date, time, well number, total well depth, water level, static water elevation, and comments. A field notebook will also be kept during water level measurement activities describing decontamination procedures, calibration procedures, monitoring procedures, and other observations during water

level measurement. Both the data sheets and notebook shall be filled out using legible handwriting, and shall be signed and dated by the person completing the page.

The measured depth to water, in feet below the measuring point, will be subtracted from the measuring point elevation to determine the elevation of the static water level. The resulting elevation shall be checked in the field to see that it is reasonable and that the subtraction was performed correctly. If there is a discrepancy, the water level shall be measured again.

3. CALIBRATION

The length of the water level measurement probe cord should be calibrated at least once per month or more often as needed to ensure the desired accuracy during water level measuring events. The calibration check consists of laying out 100 feet of steel tape next to 100 feet of the probe cord. Note any measurement discrepancies between the two at 1-foot intervals. The probe cord shall be rechecked if there is a possibility that it was stretched or damaged during water level measurements.

The procedures followed during calibration and verification of equipment shall be documented in the field notebook along with any calculations. If a correction is required, the probe will be tagged to indicate the correction.

Figure SOP 4-1. Water Level Data Sheet

Project Number: _____
Project Name: _____
Location: _____

Collected by: _____

Well Number	Date	Time	Method	MP Elev.	Well Depth	Depth to Water	Water Level Elevation	Comments

MP Elev. - Measuring Point Elevation

SOP NO. 5 - AQUIFER TESTING PROCEDURES (SLUG TESTING METHOD)

1. PURPOSE AND SCOPE

This document defines the standard procedure for measuring aquifer parameters by use of monitoring wells. This SOP serves as a supplement to the Work Plan Addendum and Sampling and Analysis Plan Addendum. This SOP gives descriptions of equipment and field procedures used to calculate the local hydraulic conductivity of the aquifer. Hydraulic conductivity will be determined by a positive displacement test and/or a negative displacement test using a solid slug.

Health and safety procedures and equipment that will be required during the investigation are detailed in the Health and Safety Plan (HSP).

2. TESTING PROCEDURES

2.1 EQUIPMENT LIST

Field equipment to be used for the slug testing activities includes:

- Organic vapor analyzer
- Electronic water level indicator
- Field books
- Slug of known volume for 2-inch diameter wells
- Pressure transducer (10-50 psig)
- Data logger, Operation Manual, and field printer
- Weighted Measuring tape (100 feet)
- Nylon rope
- Keys to well locks
- Paper towels (organic and lint free)
- Stainless steel knife
- Camera and film
- Waterproof and permanent marking pens
- Clock
- Appropriate health and safety equipment

2.2 PRE-TEST DATA RECORDING

Pre-test data will be collected in accordance with the following procedures:

1. The well casing will be approached from upwind with continuous air monitoring using an FID or PID.

2. The well cap will be unlocked and removed and FID or PID readings continued.

3. Before beginning the slug test, the following information will be recorded:

   - Monitoring well identification number or letter
   - Location and elevation of the reference point from which water depth measurements are made (top of well casing)
   - Elevation of groundwater with respect to the reference point
   - Date and time of test
   - Well depth, screen length, riser pipe radius, well screen radius, and radius of gravel pack plus the well screen depth and radius (from the installation record)
   - Aquifer or groundwater zone (Lithology) being tested (from the installation record)
   - Volume of solid cylinder (slug)
   - Type of measuring device used
   - Names of personnel conducting test

2.3 TESTING PROCEDURES

Slug testing will be conducted in accordance with the following procedures.

1. The static water levels in the well and total depth of the well will be determined to the nearest 0.01 foot. The appropriate pressure transducer will be inserted and the Hermit Data Logger activated. The water level recording interval will be programmed on the data logger to the logarithmic mode.
2. The transducer probe will be set at a maximum depth of 9 feet below the static water level in the well and the transducer will be allowed to equilibrate with the temperature of the water in the monitor well for 15 minutes.
3. The transducer cable will be secured to the well casing with duct tape to ensure that the reference point does not move once the test is started.
4. The pre-run checkout will be done prior to starting the test to ensure that all the cable connections and the initial head reading is correct. The measured head (above transducer probe) will be compared with the head measured by the transducer.
5. The slug will consist of a solid PVC cylinder with the minimum dimensions of 3 feet length and 1-1/4-inch diameter.

6. The logarithmic mode will be set to the default preprogrammed schedule shown below:

Cycle	Elapsed Time	Log Sample Internal
1	0-2 sec	0.2 sec
2	2-20 sec	1 sec
3	20-120 sec	5 sec
4	2-10 min	30 sec
5	10-100 min	2 min
6	100-1000 min	10 min

7. The slug of known volume will be instantaneously introduced to (or removed from) the well, taking care to fully submerge (or withdraw) the slug. It is important to remove or add the volume as quickly as possible because the analysis assumes an "instantaneous" change in volume in the well.
8. With the moment (time) of volume addition or removal assigned time zero, the depth of water will be measured and recorded. The pressure transducer will monitor water level change. Care must be taken to ensure that the transducer is submerged throughout the test. Once the test has started, the transducer elevation must not be changed.
9. The test will continue until the water level has stabilized or 90 percent of the excess head has dissipated.
10. The slug testing equipment will be removed and wrapped for decontamination.
11. The well will be locked upon completion.
12. Gloves, aluminum foil/visquene will be disposed of as appropriate.
13. The slug will be decontaminated before the next test, in accordance with the procedures discussed in Section 3.0 and SOP No. 6.
14. The slug test data will be downloaded from the data logger to a field printer to confirm the successful completion of the test prior to departing the site.

3. DECONTAMINATION

All testing equipment will be decontaminated prior to use. The slug will be decontaminated with:

- Soap (Alconox) and potable water wash with scrub brush
- Potable water rinse
- Distilled water rinse
- Air drying of the equipment

All decontaminated equipment will be stored on clean aluminum foil sheeting or visquene, and the equipment will not be allowed to touch the ground adjacent to the well.

4. TEST DATA ANALYSIS

Test data will be evaluated using the method of Bouwer and Rice (1976) and Bouwer (1989). The Bouwer and Rice method is applicable to unconfined and confined aquifers and considers the effect of partial penetration, the radius of the filter pack, and the effective radius of influence of the test.

5. REFERENCES

Bouwer, Herman, 1989. The Bouwer and Rice Slug Tests - an update: Groundwater, v. 27, No. 3, May-June 1989; P. 304-309.

Bouwer, H., and R.C. Rice, 1987. A Slug Test for Determining a Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells: Water Resources Research, v. 12, P. 423-428.

