LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

ADMINISTRATIVE RECORD

VOLUME 7 of 10

1997

Bate Stamp Numbers
020854 - 021465

Prepared for:

Department of the Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671

1997

Volume 7 of 10

1997

A. Title: Letter - Subject: Final Work Plan (Part I) and Sampling and Analysis Plan (Part II) for the Site 16 Phase III Remedial Investigation/ Feasibility Study and Groundwater Treatability Study at the Longhorn Army Ammunition Plant, Karnack, Texas
Enclosure: Final Work Plan for the Site 16 Phase III Remedial Investigation/ Feasibility Study and Groundwater Treatability Study at the Longhorn Army Ammunition Plant (LHAAP) Karnack, Texas
Group(s):
Site(s): Site 16
Location: Tulsa, Oklahoma
Agency: US Army Corps of Engineers
Author: Yolane Hartsfield for Burl D. Ragland, Lead Project Manager Army Team
Recipient: David Tolbert, Project Manager, Longhorn AAP
Date: 4 September 1997
Bate Stamp: 020854 - 021030

B. Title: Minutes - Technical Review Committee Meeting, Longhorn AAP
Group(s): General
Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: All Involved
Author: Yolane Hartsfield, USACE, Tulsa District
Recipient: All Parties
Date: 09 September 1997
Bate Stamp: 021031 - 021032

C. Title: Minutes - Monthly Manager's Meeting, Longhorn AAP
Group(s): General
Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: All Involved
Author: Yolane Hartsfield, USACE, Tulsa District
Recipient: All Parties
Date: 09 September 1997
Bate Stamp: 021033 - 021038

D. Title: Letter - Subject: Longhorn Sampling Observations 9/2/97
Location: Longhorn Army Ammunition Plant
Agency: Caddo Lake Institute, Inc.
Author: Dwight K. Shellman, Jr., President, Caddo Lake Institute, Inc.
Recipient: Yolane Hartsfield, USACE, Tulsa District
Date: September 9, 1997
Bate Stamp: 021039 - 021041

E. Title: Research Proposal - Study Title: Environmental Contaminants and Their Effects on Turtles at Caddo Lake, Texas
Group(s):
Site(s):
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Department of Wildlife and Fisheries Sciences
Author: Dr. Donald R. Clark, Jr., Leader Brazos Field Station
Recipient: USACE, Tulsa District
Date: Undated
Bate Stamp: 021042 - 021050

F. Title: Letter - Subject: Concurrence with Proposed No Further Action on Sites 52 and 63, Group 5 Sites, Longhorn Army Ammunition Plant, Karnack, Texas
Group(s): 5
Site(s): 52, 63
Location: Longhorn Army Ammunition Plant, Karnack, Texas
Agency: Dept of the Army
Author: James A. McPherson, Commander's Representative, Longhorn AAP
Recipient: Diane Poteet, Texas Natural Resource Conservation Comission
Date: September 24, I998
Bate Stamp: 021051 - 021052

G. Title: Letter - RE: Record of Decision for Areas Referred to as the Group 1 Sites Within the Longhorn Army Ammunition Plant
Group(s): 1
Site(s): 1, 11, 27, 54, XX
Location: Austin, Texas
Agency: Texas Natural Resource Conservation Commission
Author: Dan Pearson, Executive Director
Recipient: Myron O. Knudson, P.E.,Director, Superfund Division, EPA
Date: September 30, I997
Bate Stamp: 021465

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
P. O. BOX 61
TULSA, OKLAHOMA 74121-0061

REPLY TO
ATTENTION OF:

020853

CESWT-PP-ME (200-1c) 4 September 1997

MEMORANDUM FOR Commander, Longhorn/Louisiana Army Ammunition
Plants, ATTN: SIOLH-OR (Mr. David Tolbert),
Post Office Box 658, Doyline, LA 71023

SUBJECT: Final Work Plan (Part I) and Sampling and Analysis Plan (Part II) for the Site 16 Phase III Remedial Investigation/ Feasibility Study and Groundwater Treatability Study at the Longhorn Army Ammunition Plant, Karnack, Texas

1. Please find enclosed three copies of the subject document.

2. If you have any questions, please contact Ms. Yolane Hartsfield at 918-669-7530.

FOR THE COMMANDER:

Yolane Hartsfield

Encls

for BURL D. RAGLAND
Lead Project Manager
Army Team

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

020854

Sverdrup

Final Work Plan
for the
Site 16 Phase III Remedial Investigation/Feasiblity Study and Groundwater Treatability Study
at the
Longhorn Army Ammunition
Plant (LHAAP)
Karnack, Texas

Submitted to
U.S. Army Corps of Engineers
Tulsa District
CONTRACT NO. DACA56-96-R-0027
Delivery Order No. 1

Prepared by
Sverdrup Environmental, Inc.
St. Louis, Missouri

August 1997

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LIST of ACRONYMS and ABBREVIATIONS

BGS- Below Ground Surface

EPS- Environmental Protection Systems, Inc.

HDPE- High Density Polyethylene

ID- Inside Diameter

LAP- Load, Assemble, and Pack

LHAAP- Longhorn Army Ammunition Plant

NGVD- National Geodetic Vertical Datum

PCBs- Polychlorinated Biphenyls

QA/QC- Quality Assurance/Quality Control

RI/FS- Remedial Investigation/Feasibility Study

SAP- Sampling and Analysis Plan

SVOCs- Semi-Volatile Organic Compounds

SSHP- Site Safety and Health Plan

Sverdrup- Sverdrup Environmental, Inc.

TAL- Target Analyte List

TNT- Trinitrotoluene

USAEHA- U.S. Army Environmental Hygiene Agency

USACE- U.S. Army Corps of Engineers, Tulsa District

VOCs- Volatile Organic Compounds

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SECTION 1.0 INTRODUCTION

The U.S. Army Corps of Engineers, Tulsa District (USACE) contracted with Sverdrup Environmental, Inc. (Sverdrup) to perform an accelerated Phase III Remedial Investigation/Feasibility Study (RI/FS) and Water Treatability Study at Site 16 (Old Landfill) of the Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. Sverdrup has prepared this Work Plan as required under the provisions of Delivery Order No. 01 of Contract No. DACA56-96-R-0027.

1.1 PURPOSE

The purpose of this Phase III RI/FS is to supplement the Phase I RI, Phase II RI, and Design Analysis Report by obtaining additional information required to fully verify and characterize releases from Site 16. Additionally, as part of the FS, as discussed in Section 5.9 of this work plan, a Water Treatability Study consisting of the collection of groundwater level data over time and water samples will be performed to provide information for the evaluation of groundwater extraction as a possible remedial alternative. This Work Plan presents an overview of the field work and how it will be executed. This overview will include a description of the activities associated with mobilization, site set-up, drilling, well and piezometer installation, data collection procedures/methods, and surveying at Site 16. Additionally, the overview will present number and type of borings, wells, and piezometers to be installed; location of borings, wells, piezometers, and/or sample points; number and type of samples to be collected; and type of analysis to be performed on collected samples.

1.2 WORK PLAN ORGANIZATION

This Work Plan documents the objectives of the field work activities for the Phase III RI/FS and Water Treatability Study to be performed at Site 16 under delivery order No.1. The objectives shall be accomplished through the installation of borings, extraction wells, monitoring wells, and piezometers; and the collection and analysis of soil, surface soil, and groundwater samples. The following is a summary of information provided:

Section 1.0	Purpose and organization of Work Plan.
Section 2.0	General information including facility location and background; site location, history, and background; climatology; surface physiography; geology; and hydrogeology.
Section 3.0	Summary of previous investigations.
Section 4.0	Summary of field work objectives.
Section 5.0	Summary of field work activities.
Section 6.0	Summary of Feasibility Study.
Section 7.0	Summary of Baseline Risk Assessment.
Section 8.0	Schedule of Deliverables.
Appendix A	Forms.

The data quality procedures and techniques to be used for the investigation and study are discussed in the Sampling and Analysis Plan (SAP) presented in Part 2. The following is a summary of information provided in the SAP:

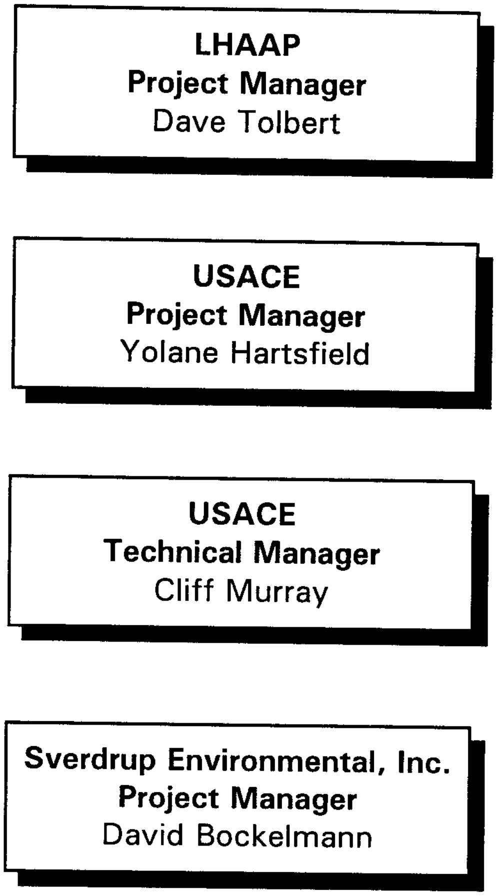
Section 1.0	Report and Project Quality Assurance/Quality Control (QA/QC) Organization
Section 2.0	Summary of the DQOs for this project.
Section 3.0	Summary of the field QA/QC procedures and techniques.
Section 4.0	Summary of sample handling and testing.
Section 5.0	Discusses sample integrity.
Section 6.0	Discusses data reduction, validation and reporting
Section 7.0	Discusses audits.
Section 8.0	Discusses corrective actions.
Section 9.0	References.
Appendix A	Forms
Appendix B	Analytical Tables

1.3 PROJECT ORGANIZATION

The USACE will use a multi-disciplinary project team to oversee all project activities. Project management will be performed by USACE. Project activities will be performed by contractors to USACE. This organizational structure is shown in Figure 1-1.

Field operations will be conducted by either Sverdrup or USACE personnel. Sverdrup will be responsible for field and office activities included in the scope of work. All subcontractors contracted by Sverdrup to perform field activities task will comply with all aspects of the Project Work Plan, SAP, and Site Safety and Health Plan (SSHP).

FIGURE 1-1: ORGANIZATIONAL STRUCTURE OF THE LHAAP REMEDIATION PROJECT.



SECTION 2.0 GENERAL INFORMATION

This section presents general information regarding the location, history, climatology, and physiography of LHAAP. Additionally, this section discusses the specific location, history, geology, and hydrogeology of Site 16.

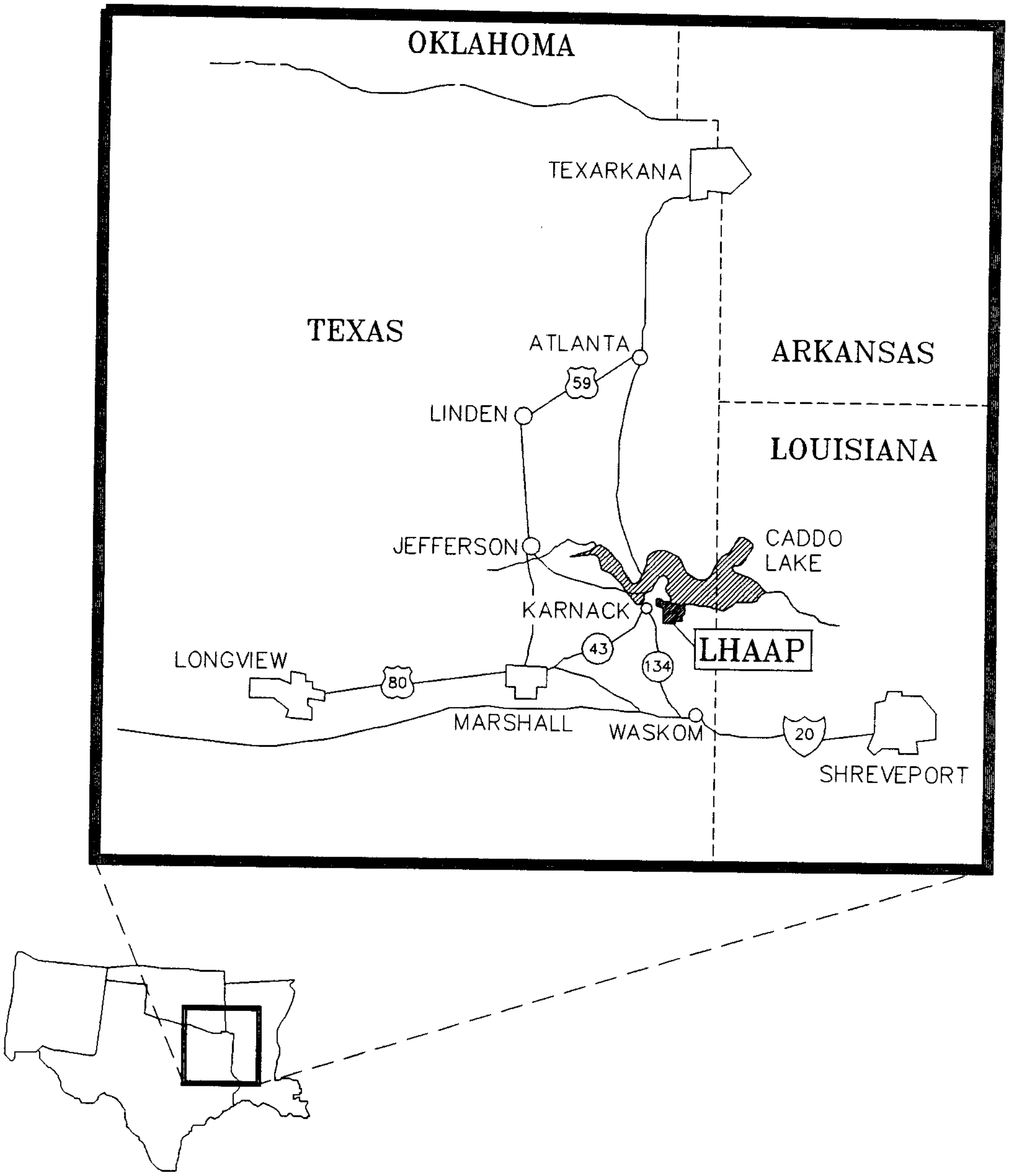
2.1 LHAAP GENERAL INFORMATION

2.1.1 Location

LHAAP is located in central east Texas in the northeast corner of Harrison County, approximately 14 miles northeast of Marshall, Texas, and approximately 40 miles west of Shreveport, Louisiana. The installation occupies 8,493 acres between State Highway 43 and the western shore of Caddo Lake. State Highways 43 and 134 access the installation. A location map is shown on Figure 2-1.

2.1.2 History and Description

LHAAP is a government-owned, contractor-operated industrial facility under the jurisdiction of the U.S. Army Armament, Munitions, and Chemical Command. Its primary mission was to load, assemble, and pack (LAP) pyrotechnic and illuminating/signal ammunition and solid propellant rocket motors. The general layout of LHAAP is shown in Figure 2-2.



CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
SITE 16 PHASE III RI/FS WORK PLAN

GENERAL SITE LOCATION MAP

Sverdrup Environmental

FIGURE 2–1

000187\DO-01\WORKPLAN\FIGURES\FIG_2-1

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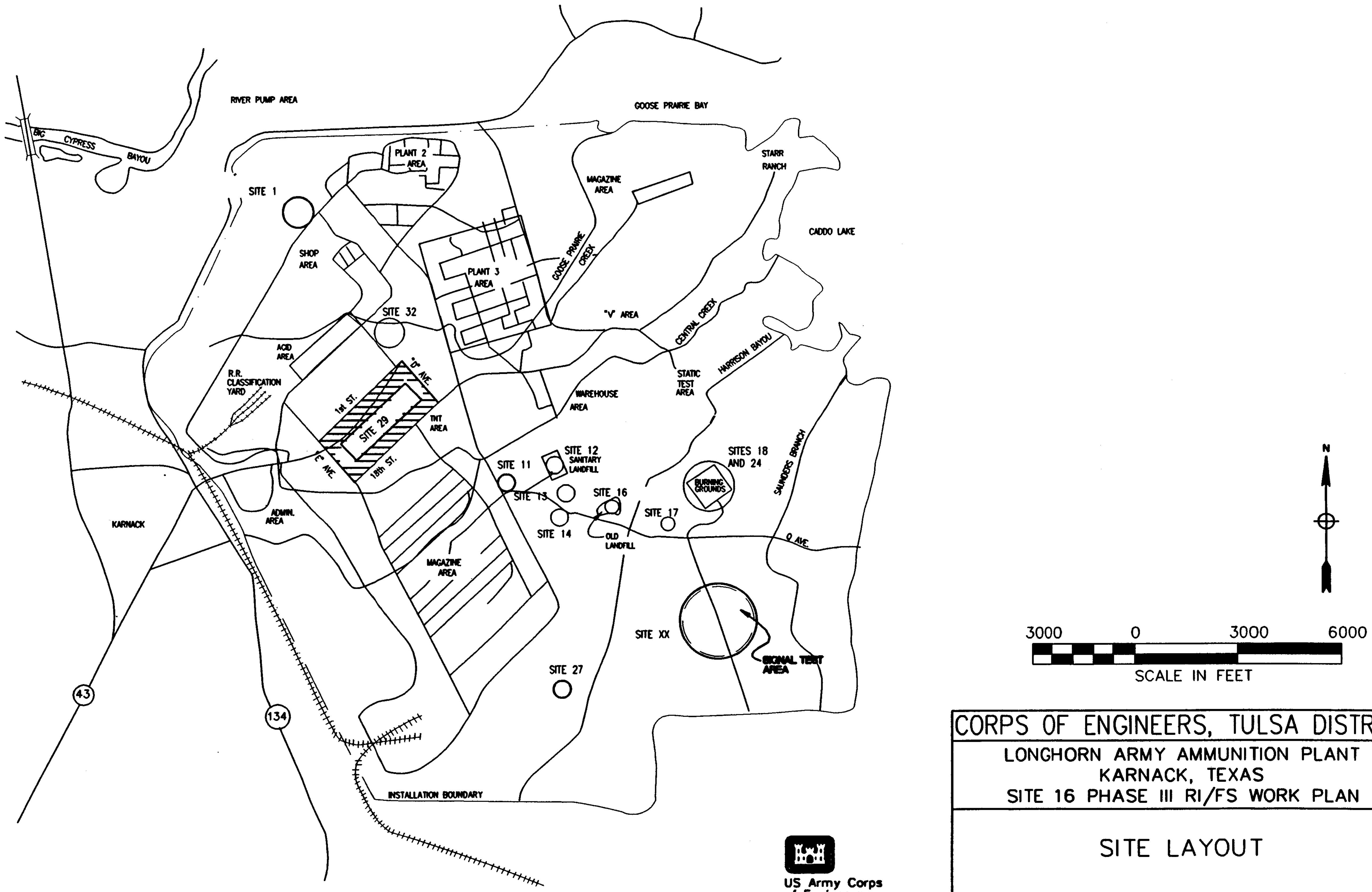

US Army Corps
of Engineers
Tulsa District

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
SITE 16 PHASE III RI/FS WORK PLAN

SITE LAYOUT

Sverdrup Environmental

FIGURE 2-2

000187\D0-01\WORKPLAN\FIGURES\FIG_2-2

Longhorn Army Ammunition Plant was established in October 1942 with the primary mission of producing 2,4,6-trinitrotoluene (TNT) flake in the TNT Production Area. Monsanto Chemical Company was the first contract operator of the plant. Production of TNT continued through World War II until August 1945 when Monsanto's role ceased. The plant was placed on standby status until February 1952. From 1952 until 1956, Universal Match Corporation was the operating contractor, producing pyrotechnic ammunition such as photoflash bombs, simulators, hand signals, and 40 mm tracers.