Table 1
Maximum Depth Below Water Table for Pressure Transducer

Pressure Transducer (PSIG[1])	Depth Below Water Table (Feet)
10	23
20	46
30	69
50	115

[1]PSIG = Pounds per square inch gauge

SOP NO. 6 - DECONTAMINATION

1. INTRODUCTION AND TYPES OF CONTAMINATION

This document defines the standard procedure for decontamination. This SOP serves as a supplement to the Work Plan Addendum and Sampling and Analysis Plan Addendum and is intended to be used together with several other SOPs. Other related SOPs are listed below:

- SOP No. 1 - Hand Auger Sampling
- SOP No. 2 - Monitoring Well Installation and Development
- SOP No. 3 - Groundwater Sampling (Monitoring Wells)
- SOP No. 4 - Water Level Measurements
- SOP No. 5 - Slug Testing
- SOP No. 7 - Sample Handling, Documentation, and Tracking
- SOP No. 10 - Surface Water Sampling
- SOP No. 11 - Sediment Sampling
- SOP No. 12 - Drum Sampling

Site and/or Sample Cross-Contamination

The overall objective of multimedia sampling programs is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g. using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., all non-disposable equipment that will come in direct contact with samples) and field support equipment (e.g., drill rigs, vehicles) is, therefore, required prior to, between, and after uses to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

2. PROCEDURE

2.1 EQUIPMENT LIST

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Scrapers, flat bladed
- Hot water - high-pressure sprayer
- Sponges or paper towels
- Alconox detergent (or equivalent)
- Potable tap water
- Laboratory-grade deionized water
- Garden-type water sprayers

2.2 DECONTAMINATION

2.2.1 Personnel

A temporary personnel decontamination line will be set up around each exclusion zone. If contamination is not encountered, a dry decontamination station may be established which consists of discarding of disposable personal protective equipment (PPE).

If real-time monitoring instruments indicate that contamination has been encountered, (i.e. action levels are exceeded requiring an upgrade from initial PPE levels), a complete personnel decontamination station will be established.

The temporary decontamination line should provide space to wash and rinse boots, gloves, and all sampling or measuring equipment prior to placing the equipment into a vehicle. A container should be available to dispose of used disposable items such as gloves, tape, or tyvek (if used).

The decontamination procedure for field personnel will include:

1. Glove and boot wash in an Alconox solution
2. Glove and boot rinse
3. Duct tape removal
4. Outer glove removal
5. Coverall removal
6. Respirator removal (if used)
7. Inner glove removal

2.3 SAMPLING EQUIPMENT

The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the HSP.
- Gross contamination on equipment will be scraped off at the sampling or construction site.
- Equipment that cannot be damaged by water will be placed in a wash tub containing Alconox or low-sudsing nonphosphatic detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub followed by a deionized water rinse.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with deionized water. Care will be taken to prevent equipment damage.
- Rinse and detergent water will be replaced with new solutions between borings or sample locations.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately after decontamination, the equipment will be covered or wrapped in plastic sheeting or heavy-duty trash bags to minimize potential contact with contaminants.

2.3.1 Drilling and Heavy Equipment

Drilling rigs will be decontaminated at a decontamination station located near a central staging area. The decontamination station may consist of a temporary or permanent structure capable of collecting all decontamination fluids. Mobile decontamination trailers may be used to decontaminate heavy equipment at each site. The following steps will be used to decontaminate drilling and heavy equipment:

- Personnel will dress in suitable PPE to reduce personal exposure as required by the HSP.
- Equipment showing gross contamination or having caked-on drill cuttings will be scraped with a flat-bladed scraper at the sampling or construction site.
- Equipment that cannot be damaged by water, such as drill rigs, augers, drill bits, and shovels, will be washed with a hot water, high-pressure sprayer then rinsed with potable water. Care will be taken to adequately clean the insides of the hollow-stem augers and backhoe buckets.

Following decontamination, drilling equipment will be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it should be stored in a designated clean area.

2.3.2 Equipment Leaving the Site

Vehicles used for activities in noncontaminated areas shall be cleaned on an as-needed basis, as determined by the Site Safety Officer, using soap and water on the outside and vacuuming the inside. On-site cleaning will be required for very dirty vehicles leaving the area. Construction equipment such as trucks, drilling rigs, backhoes, trailers, etc., will be pressure washed before the equipment is removed from the site to limit exposure of off-site personnel to potential contaminants.

2.3.3 Wastewater

Liquid waste water from decontamination, well development and purging will be left at the site where it originated.

2.4 DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions
-

3. QUALITY ASSURANCE REQUIREMENTS

Equipment rinsate samples of the decontaminated sampling equipment may be taken to verify the effectiveness of the decontamination procedures. The rinsate sampling procedure will include rinsing deionized water through or over a decontaminated sampling tool (such as a split spoon) and collecting the rinsate water into the appropriate sample bottles. The rinsate sampling procedure, including the sample number, will be recorded in the field notebook.

SOP NO. 7 - SAMPLE HANDLING, DOCUMENTATION, AND TRACKING

1. PURPOSE AND SCOPE

This document defines the standard protocols for sample handling, documentation, and tracking. This SOP serves as a supplement to the Work Plan Addendum and Sampling and Analysis Plan Addendum and is intended to be used together with several other SOPs. Applicable SOPs are listed below:

- SOP No. 1 – Hand Auger Sampling
- SOP No. 3 – Groundwater Sampling (Monitoring Wells)
- SOP No. 10 – Surface Water Sampling
- SOP No. 11 – Sediment Sampling

2. PROCEDURES FOR SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

2.1 SAMPLE IDENTIFICATION

Samples collected during site activities shall have discrete sample identification numbers. These numbers are necessary to identify and track each of the many samples collected for analysis during the life of this project. In addition, the sample identification numbers will be used in the data base to identify and retrieve the analytical results received from the laboratory.

Each sample is identified by a unique code which indicates the site identification number, sample location number, sample matrix identifier, and sample depth. The sample locations will be numbered sequentially starting at location number 0001.

Sample matrix identifiers include the following:

SF - Direct-Push Soil Sample (Field Analysis)
SL - Direct-Push Soil Sample (Laboratory Analysis)
WF - Direct-Push Groundwater Sample (Field Analysis)
SS - Soil Sample
GW - Groundwater (from a Monitoring Well)
SW - Surface Water Sample
SD - Sediment Sample
SL - Sludge or Sewer Sediment Sample

TB - Trip Blank
RN - Rinsate (Deionized Water)

An example of the sample identification number codes for a sewer sediment sample collected for field analysis will be: AUS-0A2B-004-SL-05.

Where AUS indicates Additional Uncharacterized Sites, 0A2B indicates the site location, 004 indicates the sample location, SL indicates the sample media, and 05 indicates the sampling interval.

The sampling locations, sample type, and sample sequence identifiers will be established prior to field activities for each sample to be collected. On-site personnel will obtain assistance from the Project Manager in defining any special sampling requirements.

2.2 SAMPLE LABELING

Sample labels will be filled out as completely as possible by a designated member of the sampling team prior to beginning field sampling activities each day. The date, time, sampler's signature, and the last field of the sample identification number should not be completed until the time of sample collection. All sample labels shall be filled out using waterproof ink. At a minimum, each label shall contain the following information:

- Sampler's company affiliation
- Site location
- Sample identification code
- Date and time of sample collection
- Analyses required
- Method of preservation (if any) used
- Sample matrix (i.e., soil, groundwater, surface water)
- Sampler's signature

(See Figure SOP 7-1 for example of a sample label)

2.3 SAMPLE HANDLING

This section discusses proper sample containers, preservatives, and handling and shipping procedures.

2.3.1 Sample Handling and Shipping

After sample collection, each container will be labeled as described above, and then stored on ice at 4°C in an insulated cooler until packed for shipment to the laboratory. The ice will be double bagged in Ziploc-type storage bags.

The sample containers will be placed in reclosable Ziploc plastic storage bags and wrapped in protective packing material (bubble wrap). Samples will then be placed right side up in a cooler with ice (double bagged using plastic bags), and taped with a custody seal (See Figure SOP 7-1) for delivery to the laboratory. Samples will be hand delivered or shipped by overnight express carrier for delivery to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific holding times. This may require daily shipment of samples with short holding times. A chain-of-custody (COC) form (see Figure SOP 7-2) will accompany each cooler. The temperature of all coolers will be measured upon receipt at the laboratory. A temperature blank will be included in each cooler for temperature measurement purposes.