In November 1955, Thiokol Corporation began operation of the Plant 3 area rocket motor facility. Thiokol Corporation assumed responsibility for total operation of the plant with the departure of Universal Match Corporation in 1956. Production of rocket motors continued to be the primary mission of LHAAP until 1965, when the production of pyrotechnic and illuminating ammunition was reestablished. These operations consisted of compounding pyrotechnic and propellant mixtures, LAP activities, accommodating receipt and shipment of containerized cargo, and the maintenance and/or layaway of standby facilities and equipment for mobilization planning. The installation has also been responsible for the static firing and elimination of Pershing I and II rocket motors in compliance with the Intermediate-Range Nuclear Force Treaty in effect between the United States and the former U.S.S.R.

2.1.3 Climatology

LHAAP is located in a moist, subhumid to humid, mild climate. The average annual rainfall is 46 inches. Precipitation is fairly evenly distributed throughout the year, although summer and fall are frequently drought seasons, and December through May are often the wettest months. Precipitation is usually in the form of rain and on rare occasions as snow.

2.1.4 Physiography

LHAAP is characterized by mixed pine-hardwood forests that cover gently rolling to hilly terrain with an average slope of 3 percent towards the northeast. Most of the terrain at LHAAP slopes 3 percent or less, but slopes as steep as 12 percent are common in the western and northwestern portions of the installation and also along the Harrison Bayou floodplain. LHAAP is surrounded by pine-hardwood forests and agricultural land. The northeastern border is formed by Caddo Lake and Goose Prairie Bayou. Ground surface elevations on LHAAP vary from 170 ft to 335 ft National Geodetic Vertical Datum (NGVD), 1929.

All surface water from LHAAP drains northeastwardly into Caddo Lake via four drainage systems: Saunder's Branch, Harrison Bayou, Central Creek, and Goose Prairie Creek. Caddo Lake is a part of Big Cypress Bayou, into which a small portion of the northwest corner of the installations drains. Saunder's Branch of Martin's Creek flows onto LHAAP near the southeast corner of the installation and flows northward into Caddo Lake. Approximately 11 percent of the heavily wooded eastern section of the plant is drained by this system. Harrison Bayou enters LHAAP on the southern edge of the installation. The bayou carries 30 percent of the surface drainage of LHAAP and bisects the installation in a northeasterly direction. Central Creek enters LHAAP on its western edge just south of the town of Karnack. Approximately 29 percent of the surface drainage from the installation is carried to Caddo Lake via this drainage course. The headwaters of Goose Prairie Creek are located near the northwest corner of the plant and consist of one larger creek and several smaller tributaries. Goose Prairie Creek flows across the northern edge of the installation and drains approximately 30 percent of LHAAP.

Caddo Lake is created by Caddo Dam, constructed on the Big Cypress Bayou in Caddo Parish, Louisiana. The original dam was constructed in 1914 for local navigation purposes and was reconstructed in 1971. The spillway elevation of the lake is 168.9 ft. Big Cypress Bayou resumes east of Caddo Lake and joins the Red River at Shreveport, Louisiana. The Red River flows southeast across Louisiana and joins the Mississippi River at Simmesport, Louisiana.

2.2 SITE 16 (OLD LANDFILL) INFORMATION

2.2.1 Location

Site 16 (Old Landfill) is located in the south-central portion of LHAAP, just north of Avenue Q and adjacent to the retail sales area. The site encompasses approximately 20 acres and is composed of an open, grassy area bounded on the western and northern edges by a gravel road and by wooded areas along the eastern and southern edges. A rectangular paved area, known as the former retail sales area, is located at the western edge of the site. Harrison Bayou runs along the eastern edge. A detailed map of the Old Landfill showing current site conditions is provided as Figure 2-3.

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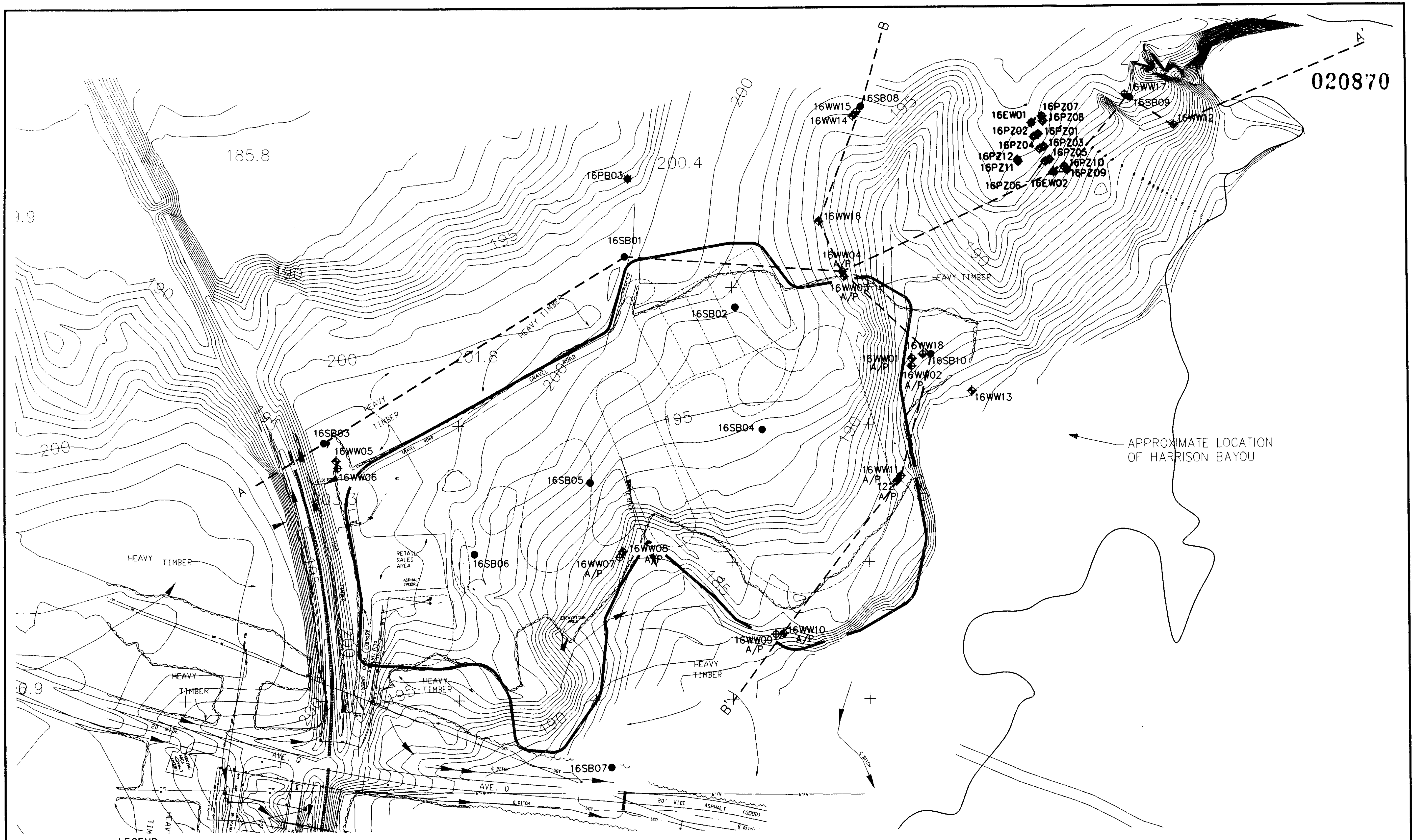

LEGEND
- ⊕ PERCHED MONITORING WELL
- ⊕ SHALLOW MONITORING WELL
- ⊕ INTERMEDIATE MONITORING WELL
- ⊕ DEEP MONITORING WELL
- ⊕ PIEZOMETER
- ⊕ EXTRACTION WELL
- ● SOIL BORING
- ◆ HARRISON BAYOU SEDIMENT AND SURFACE WATER SAMPLE

0 40 80
FEET

US Army Corps of Engineers Tulsa District

Sverdrup
ENVIRONMENTAL

SITE 16 PHASE III RI/FS
SITE MAP
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

DWN: BSM	DES.:	PROJECT NO.: 000187
CHKD:	APPD:	
DATE: FEB 97	REV.:	FIGURE NO.: 2-3

2.2.2 History

The history of Site 16 was reconstructed from information obtained from a LHAAP records search, the LHAAP RI/FS Work Plan, Volume 1, June 1992, and the LHAAP RI/FS Field Investigation Summary Report, February 1994. The Old Landfill was used, from 1942 to 1944, for the disposal of TNT red water ash generated from Site 32 (TNT Waste Disposal Plant). In the mid-to-late 1950s, three rocket motor casings were reportedly burned and possibly buried on the eastern side of the site. During this time, a large bermed depression encompassing the central section of the site was reportedly used for the disposal of a variety of materials such as substandard TNT, barrels of chemicals, oil, paint, scrap iron, and wood. This area was filled, and landfilling operations continued moving eastward, raising the ground surface to its current elevation approximately 15 ft above original grade. Burn pits and waste storage were common at the site during the history of its operation, but little is known about the nature of the wastes. The site continued to be used for a variety of waste disposal and treatment activities until the 1980s, when the disposal of inert solid wastes was moved to Site 12 (Active Landfill).

2.2.3 Geology

Surficial soils at Site 16 consist of medium plastic silts and clays ranging in thickness from 5 to 15 ft. The surficial soils are underlain by a shallow saturated sand zone, ranging in thickness from 9 to 18 ft. The sand zone consists of silty fine sand containing some silt and clay lenses, and is at first dry to moist then generally becomes saturated at depths of 15 to 20 ft below ground surface (BGS). A 10 to 30 ft thick medium to highly plastic silt and clay layer was encountered underlying the shallow saturated sand zone. An intermediate saturated sand zone consisting of a fine to medium silty sand was encountered at depths of 30 to 50 ft BGS. The intermediate saturated sand zone was generally less silty than the shallow saturated sand zone. Figures 2-4 and 2-5 provide generalized soil profiles to illustrate the stratigraphic units encountered beneath Site 16. The cross section transect lines for each section are shown in Figure 2-3.

Beneath the intermediate saturated sand zone, a silt to silty clay layer is encountered and ranges in thickness from 5 to 30 ft. Underlying this silt to silty clay layer, a massive homogeneous silty clayey fine sand is encountered that extends from a depth of approximately 75 ft BGS to the top of the Midway formation which is has been encountered at depths ranging from 225 to 307 ft BGS.

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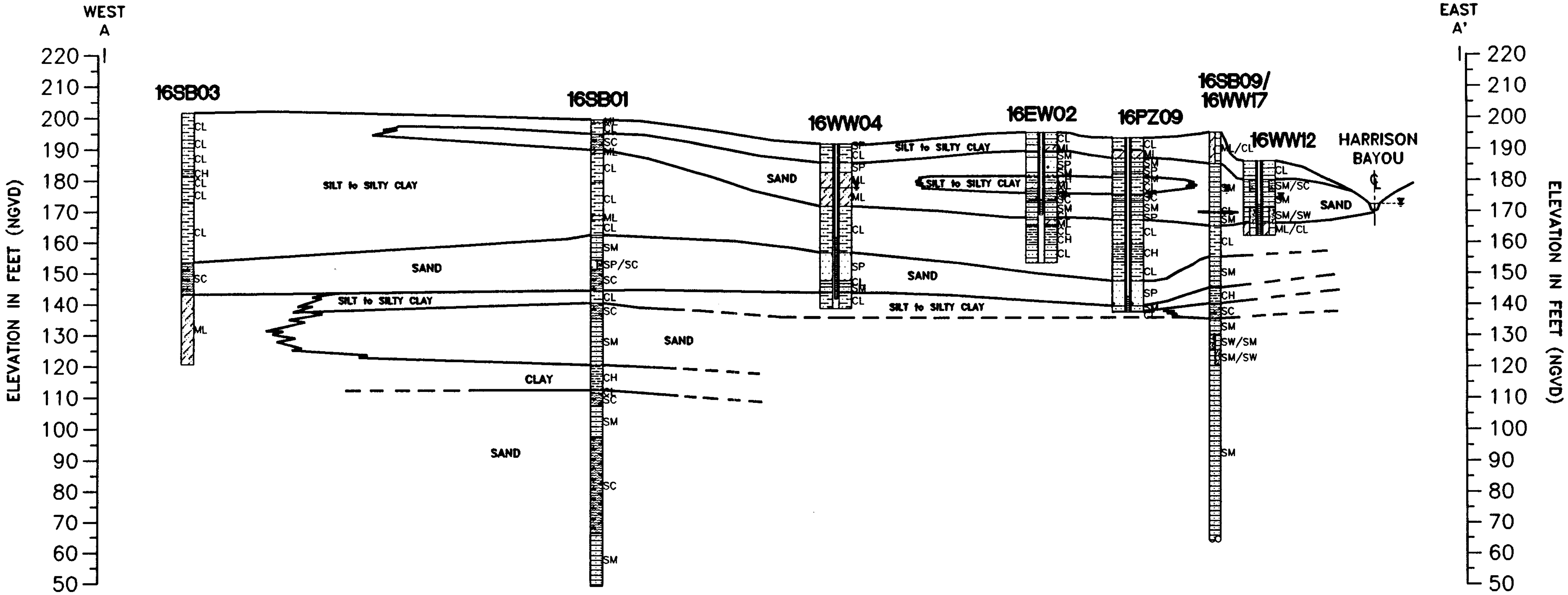

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US Army Corps of Engineers Tulsa District

Sverdrup
ENVIRONMENTAL

SITE 16 PHASE III RI/FS WORK PLAN
GEOLOGIC CROSS SECTION A-A'
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

DWN: BSM	DES.:	PROJECT NO.: 000187	
CHKD: PTS	APPD:		
DATE: FEB 97	REV.:	FIGURE NO.: 2-4	

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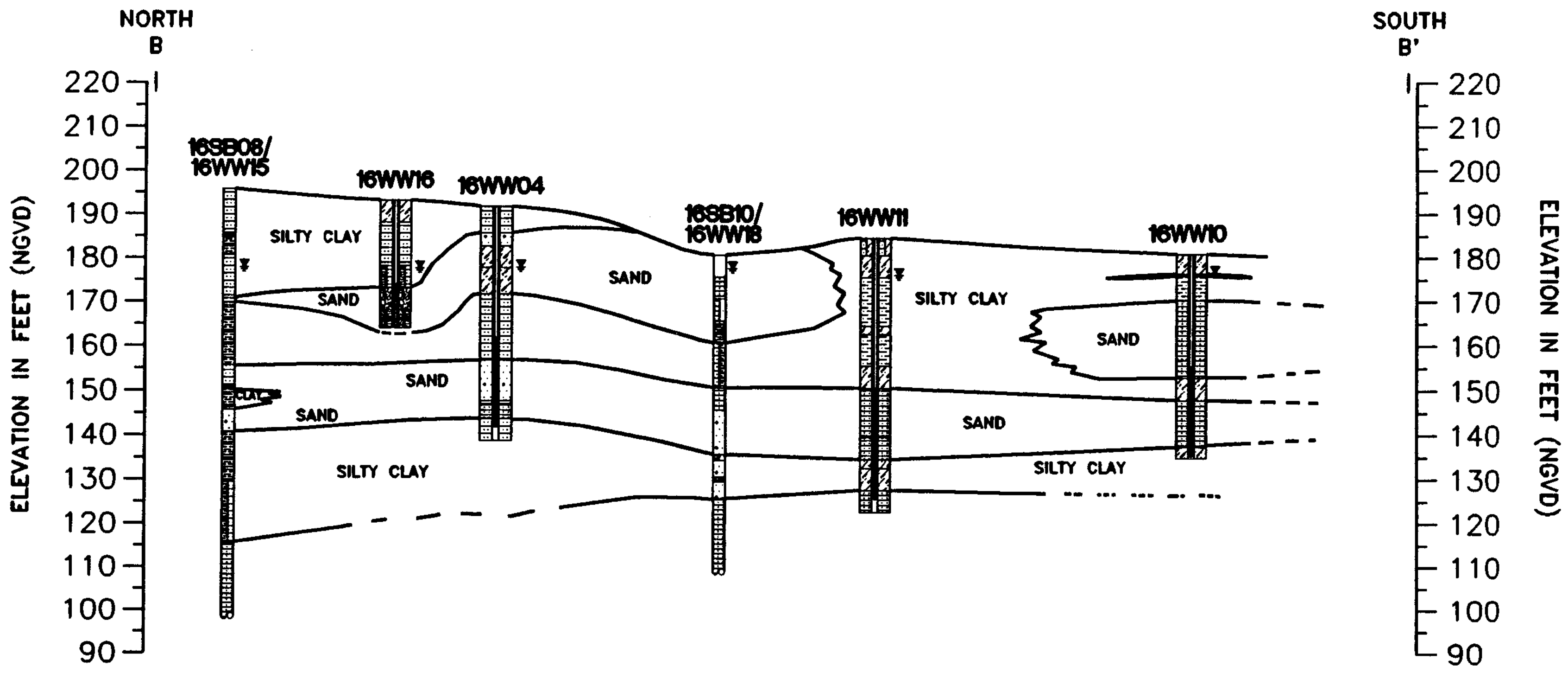

0 50 100
FEET
HORZ. SCALE 5X

US Army Corps of Engineers Tulsa District

Sverdrup
ENVIRONMENTAL

SITE 16 PHASE III RI/FS WORK PLAN
GEOLOGIC CROSS SECTION B-B'
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

DWN: BSM	DES.:	PROJECT NO.: 000187	
CHKD: PTS	APPD:		
DATE: FEB 97	REV.:	FIGURE NO.: 2-5	

2.2.4 Hydrogeology

Data obtained during previous investigations indicates varying degrees of heterogeneity within the subsurface hydrogeology at Site 16. This is indicative of the fluvial-deltaic type depositional environment typical of the Wilcox Group sediments which comprises the majority of the unconsolidated deposits underlying the site. These unconsolidated sediments within this group are comprised primarily of elongated channel-fill sands deposited within alluvial belts interbedded with lower permeability interchannel sediments which tend to form aquitards that control the flow between these saturated sand bodies.

3.0 PREVIOUS INVESTIGATIONS AND HISTORICAL DATA RESULTS

The following sections discuss the previous investigations at Site 16 and the historical data results from these investigations. The discussions are presented primarily to provide general background for Site 16. A more detailed discussions of previous investigations and data results can be found in the Phase I RI and the Phase II Field Summary Report. Not all of the previous investigation sample locations mentioned in the following sections are shown graphically on the site plan (Figure 2-3).