2.4 SAMPLE DOCUMENTATION AND TRACKING

This section describes documentation required in the field notes and on the sample Chain-of-Custody forms.

2.4.1 Field Notes

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and also provide a permanent record of field activities. The observations and data will be recorded using pens with permanent waterproof ink in a permanently bound weatherproof field log book containing consecutively numbered pages.

The information in the field book will include the following as a minimum. Additional information is included in the specific SOPs regarding the field books.

- Project name
- Location of sample
- Sampler's printed name and signature
- Date and time of sample collection
- Sample identification code including QC and QA identification
- Description of samples (matrix sampled)
- Sample depth (if applicable)
- Number and volume of samples
- Sampling methods or reference to the appropriate SOP
- Sample handling, including filtration and preservation, as appropriate for separate sample aliquots
- Analytes of interest
- Field observations

- Results of any field measurements, such as depth to water, pH, temperature, and conductivity
- Personnel present
- Level of PPE used during sampling

Changes or deletions in the field book should be lined out with a single strike mark, initialed, and remain legible. Sufficient information should be recorded to allow the sampling event to be reconstructed without relying on the sampler's memory.

Each page in the field books will be signed by the person making the entry at the end of the day, as well as on the bottom of each page. Anyone making entries in another person's field book will sign and date those entries.

2.4.2 Sample Chain-Of-Custody

During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. Initial information concerning collection of the samples will be recorded in the field log book as described above. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. An example COC form is shown on Figure SOP 7-2. The COC is a three-part carbonless form.

The sampler will be responsible for initiating and filling out the COC form. The COC will be signed by the sampler when the sampler relinquishes the samples to anyone else. One COC form will be completed for each cooler of samples collected daily. The COC will contain the following information:

- Sampler's signature and affiliation
- Project number
- Date and time of collection
- Sample identification number
- Sample type
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times
- Method of shipment
- Shipping air bill number (if appropriate)

The person responsible for delivery of the samples to the laboratory will sign the COC form, retain the last copy of the three-part COC form, document the method of shipment, and send the original and the second copy of the COC form with the

samples. Upon receipt at the laboratory, the person receiving the samples will sign the COC form and return the second copy to the Project Manager. Copies of the COC forms documenting custody changes and all custody documentation will be received and kept in the central files. The original COC forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting. After sample disposal, a copy of the original COC will be sent to the Project Manager by the analytical laboratory to be incorporated into the central files.

URS Greiner Woodward Clyde

2318 Millpark Drive
Maryland Heights, MO 63043

Phone (314) 429-0100
Fax: (314) 429-0462

Project: **Crab Orchard AUS OU 68-FOD97278.00**

Sample ID: **AUS-0A2B-004-SL-05**

Analysis: **8330 Explosives**

Preservative: **4°C** Date: _____

Samplers: Time:

CUSTODY SEAL

NAME _____ **DATE** _____

CHAIN OF CUSTODY RECORD

SHEET ___ of ___

WOODWARD-CLYDE CONSULTANTS
2318 MILLPARK DR.
MARYLAND HEIGHTS, MISSOURI 63043
314-429-0100

PROJECT NO:	PROJECT NAME:	NO. OF CONTAINERS	CONTAINER DESCRIPTION / ANALYSES REQUESTED					REMARKS
SAMPLER'S: (Signature)								
DATE	TIME	SAMPLE I.D. NUMBER						

RELINQUISHED BY: (Signature)	DATE / TIME	RECEIVED BY: (Signature)	DATE / TIME
RELINQUISHED BY: (Signature)	DATE / TIME	RECEIVED AT LAB BY: (Signature)	DATE / TIME
METHOD OF SHIPMENT:		AIRBILL NO:	

SOP NO. 8 – HEADSPACE ANALYSIS

1. PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) describes the procedures for performing headspace analysis of soil samples. The SOP will provide descriptions of equipment and procedures for field screening of soil samples. This SOP serves as a supplement to the Work Plan and is intended to be used together with other SOPs. Other related SOPs are listed below:

- SOP No. 1 – Hand Auger Sampling
- SOP No. 6 - Decontamination
- SOP No. 7 - Sample Identification, Handling, and Documentation

Health and safety procedures and equipment that will be required during the investigation are detailed in the HSP.

2. SOIL SAMPLING PROCEDURES

2.1 EQUIPMENT LIST

The following equipment is required for headspace analysis:

- Clean glass sample containers
- Zip-lock plastic bags
- Paper towels
- Aluminum foil
- Organic vapor analyzer equipped with a photoionization detector (PID)
- Waterproof/permanent marking pens
- Field notebook

- Equipment Calibration Log
- Appropriate PPE and Health and Safety Plan

2.2 SAMPLING PROCEDURE

2.2.1 Collection Method

Follow the procedures below for the proper collection of headspace analysis:

1. Collect soil sample using a split-spoon sampler, hand auger or other apparatus that will yield a soil core or intact sample.

2. Transfer approximately 100 cubic centimeters of sample to a sealable plastic bag or fill the glass container half full. If a glass container is used cover the mouth of the container with aluminum foil then put the lid back on the container.

3. Agitate the sample in the bag or container in order to break up the soil matrix and maximize the surface area of soil that is in contact with the headspace. Allow the sample to equilibrate with the headspace for 15-30 minutes.

4. Insert the instrument probe inside the bag or container. If the headspace sample is in a glass container, it shall be analyzed by removing the lid and inserting the instruments probe through the foil liner. Care must be taken in the selection of appropriate foil, foil placement over the mouth of the container, and removal of the lid so as not to compromise the integrity of the seal. If the seal has been compromised, this will be recorded appropriately or collect a new sample if possible.

5. Read the concentration of the organic vapors after a pre-determined equilibration period has elapsed (at least 30 seconds) or after the instrument read-out has stabilized.

6. Record the organic vapor concentration and the gross physical characteristics of the sample (e.g., dry, wet, sandy, discolored).

2.2.2 ORGANIC VAPOR ANALYZER SELECTION

The selection of the appropriate organic vapor analyzer equipped with either a PID or a flame ionization detector (FID) shall be based on the contaminants of concern and/or ambient conditions at the respective site. The lamp selected for the PID, where applicable, will be based on the relative ionization potentials of the expected volatile contaminants. The selected instrument and rationale for use will be recorded in the field log book.

2.2.3 CALIBRATION

The instrument(s) selected for use in accordance with data quality objectives and site requirements shall be calibrated according to the manufacturers recommendations and specifications. Calibration information shall be recorded on the equipment calibration log and in the field notebook, see Section 2.3.1

2.3 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled, and recorded as described in this SOP and in SOP No. 7.

2.3.1 DOCUMENTATION

All procedures and field conditions shall be recorded in the field log book. The record shall include a description of the material being screened as well as site conditions such as humidity and the equilibration time and temperature.

The following records will be made in the field log book:

- Date
- Time
- Personnel
- Weather
- Deviation from this SOP
- Readings collected
- Containers used
- Equipment used
- Calibration performed
- Matrix description

SOP NO. 9 – IDENTIFYING UNDERGROUND STORAGE TANKS USING A MAGNETOMETER SURVEY

1. PURPOSE AND SCOPE

This document defines the standard procedure for identifying underground storage tanks (USTs) using a magnetometer survey. This procedure gives descriptions of equipment and field procedures necessary to perform the magnetometer survey. Magnetometer survey locations are identified in the Field Sampling Plan.