3.1 Previous Investigations

Site 16 was originally investigated by the U.S. Army Environmental Hygiene Agency (USAEHA) in 1980, at which time three monitoring wells (BH-14, BH-15, and BH-16) were installed. Documentation for this investigation, "Land Disposal Study No. 38-26-0104-81" (USAEHA, 1980), does not provide construction details for the three monitoring wells. Field observations made in 1993 by Sverdrup indicate that the monitoring wells are constructed of 2 in. inside diameter (ID) PVC pipe and are still in place. The present disposition of these wells is unknown at this time. Efforts will be undertaken during this field event to verify the current status of these wells. The study did note ponding on the landfill and leachate generated, however, locations of these observations were not identified.

In 1982, Environmental Protection Systems, Inc. (EPS) investigated the site for the U.S. Army Toxic and Hazardous Materials Agency and published a report documenting the investigation in June 1984. As part of this investigation, monitoring well 122 was installed at the eastern edge of the former landfill site. A surface water and stream sediment sampling station was established immediately east of Site 16 in Harrison Bayou to determine the impact of surface water runoff and any groundwater discharge from the landfill into the bayou. Soil samples were also collected from depths of 0 - 2.5 ft and 2.5 - 5.0 ft at five locations within the landfill boundaries.

In 1987, an investigation was performed by EPS for Thiokol Corporation, to verify the presence of contamination by explosive compounds at Site 16. The EPS report was published in May 1988. Monitoring wells 122, BH-12, BH-13, and BH-16 were sampled, and ten soil samples were collected from a depth of 0 - 0.5 ft along the eastern toe of the landfill. Monitoring wells BH-14 and BH-15 were not sampled. Deeper soil samples were collected from a total of twenty soil borings within the limits of the landfill and were composited both vertically and horizontally in an effort to characterize any contamination within a given area of the landfill. The landfill was divided into quadrants and five borings were drilled in each to a depth approximating the bottom of landfilled material. Borings in quadrants II and III on the eastern half of the landfill were drilled to a depth of 5 ft each, with samples composited vertically from depths of 0.0 - 0.5 ft and 0.5 - 5.0 ft in each boring. Borings in quadrants I and IV on the western half of the landfill were drilled to a depth of 15 ft, with samples composited vertically from depths of 0.0 - 0.5 ft, 0.5 - 5.0 ft, 5 - 10 ft, and 10 - 15 ft. Vertically composited samples were then composited horizontally within a given quadrant to yield one sample for each depth interval sampled. Two other 5 ft deep soil borings, L1 and M1, were also drilled and sampled along the eastern toe of the site. Samples from these borings were composited vertically only from depths of 0.0 - 0.5 ft and 0.5 - 5.0 ft. The exact sample locations are unclear from available documentation.

During the Phase I RI conducted by Sverdrup in 1993, groundwater, surface water, sediment, and soil samples were collected and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), explosive compounds, metals, and anions. Four soil borings (16SB02, 16SB04, 16SB05, and 16SB06) were located within the suspected limits of the former waste disposal activity. Three of the borings (16SB04, 16SB05, and 16SB06) were located along the east-west centerline of the landfill in an effort to profile the depth of landfilled materials. The fourth boring (16SB02) was located at the northern end of the landfill within one of the former burn pit locations. Three deep borings (16SB01, 16SB03, and 16SB07) were drilled to further define the geologic stratigraphy beneath the site. These borings were completed outside of the boundary of the landfill to reduce the potential for cross contamination of water-bearing zones. Five surface water samples (16SW01 through 16SW05) and five sediment samples (16SD01 through 16SD05) were also collected. Four of the sample locations targeted the surface water drainage paths leading from the site to determine if contaminants are migrating toward Harrison Bayou. Monitoring wells 16WW01 through 16WW11 were installed at locations along the perimeter of the landfill area.

The Phase II RI performed by Sverdrup in 1995 included the collection of surface water and sediment samples for chemical analyses; the collection of subsurface soil samples for geotechnical analyses; a downhole geophysical survey; the collection of groundwater samples for chemical analyses; and the installation of monitoring wells. Twenty surface water samples (16SW01 through 16SW04 and 16SW06 through 16SW21) and twenty sediment samples (16SD01 through 16SD04 and 16SD06 through 16SD21) were collected. A total of ten borings were advanced as part of the Phase II RI, with seven of the boreholes completed as monitoring wells (16WW12 through 16WW18). A total of 140 samples were submitted for laboratory geotechnical analyses. A downhole geophysical survey (natural gamma ray and single point resistivity) was executed at soil borings 16SB08, 16SB09, and 16SB10 to provide additional stratigraphic data relative to the subsurface geology. A total of twenty-one shallow groundwater samples (16PB02, 16PB04 through 16PB14, 16PB16 through 16PB21, and 16PB25 through 16PB28) were collected using a Geoprobe unit. Groundwater samples collected from the seven newly installed monitoring wells (16WW12 through 16WW18) and twelve existing monitoring wells (16WW01 through 16WW11 and 122) were submitted for laboratory analyses.

On August 31, 1995 and September 11, 1995 USACE performed a post Phase II investigation which included the collection of twenty surface water and sediment samples from ten locations on Harrison Bayou adjacent to Site 16. Surface water and sediment samples were analyzed for VOCs only. The sample location from which the surface water and sediment samples HBW-1, HBW-1B, HBS-1, and HBS-1B were collected was adjacent to a groundwater seep which drains into Harrison Bayou.

During the Design Analysis Study performed by Sverdrup in 1996, two extraction wells and twelve piezometers were installed. A total of eighteen groundwater samples were collected. Groundwater samples were collected during each of the pumping tests and submitted for laboratory analysis for VOCs, SVOCs, explosive compounds, and target analyte list (TAL) metals.

3.2 Historical Data Results

Historical data results are presented in Tables 3-1, 3-2, and 3-3. The tables summarize the compounds detected in groundwater, surface water, sediment, and soil samples from previous investigations. Previous investigations include Preliminary Assessment/Site Investigations, Phase I RI, Phase II RI, Post Phase II Sampling, and a Design Analysis Study. For a more detailed presentation of historical data results refer to the "Phase II, Group 2 Sites Remedial Investigation, Field Summary Report", July, 1996

TABLE 3-1
SUMMARY OF COMPOUNDS DETECTED IN PRE-PHASE III INVESTIGATIONS
SITE 16

MATRIX	COMPOUNDS	Threshold Limits	LOCATIONS CONTAINING DETECTED COMPOUNDS	MAXIMUM DETECTED CONCENTRATION
GROUNDWATER **(Units µg/l)**	Acetone	3700[c]	16WW06	17
	2-(1-1-Dimethylethoxy) Ethanol	-	122	12
	2-Dimethyl-4-Delene	-	122	12
	cis-1,2-Dichloroethene	70	16WW(01, 03, 04)	52
	Methylene Chloride	5	16WW03	520
	Tetrahydrofuran	-	BH-13	10
	Trichloroethene	5	16WW(01, 03, 04, 11)	6400
	Trichloromethane	-	BH-13	10
	2,6-DNT	0.4	122	8.6
	Vinyl Chloride	2	122	10.5
GROUNDWATER **(Units mg/l)**	Aluminum	0.050[a]	122, BH(12, 13, 14, 16)	24.1
	Arsenic	0.05	122	0.017
	Barium	2	122, 16WW(01-11)	1.2
	Beryllium	0.004	BH(12, 13)	0.02
	Cadmium	0.005	122, BH(12, 13, 16)	0.02
	Chromium	0.1	122, BH(12, 13, 16) 16WW03	0.041
	Copper	1.3[b]	122, BH(12,13, 16)	0.1
	Lead	0.015[b]	122, BH(12, 13, 16) 16WW(05,07)	0.0809
	Manganese	0.05[a]	122, BH(14, 16, 12)	4.46
	Mercury	0.002	BH-12	0.0032
	Nickel	0.1	BH-16, 16WW(03, 04)	0.165
	Selenium	0.05	16WW04	0.0156
	Strontium	-	122, BH(12, 13, 16)	1.79
	Thallium	0.002	BH(14, 16)	0.16
	Chloride	250[a]	122, BH(13, 14, 16), 16WW(01-11)	1,056
	Fluoride	4	BH(13, 14, 16)	2
	Nitrate	10	16WW(02, 05, 07)	0.39
	Sulfate	250[a]	122, 16WW(01-11)	7266.0
	Phosphates	-	BH-13	3.93

TABLE 3-1 (Continued)
SUMMARY OF COMPOUNDS DETECTED IN PRE-PHASE III INVESTIGATIONS
SITE 16

MATRIX	COMPOUNDS	Threshold Limits	LOCATIONS CONTAINING DETECTED COMPOUNDS	MAXIMUM DETECTED CONCENTRATION
SURFACE WATER (Units: µg/l)	1,1'-Bicyclohexyl	-	SW 017	17
	2-Quinolinecarbox-Aldehyde-8-Hydroxyoxime	-	SW 017	10
SURFACE WATER (Units: mg/l)	Aluminum	0.05[a]	SW017	0.337
	Barium	2	16SW(01-05)	0.192
	Lead	0.015[b]	SW 017, 16SW02	0.0201
	Thallium	0.002	SW 017	0.04
	Chloride	250[a]	16SW(01, 04, 05)	85.6
	Nitrate	10	16SW01	4.74
	Sulfate	250[a]	16SW(01, 04, 05)	169
SEDIMENT (mg/kg)	Arsenic	23[d]	16SD(02-04)	7.17
	Barium	5500[d]	16SD(02-05)	224
	Chromium	78000[d]	16SD(02-05)	40.9
	Lead	-	16SD(02-05)	31.2
	Nickel	1600[d]	16SD(02-05)	14.4
	Selenium	390[d]	16SD04	1.95 J
	Thallium	-	16SD05	1.83
	Chloride	7800[d]	16SD(02, 04, 05)	54.7
	Nitrate	130000[d]	16SD(02, 04)	0.37
	Sulfate	-	16SD(02-05)	171