This SOP serves as a supplement to the Field Sampling Plan and is only intended to be used to verify or disprove the existence of USTs identified from engineering drawings or site visual inspection. **It is not intended to be used as a substitute SOP for UXO identification and removal.** No other SOP is required to be used in conjunction with this SOP.

Health and safety procedures and equipment that will be required during the investigation are detailed in the HSP.

2. MAGNETOMETER SURVEY PROCEDURES

2.1 EQUIPMENT LIST

Equipment used during magnetometer surveys:

- Schonstedt GA-52Cx magnetometer (or similar)
- Fisher 1266XB Metal Detector (for nonferrous metals)
- Survey markers

2.2 SURVEYING PROCEDURE

This section gives the step-by-step procedures for performing the magnetometer survey. Persons trained in the use of magnetometers and the identification of magnetic anomalies will perform all surveys. Observations made during the survey should be recorded in the field notebook and field data sheet as specified in Section 2.3 of this SOP.

2.2.1 Vegetation and Debris Removal

Prior to performance of the magnetometer survey, the ground surface in the designated survey area shall be visually inspected for surface debris and vegetation that may interfere with survey performance. Any vegetation determined to impede the inspection of the ground surface shall be moved or removed to allow a complete inspection of the ground surface in the survey area. All surface debris identified during the visual inspection shall be removed and disposed of properly so as not to interfere with magnetometer readings.

2.2.2 Survey Coverage

Magnetometer operator will walk in a straight line from one end of the survey area to the opposite end advancing in a slow continuous pace. Once a line of the survey is done then the operator will move to an adjacent line of travel and move back to the other end of the survey area. The operator will continue in this manner until the entire survey area has been surveyed. Each time a change (an anomaly) in the earth's ambient magnetic field is observed on the meter then this change will be noted on a survey map.

2.2.3 Survey Review

Prior to leaving the survey site the survey map shall be reviewed by the survey operator to determine the nature of any magnetic anomalies observed. The possibility that any anomalies may represent USTs shall be adjudged considering the size of any anomalies and the areal extent of the observed anomalies. Where the survey operator determines that USTs are likely present at a site a statement shall be written on the survey map noting such a judgement.

2.3 SURVEY DOCUMENTATION

Surveys will be documented on a survey sheet and in the field logbook as identified in sections 2.3.1 and 2.3.2

2.3.1 Field Notes

Field notes shall be kept in a bound field book. The following information will be recorded using waterproof ink:

- Names of personnel
- Weather conditions
- Location and site number
- Date and time of survey
- Instrument identification numbers

- Identification of magnetic anomalies
- Operators judgement of UST existence
- Any irregularities or problems which may have a bearing on survey quality

2.3.2 Survey Map

Results of the magnetometer survey shall be identified on a survey map of the survey area. Information on the survey map shall include:

- Names of personnel
- Weather conditions
- Location and site number
- Date and time of survey
- Instrument identification numbers
- Field drawing of the survey area including any physical site markers like foundations, pipes, or ditchlines
- Identification of magnetic anomalies
- Operators judgement of UST existence
- Any irregularities or problems which may have a bearing on survey quality

SOP NO. 10 – SURFACE WATER SAMPLING

1. PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) describes the procedures for collecting a surface water sample. This SOP describes the needed equipment, the field procedures for collection of samples and decontamination of equipment, documentation of the activity, and field quality assurance/quality control (QA/QC) procedures necessary to collect surface water samples. This procedure can be applied to the collection of surface water samples from streams, rivers, ditches, lakes, ponds, lagoons or other bodies of water.

This SOP serves as a supplement to the Work Plan and is intended to be used together with other SOPs. Other related SOPs are listed below:

- SOP No. 6 - Decontamination
- SOP No. 7 - Sample Identification, Handling, and Documentation
- SOP No. 13– Water Quality Monitoring Equipment

Health and safety procedures and equipment that will be required during the investigation are detailed in the HSP.

These procedures are to be strictly followed. Any modifications to this SOP must be approved by the project manager or task leader and the QA/QC officer.

A goal of surface water sampling is to obtain chemistry data that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. Details are provided in this procedure so that all sampling personnel following these procedures will collect samples in a consistent and documented manner, resulting in acceptable chemistry data.

In all sampling, one person will be designated the sample manager. This person will be responsible for keeping all the completed forms and packed coolers ready for shipment. This person will sign-off on the chain of custody (COC) forms and ensure all coolers are turned over to the shipper, or other transport service to the laboratory.

2. SURFACE WATER SAMPLING PROCEDURES

2.1 EQUIPMENT LIST

The following is a list of equipment and materials that will be used during surface water sampling:

- Applicable field logbook
- Indelible ink pen
- Cooler with ice
- Sample bottles or other laboratory-provided sample containers
- Self-adhesive labels
- Plastic sheeting
- Utility knife
- Location map

The following Health and Safety Items may be required:

- PPE
- PID (Photoionization detector)

One of the following items may be used to collect the sample.

- Stainless steel or PTFE-lined bucket
- Long-handled dip sampler (PTFE or stainless steel)
- Short-handled dip sampler (PTFE or stainless steel)
- PACS grab sampler
- Wheaton dip sampler
- Kemmerer sampler

The following are required if conducting field measurements:

- Polyethylene jar for field management samples
- pH meter
- Temperature meter
- Specific conductivity meter

Before sampling begins, the sampling equipment will be decontaminated according to the procedures contained in SOP No. 6.

2.2 SAMPLING PROCEDURE

This section gives the step-by-step procedures for collecting surface water and corresponding sediment samples in the field. Observations made during sample collection should be recorded in the field notebook and field data sheet as specified in Section 2.3.1 of this SOP.

If surface water and sediment samples are to be collected at the same location, collect the surface water sample first so as not to disturb the surface water while collecting the sediment sample. Whenever possible, start collecting samples downstream and work upstream as sampling will disturb the stream load and affect sample collection.

Surface water samples will be collected as grab samples. Grab samples characterize a medium at a particular point in space and time. Grab samples are collected by sample container immersion or by using a transfer device, such as a beaker or dipper.

Grab water samples are often collected by filling a container held just beneath the surface of a body of water. If an open bottle is lowered to the bottom and raised to the surface at a uniform rate, and at such a rate as to have the bottle filled when reaching the surface, the resulting sample will roughly approach the collection of what is known as a depth-integrated sample. This approach may be used for grab samples that will be collected or collected and transferred when the depth of water exceeds 1.0 foot. If depth is less than 1.0 foot, the bottle will be held just beneath the surface of the water and filled. Thorough documentation in the field is required to ensure proper labeling and tracking of samples, identify potential sources of error, and maintain accountability among field personnel.

The following procedures are used in the collection of surface water samples:

1. For all surface water samples, mark the sampling locations on a site map. Describe each location, and place a numbered stake above the visible high water mark on the bank closest to the sampling location, and/or mark adjacent trees with surveyor's flagging. The descriptions must be adequate to allow the

sampling station to be relocated at some future date by someone other than the original sampling crew. Use the long handled dip sampler where access is poor or non-contact with water is suggested in the health and safety plan.

2. Sampling should be performed deliberately and methodically to minimize disturbance of bottom sediments, yet as quickly as possible to ensure a representative sample.

3. Remove the cap from the sample bottle.

4. All sample bottles and caps will be triple rinsed with the surface water being sampled before filling the bottles with the sample to be analyzed. This step will only be followed if bottles are not pre-preserved.