TABLE 3-1 (Continued)
SUMMARY OF COMPOUNDS DETECTED IN PRE-PHASE III INVESTIGATIONS
SITE 16

MATRIX	COMPOUNDS	Threshold Limits	LOCATIONS CONTAINING DETECTED COMPOUNDS	MAXIMUM DETECTED CONCENTRATION
SOIL (Units: µg/kg)	Acetone	780000[d]	16SB[02(0-2), 02(5-7), 04(0-4), 04(10-12), 04(15-17)] 16WW[04(5-7), 07(5-7), 09A(5-7), 10(4.5-6.5), 11(4.5-6)]	90
	Butyl benzyl phthalate	16000[d]	16WW04(0-2)	960
	cis-1,2-Dichloroethene	780[d]	16SB[08(5-7), 02(15-16), 02(16-17), 02(20-22), 04(0-4), 04(10-12), 04(15-17)]	16000
	1,1-Dichloroethene	1100[d]	Quad IV[(6"-5'),(5-10')] Quad I[(5-10'), (10-15')]	1900
	Di-n-butyl phthalate	7800[d]	16SB[02(15-16), 02(16-17), 04(15-17), 04(20-22), 05(0-2), 05(8.5-10),] 16WW[04(0-2), 05(5-7), 05(10-12), 09A(5-7), 11(4.5-6)]	3200 B
	2,4-Dinitrotoluene	160[d]	Quad I(10-15'), Quad IV(10-15')	73
	2,6-Dinitrotoluene	78[d]	Quad IV(5-10'),Quad IV(10-15'), Quad I(10-15')	173
	Fluoranthene	-	16SB05(15-16)	460
	Methylene Chloride	85000[d]	16SB[02(15-16), 02(16-17)] 16WW[02(0-2), 04(5-7)]	1400
	Toluene	16000000[d]	16WW09A(5-7)	6
	Trichloroethene	58000[d]	Quad II(0-6"),Quad IV[(6"-5'), (5-10')],Quad I(0-6"), 16SB[02(0-2), 02(5-7), 02(10-12), 02(15-16), 02(16-17), 02(20-22), 04(0-4), 04(10-12), 04(15-17), 04(20-22)], 16WW[01(10-12), 01(10-12), 03(10-12), 03(15-17), 04(0-2), 04(5-7), 04(10-12)]	10000
	1,3,5-Trinitrobenzene	3.9[d]	SS(1, 4,5,9), Quad II (0-6")	153
	Vinyl Chloride	340[d]	Quad IV[(6"-5'),(5-10'), (10-15')],Quad I[(5-10'),(10-15')], 16SB[04(0-4),04(15-17)]	2100

TABLE 3-1 (Continued)
SUMMARY OF COMPOUNDS DETECTED IN PRE-PHASE III INVESTIGATIONS
SITE 16

MATRIX	COMPOUNDS	Threshold Limits	LOCATIONS CONTAINING DETECTED COMPOUNDS	MAXIMUM DETECTED CONCENTRATION
SOIL (Units: mg/kg)	Arsenic	23 [d]	16SB[04(10-12), 04(15-17), 04(20-22), 05(0-2), 05(8.5-10), 05(15-16), 06(0-2), 06(5-7), 05(10-11), 04(14-15), 06(20-22)], 16WW[01(0-2), 01(5-7), 01(10-12), 02(0-2), 02(5-7), 03(0-2), 03(5-7), 03(10-12), 03(15-17), 04(0-2), 04(5-7), 04(10-12), 05(0-2), 05(5-7), 05(10-12), 05(20-22), 05(25-27), 06(0-2), 06(5-7), 06(10-12), 06(15-17), 06(20-22), 07(0-2), 07(5-7), 09A(0-2), 09A(5-7), 10(0-2), 10(4.5-6.5), 11(0-2), 11(4.5-6)]	14.4 J
	Barium	5500 [d]	All Phase I, Group 2, Site 16, Soil Boring Samples (SvE)	935
	Chromium	78000 [d]	All Phase I, Group 2, Site 16, Soil Boring Samples (SvE)	36.7
	Lead	-	Quad II[(0-6"),(6"-5')] Quad IV[(6"-5'), (5-10')] All Phase I, Group 2, Site 16 Soil Boring Samples (SvE)	2000
	Manganese	-	SS(9, 10) BG(0-6"), L1(0-6")	2100
	Nickel	1600 [d]	All Phase I, Group 2, Site 16 Soil Boring Samples (SvE)	47.2
	Silver	390 [d]	16SB[04(0-4), 04(10-12)], 16WW[07(5-7), 09A(5-7)]	4.88
	Thallium	-	16WW[02(0-2), 03(0-2), 03(10-12), 04(0-2), 05(15-17), 06(0-2), 06(5-7), 06(15-17), 06(20-22)]	5.96

TABLE 3-1 (Continued)
SUMMARY OF COMPOUNDS
DETECTED IN PRE-PHASE III INVESTIGATIONS
SITE 16

MATRIX	COMPOUNDS	Threshold Limits	LOCATIONS CONTAINING DETECTED COMPOUNDS	MAXIMUM DETECTED CONCENTRATION
SOIL (Units: mg/kg)	Chloride	7800[d]	16SB[02(0-2), 02(5-7), 02(10-12), 02(15-16), 02(16-17), 02(20-22), 04(0-4), 04(10-12),04(15-17), 04(20-22), 04A(0-1), 05(0-2), 05(8.5-10), 05(15-16), 06(5-7), 06(10-11), 06(14-15), 06(20-22), 16WW[01(5-7), 03(5-7), 03(10-12), 03(15-17),04(5-7), 04(10-12), 05(5-7), 05(10-12), 05(15-17), 05(20-22), 05(25-27), 06(5-7), 06(16-17), 06(20-22), 07(0-2), 07(5-7), 10(0-2), 10(4.5-6.5)]	393
	Nitrate	130000[d]	16SB[02(15-16), 02(16-17), 04A(0-1), 05(15-16)], 16WW[01(0-2), 06(5-7), 06(10-12), 06(15-17) 06(20-22), 09A(0-2), 10(0-2), 11(0-2)	1.4
	Sulfate	-	701T(0-2.5'), 702T(0-2.5'), 703T(0-2.5'), 704T(0-2.5'),704B(2.5-5') All Phase I, Group 2, Site 16 Soil Boring Samples (SvE) except 16SB02(5-7)	4460

[a] Secondary Maximum Contaminant Level.
[b] MCL for lead is not promulgated, but represents a treatment technique action level (see Lead and Copper Rule, 40 CFR 141, Subchapter I).
[c] Data obtained from: "USEPA Region III Risk Based Concentrations (RCB)", January-June 1995, "tap water".
[d] Data obtained from: "USEPA Region III Risk Based Concentrations (RCB)", January-June 1995, Soil Ingestion Levels, "Residential".
B - The analyte was detected in an associate blank (Organics Only).
J - Analyte positively identified, but the concentration was approximate.
Sources: "LHAAP RI/FS Work Plan", Volume 1, June 1992 & "LHAAP RI/FS Field Investigation Summary Report", February 1994.

TABLE 3-2
DETECTED CONSTITUENTS IN GROUNDWATER SAMPLES
SITE 16
LHAAP PHASE II RI/FS

CONTAMINANT	MCL	Samples w/ Concentrations Above MCL's	Maximum Detected Concentration
VOC's (ug/l)			
Acetone	3700[a]	---	10
Benzene	5	16WW16	5
Chlorform	100[c]	---	(4) J
1,1 Dichloroethane	810[a]	---	34
1,2 Dichloroethane	5	16WW16	103
1,1-Dichloroethene	7	16WW03, 16WW16	603
1,2-Dichloroethene (Total)	170	16WW01, 16WW16	275000
Ethylbenzene	700	---	5
Methylene Chloride	5	16WW03, 16WW04, 16WW16	73
1,1,2-Trichlorethane	5	16WW16	12
Toluene	1000	---	29
Trichlorethene	5	16WW01-16WW04, 16WW10-16WW14, 16WW16	20900
Trichlorofluoromethane	1300[a]	---	892
Vinyl Chloride	2	16WW01, 16WW04, 16WW13, 16WW11, 16WW16	(7980) J
Total Xylenes	10000	---	12
Explosives (ug/l)			
HMX	1800[a]	---	2.9 J
RDX	0.61[a]	---	0.6 J
1,3,5-Trinitrobenzene	1.8[a]	---	0.74
2,4,6-Trinitrotoluene	2.2[a]	16WW03	0.9 J
Metals (mg/l)			
Arsenic	0.05	---	0.034 J
Barium	2	16WW09, 16WW17	9.9
Chromium	0.1	---	0.051
Lead	0.015[b]	16WW15, 16WW17	0.03
Mercury	0.002	---	0.00086
Nickel	0.1	16WW13	0. 36

--- No current MCL or Regulation; Did not exceed current MCL or Regulation

J - The analyte was positively identified; the associated numerical value is the estimated concentration of the analyte in the sample.

[a] Data obtained from: USEPA Soil Screening Document, January - June 1995, "tap water"

[b] MCL for lead is not promulgated, but represents a treatment technique action level (see Lead and Copper Rule, 40 CFR 141, Subchapter I)

[c] Total for all THM's combined cannot exceed 80 ug/l level.