5. Gently dip sample bottle or sampling device in the water, fill and carefully lift from water body.

6. Allow container to fill to desired volume. Do not overfill pre-preserved sample bottles.

7. Remove the container.

8. Tilt sampling device and gently pour sample from sampler into the bottle. Allow the sample to trickle down the side of the bottle. Avoid aerating the sample.

9. Preserve the sample, if necessary, and place the cap on the container and tighten.

10. Label samples.

11. Decontaminate the container's outside surface as indicated by the decontamination SOP and place in cooler on ice.

If field parameters are to be measured:

1. Record time of sampling.

2. Store samples on ice in coolers.

3. Using a decontaminated polyethylene jar, collect a water sample, then measure and record field parameters: pH, specific conductance, and temperature (this sample is not sent to the lab).

4. Decontaminate the sample cooler and deliver it to the sample manager.

2.3 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled, and recorded as described in this SOP and in SOP No. 7.

2.3.1 DOCUMENTATION

Each field activity must be properly documented to facilitate a timely and accurate reconstruction of events in the field. Observations and data acquired in the field will be recorded with black ink in a bound weatherproof field book with consecutively numbered pages. The information in the field book will include the following as a minimum:

- Project name and number
- Names of field personnel
- Weather conditions
- Decontamination times and observations
- Breathing zone Photoionization (PID) or Flame Ionization (FID) readings
- Date and time of sampling
- Sampler's name
- The interval(s) at which the sample was collected
- The sampling method
- The sample container type and size
- The number of containers.
- The type of analysis to be performed on each sample container
- Any remarks about the sample (i.e. color of the sample as determined from standard Munsell Color Charts, clarity, etc.)
- Anything unusual about the site or sample
- Describe the location where the sample was taken, along with distances to landmarks. (drawings are helpful).
- Any deviation from the SOP and reasons for the deviation

- Number of samples taken
- Order that sample bottles were filled
- Sample identification numbers (unique, sequential numbers)
- Sampling devices
- Preservation and storage of samples
- Record of any QC samples
- Any irregularities or problems which may have a bearing on sampling quality

Record the following for all field parameters collected:

- record the pH of the sample
- record the temperature of the sample
- record the conductivity of the water
- record any other parameters collected

3. REFERENCES

New Jersey Department of Environmental Protection. 1988. Field Sampling Procedures Manual. Prepared by Bureau of Environmental Measurements and Quality Assurance.

Woodward-Clyde Consultants. 1988. Technical Memorandum No. 5, Water Sampling in Site Investigation Procedures for Hazardous Waste Projects, Technical Monograph Series.

WATER SAMPLE COLLECTION FIELD SHEET

GENERAL INFORMATION

SITE NAME: _____ PROJECT NO. _____

SAMPLE NO. _____ BORING NO. _____

DATE/TIME COLLECTED: _____ PERSONNEL: _____

SAMPLE METHOD / DEPTH: _____ _____

SAMPLE MEDIA: GROUNDWATER SURFACE WATER

SAMPLE QA SPLIT: YES NO SPLIT SAMPLE NO. _____

SAMPLE QC DUPLICATE: YES NO DUPLICATE SAMPLE NO. _____

MS/MSD REQUESTED: YES NO

SAMPLE CONTAINERS, PRESERVATIVES, ANALYSIS

Sample Container	Preservative	Analysis Requested

HNU MEASUREMENTS

Background _____

Breathing zone _____

Boring _____

Headspace _____

FIELD EQUIPMENT AND CALIBRATION

	Instrument Model	Calibration
Water Level Indicator		
Conductivity Meter		
pH Meter		Before _____ After _____

Comments _____

SOP NO. 11 - SEDIMENT SAMPLING

1. PURPOSE AND SCOPE

The document defines the Standard Operating Procedure (SOP) for collecting sediment and sludge samples. This SOP describes the needed equipment, field procedures for the collection of sediment and sludge samples and decontamination of equipment, documentation of the activity, and field quality assurance/quality control (QA/QC) procedures necessary to collect sediment samples. Separate procedures are provided for collecting samples in the absence and presence of standing water.

This SOP serves as a supplement to the Work Plan ans is intended to be used together with and other SOPs. Other related SOPs are listed below:

- SOP No. 6 – Decontamination
- SOP No. 7 - Sample Handling, Documentation, and Tracking
- SOP No. 8 - Headspace Analysis

Health and safety procedures and equipment that will be required during the investigation are detailed in the HSP.

These procedures are to be strictly followed. Any modifications to this SOP must be approved by the project manager or task leader and the QA/QC officer.

A goal of sediment sampling is to obtain chemistry data that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. Details are provided in this procedure so that all sampling personnel following these procedures will collect samples in a consistent and documented manner, resulting in acceptable chemistry data.

In all sampling, one person will be designated the sample manager. This person will be responsible for keeping all the completed forms and packed coolers ready for shipment. This person will sign-off on the chain of custody (COC) forms and ensure all coolers are turned over to the shipper, or other transport service to the laboratory.

2. PROCEDURES FOR COLLECTING SEDIMENT SAMPLES

2.1 SEDIMENT SAMPLING NOT IN STANDING WATER

The following list of equipment will be needed to collect sediment samples from areas without standing water:

2.1.1 Equipment List

- Applicable field logbook
- Indelible ink pen
- Cooler with ice
- Stainless-steel sampling spoon or trowel
- Stainless-steel split spoon
- Weighted tape measure with 0.1-foot increments
- Sample bottles or other laboratory provided sample containers
- Sample bottle labels

The following Health and Safety Items may be required:

- PPE
- PID (Photoionization detector)

Before sampling begins, the sampling equipment will be decontaminated according to the procedures contained in SOP No. 6.

2.1.2 Sampling Procedures

The following procedure should be used when collecting sediment samples that are not in standing water.

1. Record the sample location on a site base map and in the field log book.
2. Obtain background (BG) PID readings at the sampling location, just above the sediment and in the breathing zone.

3. Clear and remove vegetation and any surface debris such as rocks, as necessary with a decontaminated stainless-steel spoon or trowel.

4. Gather the sample from the target depth with a stainless-steel split spoon, stainless-steel hand auger, or trowel. If more sediment is necessary to fill the sample jar, the area is to be increased without increasing the depth.

5. Fill the volatile organic analysis (VOA) jars completely full with sediment from the sampling spoon with as little disturbance as possible.

6. Homogenize the remaining sediment by thoroughly mixing the sediment from the sampling point in a decontaminated stainless-steel bowl with the sampling spoon. Fill the remaining jars with the homogenized sediment for the specified analysis.

7. Determine the thickness of the sediment, if possible, and document in field logbook.

8. Identify the location for future reference using surveying stakes and flags.

9. The applicable information is completed on the Sample Collection Field Sheet (Figure SOP 11-1).

2.2 SEDIMENT SAMPLING IN STANDING WATER

2.2.1 Equipment List

2.2.2 The following equipment items may be used for pond or ditch sediment sampling in standing water:

- Applicable field logbook
- Indelible ink pen
- Cooler with ice
- Stainless-steel sludge sampler
- Stainless-steel scoop or spoon
- Extension rods and connecting clamps
- Mixing pan
- Weighted tape measure with 0.1-foot increments
- Sample bottles or other laboratory-provided containers

- Sample bottle labels
- Label tape (clear)

2.2.3 Sampling Procedures

Sampling points will be sampled from the shore when possible and proceed from the furthest downstream point to the furthest upstream point. When sampling from an area with shallow water conditions, sampling personnel may wade into the water in order to obtain samples. When wading, sampling personnel shall take care to minimize agitation of the bottom sediment.