Source: LHAAP RI/FS Phase II, Group 2 Sites Draft Site Characterization Summary Report, May 1996

TABLE 3-3
DETECTED CONSTITUENTS IN GROUNDWATER SAMPLES
LHAAP SITE 16
DESIGN ANALYSIS STUDY

CONTAMINANT	MCL	Samples w/ Concentrations Above MCL's	Maximum Detected Concentration
VOC's (ug/l)			
Acetone	3700[a]	16EW01B	3920
Chlorform	100[c]	16EW01A	13
1,2 Dichloroethane	5	16EW01A	85
1,1-Dichloroethene	7	16EW01A	36
1,2-Dichloroethene (Total)	170	16EW01C	2578
Methylene Chloride	5	16EW01A	256J
Trichlorethene	5	16EW01J	52380
Vinyl Chloride	2	16EW01A	42
SVOC's (ug/l)			
Butylbenzylphthalate		16EW02B	7
Bis(2-ethylhexyl)phthalate		16EW02G	26
Explosives (ug/l)			
4-Am-2,6-DNT	-	16EW02B	0.875
1,3-DNB	-	16EW01D	1.56
2,4-DNT	-	16EW02G	0.083J
2,6-DNT	-	16EW01D	0.263J
NB	-	16EW02B	0.344
HMX	1800[a]	16EW01E	0.12
RDX	0.61[a]	16EW02B	4.75J
1,3,5-Trinitrobenzene	1.8[a]	16EW02G	0.302J
Total tetryl	-	16EW02E	0.349J
2,4,6-Trinitrotoluene	2.2[a]	16EW01E	1.56
Metals (mg/l)			
Aluminum	0.05	16EW02B	26.8
Arsenic	0.05	16EW02B	0.007
Barium	2	16EW02B	0.192
Chromium	0.1	16EW02B	0.047
Copper	0.015[b]	16EW02H	0.484
Iron	0.3	16EW02B	28.1
Magnesium	-	16EW02E	473
Manganese	0.05	16EW02B	1.68
Mercury	0.002	16EW01J	0.0003
Nickel	0.1	16EW02B	0.079
Strontium	-	16EW02E	8.5
Zinc	5	16EW02F	37

--- No current MCL or Regulation; Did not exceed current MCL or Regulation

J - The analyte was positively identified; the associated numerical value is the estimated concentration of the analyte in the sample.

[a] Data obtained from: USEPA Soil Screening Document, January - June 1995, "tap water"

[b] MCL for copper is not promulgated, but represents a treatment technique action level (see copper Rule, 40 CFR 141, Subchapter I)

[c] Total for all THM's combined cannot exceed 80 ug/l level.

Source: Site 16 - Time Critical Removal Action

SECTION 4.0 FIELD INVESTIGATION ACTIVITIES

To further investigate potential contamination with VOCs, high explosives, and metals, this Phase III RI/FS and Groundwater Treatability Study shall includes the following:

- Installation of six extraction wells
- Installation of twenty monitoring wells
- Installation of eight piezometers
- Collection of soil samples from four borings during the installation of monitoring wells
- Collection of five sediment and surface water samples
- Collection of thirty-seven groundwater samples from the twenty-six newly installed wells and eleven existing wells
- Slug tests of the twenty newly installed monitoring wells
- Surveying of new well and piezometer locations; surface soil sample locations; and Harrison Bayou
- Installation of groundwater control system
- Site access improvement
- Groundwater model data
- Feasibility Study data compilation

Each of these field activities are designed to obtain site-specific data to assist in defining both the physical and chemical characteristics for Site 16. Sampling and analyses described in this plan will be performed in accordance with the procedures outlined in the SAP and SSHP. Unless otherwise stated, the following parameters, where applicable, will be analyzed for all soil, surface soil, and groundwater samples: pH; specific conductance; temperature; dissolved oxygen; Total VOCs; high explosives; metals (aluminum, antimony; arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, strontium, thallium, vanadium, and zinc); and anions (sulfate, chloride, nitrates, and nitrites). Additionally, for use in the risk assessment, groundwater samples from three wells expected to have the highest contamination will be analyzed for pesticides, polychlorinated biphenyls (PCBs), and dioxins/furans. All soil and surface soil samples will include visual classification.

4.1 Installation of Extraction Wells

A total of six extraction wells will be installed at the proposed locations shown on Figure 4-1. Intermediate extraction wells (16EW05 and 16EW06) will be installed to a depth of approximately 55 ft BGS adjacent to shallow extraction wells 16EW01 and 16EW02 respectively. The remaining four extraction wells will be installed as two nested pairs consisting of one shallow extraction well (16EW03 or 16EW04) installed to a depth of approximately 35 ft and one intermediate extraction well (16EW07 or 16EW08) installed to a depth of approximately 55 ft. The exact depth and location of the extraction wells will be determined in the field based on lithology and field data.

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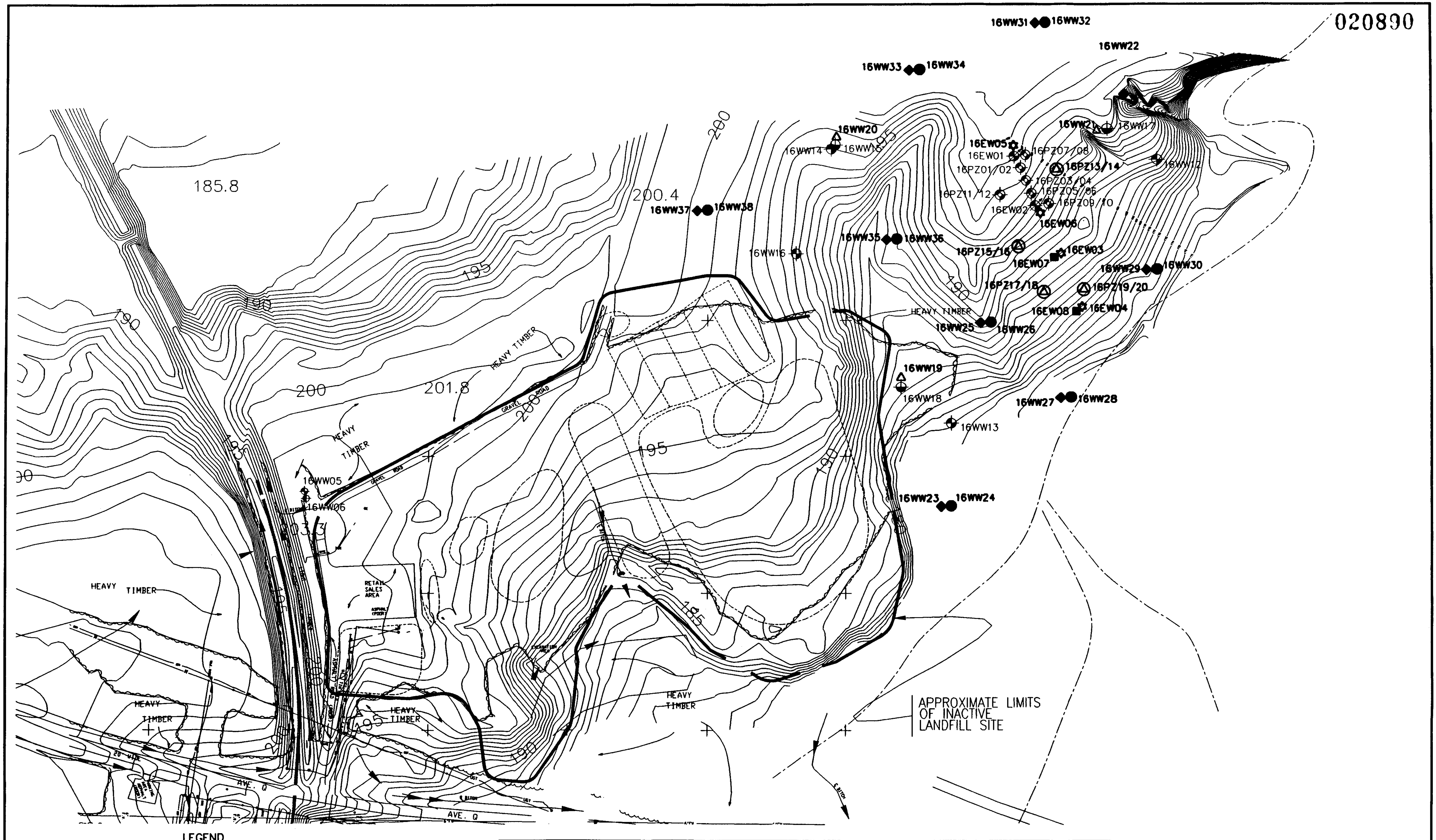

LEGEND

- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- DEEP MONITORING WELL
- PIEZOMETER
- SHALLOW EXTRACTION WELL
- ● PROPOSED INTERMEDIATE MONITORING WELL LOCATION
- ◆ PROPOSED SHALLOW MONITORING WELL LOCATION
- △ PROPOSED DEEP MONITORING WELL LOCATION
- ■ PROPOSED SHALLOW EXTRACTION WELL LOCATION
- ✡ PROPOSED INTERMEDIATE EXTRACTION WELL LOCATION
- PROPOSED PIEZOMETER NEST LOCATION

0 40 80
FEET

US Army Corps of Engineers Tulsa District

Sverdrup
ENVIRONMENTAL

SITE 16 PHASE III RI/FS PROPOSED EXTRACTION WELL, MONITORING WELL, PIEZOMETER AND SAMPLE LOCATIONS
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

DWN: BSM	DES.:	PROJECT NO.: 000187
CHKD:	APPD:	
DATE: FEB 97	REV.:	FIGURE NO.: 4-1

4.2 Installation of Monitoring Wells

A total of 20 monitoring wells, to be designated 16WW19 through 16WW38, will be installed at the proposed locations shown on Figure 4-1. Sixteen of the monitoring wells will be installed as eight nests consisting of one shallow monitoring well to a depth of approximately 35 ft and one intermediate monitoring well to a depth of approximately 55 ft. The remaining shallow monitoring well will be installed to a depth of approximately 35 ft BGS as an unnested monitoring well. The shallow monitoring wells will monitor the base of the first saturated zone and the intermediate monitoring wells will monitor the base of the second saturated zone. Three deep monitoring wells, (16WW19, 16WW20, and 16WW21) will be installed at a depth of approximately 100 ft BGS to monitor the upper portion of the third saturated zone. These wells will be installed adjacent to monitoring wells 16WW15, 16WW17, and 16WW18, which monitor the base of the third saturated zone. The exact depth and location of all monitoring wells will be determined in the field based on lithology and field data.