Procedures to be followed in collecting sediments in standing water are:

1. Record the sample location on a site base map and in the field logbook.
2. Obtain background PID readings at the sample locations.
3. Measure depth of water overlying sediment material.
4. Decontaminate all sampling equipment according to SOP No. 6
5. Place all sampling equipment on plastic sheeting near the sampling location.
6. If VOC samples are required, they will be collected first from the upper portion of bed materials. To collect a VOC sample, push and slowly turn the sludge sampler into the bed material. The sampler should be pushed in far enough to fill the sampler bucket beyond the butterfly valve. Retract the sludge sampler slowly. Remove sediment material from the center of the sampler to obtain the least disturbed material for VOC analysis. Do not mix sample material collected for VOC analysis.
7. Fill sample containers for the remaining analytes. If liquid is present, attempt to maintain the proportion of solid to water that exists in the mixture while filling the sample containers.
8. As each container is filled, carefully wipe the upper edges of the container with a paper towel so that sediments are removed from the threads and mouth of the jar. This is done to ensure that a tight seal exists after the container is closed.
9. Label, store, and document the samples as described SOP No. 7.
10. Identify the location for future reference using survey stakes and flags using offset distances, if necessary.

2.3 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled, and recorded as described SOP No. 7.

2.3.1 Field Sampling Data Sheet

A field sampling data sheet for sediment samples (Figure SOP 11-1) will be completed at each sampling location. The data sheet will be completely filled in. If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Location number
- Date and time of sampling
- Person performing sampling
- Depth of sample
- Number of samples taken
- Sample identification number
- Description of sample
- Record of any QC samples from site
- Headspace analysis (if taken)
- Any irregularities or problems which may have a bearing on sampling quality

2.4 DOCUMENTATION

Each field activity must be properly documented to facilitate a timely and accurate reconstruction of events in the field. Observations and data acquired in the field will be recorded with black ink in a bound weatherproof field book with consecutively numbered pages. The information in the field book will include the following as a minimum:

- Project name and number
- Names of field personnel
- Weather conditions
- Decontamination times and observations
- Breathing zone Photoionization (PID) or Flame Ionization (FID) readings
- Date and time of sampling
- Sampler's name
- The interval(s) at which the sample was collected

- The sampling method
- The sample container type and size
- The number of containers.
- The type of analysis to be performed on each sample container
- Any remarks about the sample (i.e. color of the sample as determined from standard Munsell Color Charts, clarity, etc.)
- Anything unusual about the site or sample
- Describe the location where the sample was taken, along with distances to landmarks. (drawings are helpful).
- Any deviation from the SOP and reasons for the deviation
- Number of samples taken
- Order that sample bottles were filled
- Sample identification numbers (unique, sequential numbers)
- Sampling devices
- Preservation and storage of samples
- Record of any QC samples
- Any irregularities or problems which may have a bearing on sampling quality

3. REFERENCES

New Jersey Department of Environmental Protection. 1988. Field Sampling Procedures Manual. Prepared by Bureau of Environmental Measurements and Quality Assurance.

Woodward-Clyde Consultants. 1988. Technical Memorandum No. 5, Water Sampling in Site Investigation Procedures for Hazardous Waste Projects, Technical Monograph Series.

SAMPLE COLLECTION FIELD SHEET

SITE NAME _____ PROJECT NO. _____

SAMPLE NO. _____ WELL NO. _____

DATE/TIME COLLECTED _____ PERSONNEL _____

SAMPLE METHOD AND DEPTH _____ _____

SAMPLE MEDIA (Circle 1): Soil Sediment Sludge MS/MSD

SAMPLE SPLIT (Circle 1): Yes No SPLIT SAMPLE NUMBER _____

FIELD DUPLICATE (Circle 1): Yes No DUPLICATE SAMPLE NUMBER _____

Sample Container	Preservative	Analysis Requested

DESCRIPTION:

DEPTH: DESCRIPTION:

Comments _____

SOP NO. 12 – DRUM SAMPLING

1. PURPOSE AND SCOPE

This document defines the Standard Operating Procedure (SOP) for drum sampling. This SOP lists the equipment and procedures to follow when preparing to sample drums containing solid and liquid. The drums that have been observed are old, rusted, and open, and probably contain little if any liquids.

This SOP serves as a supplement to the Work Plan and is intended to be used together with other SOPs. Other related SOPs are listed below:

- SOP No. 6 - Decontamination
- SOP No. 7 - Sample Identification, Handling, and Documentation

1.1 HAZARD AWARENESS

A variety of site activities may require unearthing, moving, lifting, overpacking, or sampling drums. Such activities are inherently hazardous and will always require special health and safety precautions. Drum handling presents numerous serious physical hazards including back injury, crushing, bruising, laceration, and severe trauma from mishandling. Drum contents may represent a fire or explosion hazard or may consist of shock-sensitive or pyrophoric materials. Drum contents may be pressurized or be acutely toxic. Contents may be corrosive or irritating or have other toxic effects. Drum handling may, therefore, represent both physical and chemical hazards.

1.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The appropriate PPE ensemble for drum handling and sampling can vary significantly depending on the particular job conditions. Supplied air equipment (SCBAs or airlines) may be appropriate respiratory protection for a wide range of potential exposures. Full face air-purifying respirators may be adequate for other situations. Some drums may be safely handled without respiratory protection. The types of gloves, coveralls (coated or uncoated), boots, and other PPE can also vary based on hazard evaluation. The selection of the appropriate PPE should ultimately be performed by a WCFS Health and Safety Officer, as part of the site-specific HSP.

1.3 REGULATORY CONSIDERATIONS

The primary regulation dealing with drum handling in hazardous waste operations is section (J) of 29 CFR 1910.120. These OSHA regulations are unique to hazardous waste operations and do not cover all contingencies.

2. SOIL SAMPLING PROCEDURES

This section outlines the procedures to be used in drum sampling.

2.1 EQUIPMENT LIST

The following equipment will be required to complete the drum sampling activities:

- Crescent wrench for removing drum heads or 3/4" socket and driving if standard size bolt is used,
- Non-sparking bung wrench,
- Disposable soda lime glass coliwasa's for taking liquid grab samples,
- Stainless steel mixing bowl or bucket for compositing solid samples, or
- For liquid composite samples, glass sample jar large enough to contain the liquid,
- Stainless steel trowels or mixing spoons,
- Stainless steel two-inch diameter hand auger with two foot and four foot extensions,
- Appropriate decontamination equipment as specified in the Decontamination SOP,
- Appropriate Health and Safety equipment and PPE as specified in the Health and Safety Plan,
- Spray paint or wax pen to mark the drums,
- Field book and writing instruments.

2.2 INSPECTION OF DRUMS

Follow these steps to inspect the drums before opening:

1. Prior to any handling, drums with unknown contents should be visually inspected for any words, symbols or labels on the drum surface which would indicate the nature of its contents.

2. A careful inspection should also be made for signs of leakage, rusting, corrosion, or bulging.

3. If the drum is of unusual construction or material, such as nickel or stainless steel, it may contain a particularly hazardous or sensitive material.

4. The type of drumhead and type of bungs (if any) should be inspected. If the whole drum lid is removable, it may be designed to contain solid materials. If it has a bung (or bungs) it may be designed to contain a liquid.

5. If the drum has a polyethylene or PVC liner, it may have been designed to contain a corrosive material.

6. The top of the drum and the area around the bungs should be inspected for any signs of crystal formation, staining or unusual materials on the surface.

7. The drum may need to be photographed and numbered during the inspection process.

2.3 SPILL CONTROL DURING HANDLING

Spills or leaks may occur during drum movement and handling. Absorbent materials (clay, oil-dry, etc.) should be readily available in sufficient quantity to absorb spilled or leaked material. Where large spills could occur, a containment berm should be constructed around the area. A special pad for drum handling (concrete, HDPE, etc.) with containment berms may be required for certain types of work. Spill control should be performed by appropriately trained personnel wearing adequate personal protective equipment (PPE). A Spill Plan should be part of the Site Health and Safety Plan (HSP).

2.4 OPENING DRUMS

Follow these precautions when preparing to open a drum:

1. Use a crescent wrench or equivalent and/or a non-sparking bung wrench to remove bungs and/or the drumhead to gain access to the drum interior. Bungs

should be turned slowly to allow the drum to vent gradually prior to removing the bung and/or the drumhead.

2. An appropriately rated fire extinguisher should be on hand ready for use to control incipient fires.

3. OSHA specifies that a "suitable shield" be placed between the employee and the drum being opened to protect the employee in case of accidental explosion.

4. If there appears to be real danger of accidental explosion, the drum should be opened remotely. One of the best ways to do this is to use a bronze spike mounted on the end of a backhoe arm. The backhoe operator looks out through a clear explosion shield. The spike is used to punch a hole through the surface of the drum.

5. A variety of pneumatic and hydraulic remote drum-operating devices may be available. The efficiency of their use must be evaluated on a case-by-case basis.

2.5 SAMPLING PROCEDURES

Before sampling begins, the sampling equipment will be decontaminated according to the Protocols listed in the Work Plan and the Decontamination SOP. Sampling equipment will be decontaminated between sample locations.

2.5.1 Containerized Solids Sampling Procedure

The following procedures are to be followed for obtaining a sample of containerized solids:

1. Inspect, clean, and put on appropriate PPE.

2. Remove the drum lids from all drums that are to be sampled in a set if compositing samples.

3. Utilizing a 2-inch diameter stainless steel hand auger, auger down into the cuttings at the center of the drum. Place auger contents into the stainless steel mixing bowl. Continue augering until the bottom of the drum is encountered, collecting additional grab samples with the auger.

4. This procedure will be repeated, if compositing samples, for each drum to be sampled.

5. Utilizing stainless steel spoons or trowels, gently mix the cuttings in the bowl so that the contents are slowly combined, until a uniform, homogeneous color is obtained.

6. Samples for Volatile Organic Compounds will not be mixed in the mixing bowl and will be collected directly into the lab supplied containers assuring that a representative sample is collected.

7. The remaining solid material shall then be transferred into the appropriate sample jars.

8. Label and handle the jars according to the procedures outlined in the Sample labeling, Handling, and Documentation SOP.

9. Replace drum covers and secure them.

2.5.2 Containerized Liquids Sampling Procedure

The following procedures are to be followed for obtaining a sample of containerized liquid:

1. Inspect, clean, and put on appropriate PPE.

2. Remove the bungs (or drum lids if no bung is present) from all drums that are to be sampled in a set if compositing samples.

3. Utilizing a 3/4-inch diameter disposable glass coliwasa, a sample of the liquid will be obtained by inserting the coliwasa into the center of the drum.

4. Close the coliwasa, remove it from the drum, and release its contents directly into a glass sample jar of appropriate size for compositing the number of drums in the sample group.

5. After all drums in a set are sampled, transfer the composited sample to the appropriate lab supplied bottle(s).

6. VOC samples will be collected directly into the lab supplied containers assuring that a representative sample is collected.

7. Label and handle the jars according to the procedures outlined in the Sample Labeling, Handling, and Documentation SOP.

8. Replace bungs or drum covers and bolt them down tightly.

9. Dispose of the glass coliwasa according to the Protocols specified in the work plan after sampling each set of drums.

After sampling, record all relevant observations and sampling information in the site field log book (see Section 2.3.1).

2.6 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled, and recorded as described in this SOP and in SOP No. 7.

2.6.1 Field Sampling Data Sheet

A field sampling data sheet for soil samples (Figure SOP 12-1) will be completed at each sampling location. The data sheet will be completely filled in. If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Location number
- Date and time of sampling
- Person performing sampling
- Depth of sample
- Number of samples taken
- Sample identification number
- Description of sample
- Record of any QC samples from site
- Headspace analysis (if taken)

Any irregularities or problems which may have a bearing on sampling quality

2.6.2 DOCUMENTATION

Each field activity must be properly documented to facilitate a timely and accurate reconstruction of events in the field. Samples will be identified, handled and recorded as described in this SOP and the Sample Labeling, Handling, and Documentation SOP. The analytical parameters and preservation of analytical samples are specified in the Field Sampling Plan.

As with all field procedures, drum handling activities shall be documented in the field book. Information should include:

- Project name and number
- Personnel and subcontractors present

- Date and time of activity
- Level of PPE
- Weather
- Location
- Number, type, and description of drums and waste contained
- Sample numbers collected
- Analysis requested and description of sample collected

SAMPLE COLLECTION FIELD SHEET

SITE NAME _____ PROJECT NO. _____

SAMPLE NO. _____ WELL NO. _____

DATE/TIME COLLECTED _____ PERSONNEL _____

SAMPLE METHOD AND DEPTH _____ _____

SAMPLE MEDIA (Circle 1): Soil Sediment Sludge MS/MSD

SAMPLE SPLIT (Circle 1): Yes No SPLIT SAMPLE NUMBER _____

FIELD DUPLICATE (Circle 1): Yes No DUPLICATE SAMPLE NUMBER _____

Sample Container	Preservative	Analysis Requested

DESCRIPTION:

DEPTH: DESCRIPTION:

Comments _____

SOP NO. 13 – WATER QUALITY MONITORING EQUIPMENT

1. PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) describes the standard protocols for operating, calibrating, and maintaining equipment commonly used during water quality monitoring. This SOP also defines the documentation necessary when using this equipment.

This SOP serves as a supplement to the Work Plan and is intended to be used together with other SOPs. Other related SOPs are listed below:

- SOP No. 3 – Groundwater Sampling (Monitoring Wells)
- SOP No. 8 – Surface Water Sampling

Health and safety procedures and equipment that will be required during the investigation are detailed in the HSP.

2. WATER QUALITY MONITORING PROCEDURES

2.1 EQUIPMENT LIST

Equipment used for monitoring water quality parameters is as follows:

- Horiba U-10 Water Quality Checker – measures pH, temperature, turbidity, dissolved oxygen and conductivity
- Other water quality monitoring devices (if necessary)
- Distilled water
- Dry, clean paper towels
- Latex gloves
- Field log book

- Manufacturer's guide for each meter used
- Calibration fluids

2.2 CALIBRATION PROCEDURE

The following are general calibration procedures:

- Field instruments will be checked and calibrated prior to their use on site. Batteries will be charged and checked daily where applicable.
- Equipment that fails calibration and/or becomes otherwise inoperable during the field investigation will be removed from service and segregated to prevent inadvertent use. Such equipment will be properly tagged to indicate that it should not be used until the nature of the problem can be determined.
- Equipment requiring repair or recalibration must be approved for use by the site manager or Site Health and Safety Officer prior to placement back into service. Equipment that cannot be repaired or recalibrated will be replaced.

Calibration of the Horiba U-10 Water Quality Checker is usually done with one calibration solution in accordance with the manufacturer's specifications. However, should it become necessary to use other water quality monitoring instruments, the following calibration procedures may be used.

2.2.1 pH METER

Calibration of the pH meter should follow the manufacturer's specific instructions. In general, calibration is done by adjusting the meter with standard buffers that bracket the expected pH of the field water. Calibration will consist of the following general procedures:

1. Adjust the reading of the pH meter with the electrode placed in the pH 7 buffer by using the calibration knob. Rinse the electrodes with distilled water between buffer adjustments.
2. Adjust the reading of the meter with the electrode placed in the pH 4 buffer with the slope (or temperature) knob.
3. Repeat steps 1 and 2 until the meter gives acceptable readings ($\pm$0.1 pH unit) for all the buffers used for calibration.

2.2.2 TEMPERATURE METER

Calibration of the temperature meter should follow the manufacturer's specific instructions.

2.2.3 TURBIDITY METER

Calibration of the turbidity meter should follow the manufacturer's specific instructions.

2.2.4 DISSOLVED OXYGEN METER

Calibration of the dissolved oxygen meter should follow the manufacturer's specific instructions. Calibration is accomplished by exposing the probe to a known oxygen concentration, such as water-saturated air (%), or water of a known oxygen content (mg/L), and then adjusting the calibration controls so the display shows a reading matching the oxygen concentration of the known sample.

Calibration will consist of the following general procedures:

1. Place the probe in moist air. Biological Oxygen Demand (BOD) probes can be placed in partially filled (50 ml) BOD bottles. Wait 10 minutes for temperature stabilize within a ± 2 degree C range.

2. Turn the meter's switch to temperature and read. Refer to Table 1 for solubility of oxygen in fresh water (calibration value).

3. Determine altitude or atmospheric correction factor from Table 2.

4. Multiply the calibration value from Table 1 by the atmospheric correction factor from Table 2 to obtain the corrected solubility value for instrument calibration value.

   EXAMPLE: Assume a temperature of 20 degrees C and an altitude of 1100 ft. From Table 1, the calibration value of solubility of oxygen in water 20 degrees C is 9.09 mg/L. From Table 2, the atmospheric correction factor for 1100 ft is 0.96. Therefore, the corrected calibration value solubility is 9.09 mg/L x 0.96 = 8.73 mg/L.

5. Switch to the appropriate mg/L range, set the salinity knob to zero and adjust the calibrate knob until the meter reads the corrected solubility calculated in Step 4. Wait two minutes to verify calibration stability. Readjust if necessary.

2.2.5 SPECIFIC CONDUCTANCE METER

Calibration of the conductivity meter should follow the manufacturer's specific instructions. In general, calibration is done by noting the response of the meter to several standard conductivity solutions which bracket the values expected to be measured in the field. Adjust the calibration controls so the display shows a reading matching the value of the standard solution.

2.3 OPERATING PROCEDURES

Operation of the Horiba U-10 Water Quality Checker will be done in accordance with manufacturer's specifications. However, should it become necessary to use other water quality monitoring instruments, the following procedures may be used.

2.3.1 pH METER:

Operating procedures should follow manufacturer's specific instructions. Generally, operating procedures are as follows:

Connect the ATC and pH electrodes to the appropriate inputs.

1. Turn on instrument, clear instrument.
2. Rinse a small beaker with distilled water. Fill the beaker with sample water.
3. Rinse the probes with distilled water. Blot excess.
4. Immerse the probes in the sample and swirl gently, keeping the probes in the sample until the display stops flashing.
5. Record the sample pH and temperature after stabilization. Note any problems such as meter drift.
6. Rinse the probes with distilled water. Blot excess.
7. Repeat steps 3-7 for additional samples.

2.3.2 TEMPERATURE METER:

Operating procedures should follow manufacturer's specific instructions. Generally, operating procedures are as follows:

1. Rinse the probe with distilled water.

2. Insert the probe into the sample, and leave in the sample until temperature stabilizes.

3. Record the temperature reading, being sure to indicate degrees C or degrees F.

****

Note: degrees C = (degrees F - 32) (5/9)

degrees F = ((9/5)C degrees) + 32

****

2.3.3 TURBIDITY METER:

Operating procedures should follow manufacturer's specific instructions. Generally, operating procedures are as follows:

1. Pour aqueous sample into a new curette assuring no air bubbles.

2. Place curette in turbidity meter.

3. Allow the turbidity meter to stabilize before recording the NTU value.

4. Do not leave the filled curette in the sample well for long periods of time.

5. Repeat steps 1-4 for additional samples.

2.3.4 DISSOLVED OXYGEN METER:

Operating procedures should follow manufacturer's specific instructions. Generally, operating procedures are as follows:

1. Pour aqueous sample into a clean beaker assuring no air bubbles.

2. Place the probe in the sample.

3. Turn the stirrer knob on.

4. Adjust the salinity knob to the salinity of the sample if appropriate.

5. Allow sufficient time for the probe to equilibrate to the sample's temperature and dissolved oxygen content.

6. Read dissolved oxygen on appropriate scale.

7. Rinse probe and sample beaker with distilled water and then with next water. sample.

8. Follow steps 1-7 for additional samples.

****

Note: The DO meter should be left on during the working day to avoid waiting for probe repolarization.

****

2.3.5 SPECIFIC CONDUCTANCE METER:

Operating procedures should follow manufacturer's specific instructions. Generally, operating procedures are as follows:

1. Rinse probe and sample beaker with distilled water and then with sample water.

2. Measure the temperature of the sample water.

3. Place the probe in the sample beaker with enough sample to completely submerge the probe. Swirl the probe to remove any air bubbles trapped in the probe.

4. Select the highest multiplier scale on the meter and turn the instrument on. Progressively use lower multiplier scales until a mid-scale deflection is obtained.

5. If appropriate, check probe accuracy by pressing cell test button. If value change is > 10% check probe.

6. Record the temperature and conductivity values.

2.4 MAINTENANCE

- All field instrumentation, sampling equipment, and accessories will be maintained in accordance with the manufacturer's recommendations and specifications and established field practice.

- All maintenance will be performed by qualified project personnel and will be documented by the appointed equipment manager or designee under the direction of the equipment manager.

- All field instruments will be properly protected against inclement weather conditions during the field investigation. Each instrument is specially designed

to maintain its operating integrity during variable temperature ranges that are representative of ranges that will be encountered during expected working conditions.

- At the end of each working day, all field equipment will be taken out of the field and placed in a dry room for overnight storage.

2.5 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled, and recorded as described in this SOP and in SOP No. 7.

2.5.1.1 DOCUMENTATION

The following information should be recorded in the field log book:

- Calibration of equipment will be recorded in the field logbook to document that appropriate procedures have been followed.
- Calibration will also be recorded on a calibration log. Entries made on the equipment calibration log regarding the status of any field equipment will contain, but are not necessarily limited to, the following information:
  1. Date and time of calibration.
  2. Name of person doing calibration.
  3. Type of equipment being serviced, and identification number (such as serial number).
  4. Reference standard used for calibration (such as pH of buffer solutions).
  5. Calibration and/or maintenance procedure used.
  6. Any problems or other pertinent information.
- Each reading taken for a particular sample will be recorded in the field logbook and on a field form. Entries will include, but are not limited to the following:
  1. Date and time of reading.
  2. Type of reading.
  3. Value of reading with units.

4. Any problems or other pertinent information