4.3 Installation of Piezometers

A total of eight piezometers, to be designated 16PZ13 through 16PZ20, will be installed at the proposed locations shown on Figure 4-1. The eight piezometers will be installed as four nests consisting of one shallow piezometer to a depth of approximately 35 ft and one intermediate piezometer to a depth of approximately 55 ft. The exact depth and location of the piezometers will be determined in the field based on lithology and field data.

4.4 Collection of Soil Samples

A total of sixteen depth discrete soil samples will be collected from the soil borings during the installation of four intermediate monitoring wells, 16WW27, 16WW31, 16WW35, and 16WW37. The proposed locations of these intermediate monitoring wells are shown on Figure 4-1. These locations were selected so that one location is positioned in the center portion of the mapped groundwater plume and the remainder chosen so as to be representative of the surrounding area to be investigated. A total of four depth discrete soil samples will be collected from each boring locations at depth intervals of 0 - ½ ft, 1 - 3 ft, 5 - 7 ft, and 14 - 15 ft. Soil samples will not be collected if the desired depth interval(s) are in or below a saturated zone. These soil samples will be analyzed for Total VOCs, high explosives, metals, anions, pesticides, PCBs, and dioxins/furans. The proposed locations were selected to provide a sample location in the central portion of the groundwater contamination plume and three sample location representative of the surrounding area of investigations. These sample are for risk assessment purposes to determine if soil contamination exists above the zone of saturation.

4.5 Collection of Sediment and Surface Water Samples

A total of five sediment and surface water samples will be collected from the five proposed locations on Figure 4-2. Sediment samples will be collected from a depth interval of 0 - ½ ft and surface water samples will be collected several inches below the surface of any flowing or standing surface waters. These samples will be analyzed for Total VOCs, high explosives, metals, pesticides, PCBs, and

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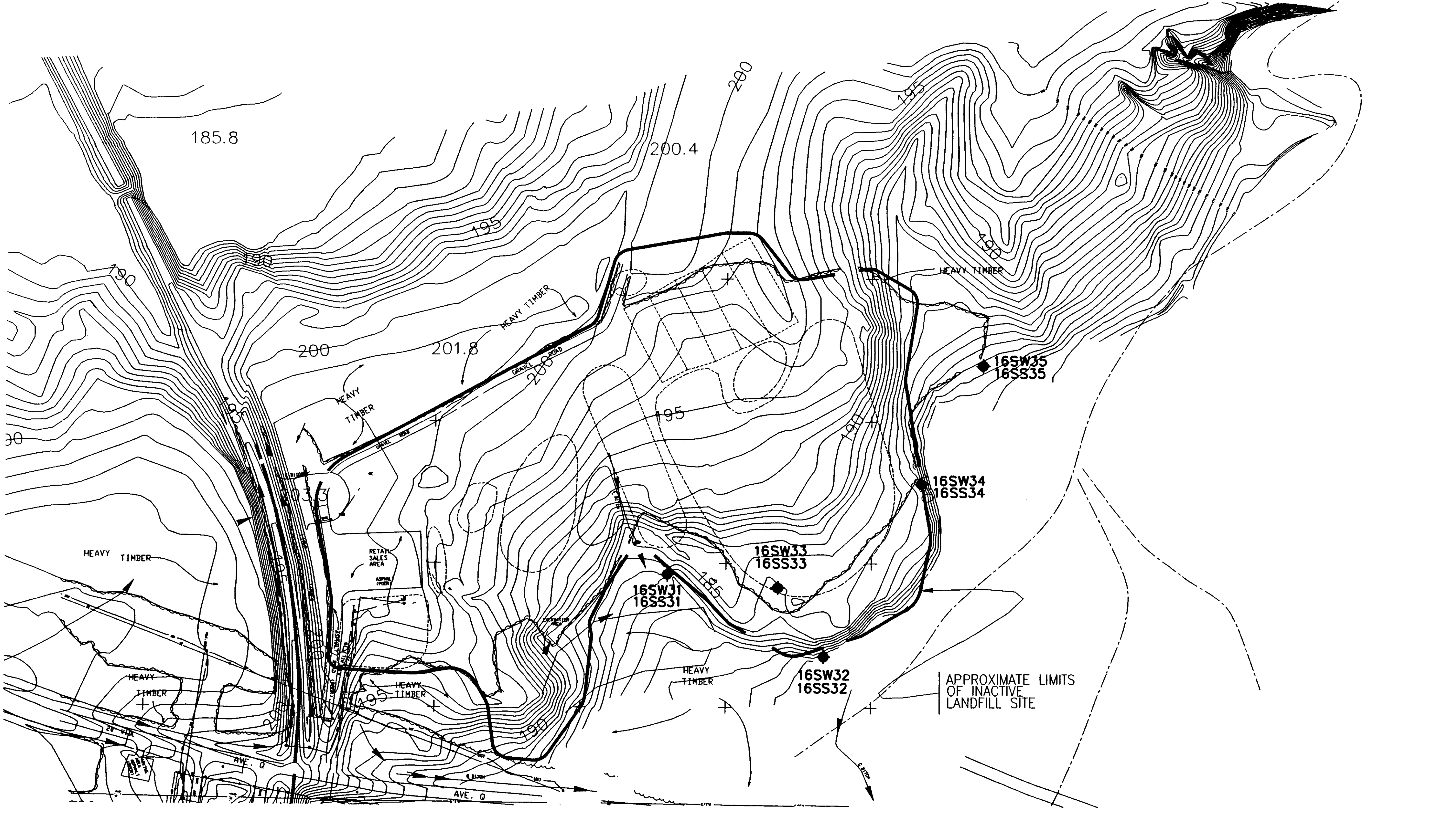


LEGEND

- ■ SURFACE SEDIMENT SAMPLE LOCATION
- ◆ SURFACE WATER SAMPLE LOCATION

US Army Corps of Engineers Tulsa District

Sverdrup ENVIRONMENTAL

SITE 16 SURFACE WATER AND
SEDIMENT SAMPLE LOCATIONS
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

DWN: BGC	DES.:	PROJECT NO.: 000187
CHKD:	APPD:	
DATE: AUG 97	REV.:	FIGURE NO.: 4-2

dioxins/furans. These samples are intended to characterize drainage pathways away from the landfill in order to fill in a data gap identified by the USACE.

4.6 Collection of Groundwater Samples

A total of thirty-seven groundwater samples will be collected from the twenty-six newly installed wells and from the eleven existing wells shown on Figure 4-1. All groundwater samples will be analyzed for Total VOCs, high explosives, metals, and anions. Additionally, for use in the Risk Assessment, samples from three wells (16WW16, 16EW01, and 16WW36) which are anticipated to have the highest levels of contamination, will be analyzed for pesticides, PCBs, and dioxins/furans.

4.7 Slug Tests

A total of twenty slug tests will be performed on the newly installed monitoring wells. At a minimum, a rising head test will be performed on each of the newly installed wells. A falling head test may also be performed on each of the newly installed wells which have water levels above their screened and filter packed intervals.

4.8 Surveying

A survey of the locations and elevations of the newly installed extraction wells, monitoring wells, and piezometers; and five surfacewater/sediment sample locations will be completed as part of these Phase III field activities. Additionally the course of Harrison Bayou from Avenue Q to the furthest down stream surface water and sediment sample location will be defined by survey.

4.9 Groundwater Control System

The six newly installed extraction wells will be incorporated into the existing groundwater control system at Site 16. The extraction wells will be completed by installing level actuated pneumatic pumps with below grade air supply and water discharge lines which feed into the existing control building. Each extraction well discharge line will have a sampling port located within the control building to allow collection of groundwater samples. Water discharge lines for the six new extraction wells will be added and feed into the existing 5,000 gal high density polyethylene (HDPE) transfer tank. All below grade discharge lines from each of the eight extraction well will have a form of secondary containment.

4.10 Site Access Improvement

Improvements to the existing road to the wells and control building at Site 16 will be performed as part of the Phase III field activities. These improvements will insure future access to extraction and monitoring well locations and will facilitate future collection of groundwater samples and data. Improvements will include the regrading of existing roads, clearing of recent dead fall, and using fill dirt and geotextiles to build new roads.

4.11 Groundwater Model Data

Additional data for the groundwater model will be collected during the field activities. The additional data will consist of boring logs from the newly installed wells and piezometers; water level measurements from all new and existing wells and piezometers at Sites 16, 17, and 18/24;

survey of Harrison Bayou; measurement of the width and depth of Harrison Bayou at select locations; and measurement of the thickness and composition of Harrison Bayou sediments at select locations.

4.12 Feasibility Study Data Compilation

Data will be gathered during the operation of the extraction well system to aid in the evaluation of this remedial technology as an alternative for the Site 16 Feasibility Study. Data shall consist of water levels collected on a weekly basis from the extraction wells, monitoring wells, and piezometers for a twelve month period. Groundwater samples will be collected for chemical analyses of Total VOCs and high explosives from the eight extraction wells and twelve monitoring wells after 2½ and 5 months of system operation. A determination as to which wells to be sampled will be made based upon the analytical results of the groundwater samples collected following well installation.

SECTION 5.0 FIELD OPERATIONS

This section discusses drilling; extraction well, piezometer, and monitoring well installations; sampling; decontamination; waste disposal; and other field procedures.

5.1 DRILLING

An experienced geologist, engineer, or technician will serve as an inspector for all drilling activities. The inspector will prepare and describe samples and cuttings, monitor drilling operations, oversee well and piezometer installation, record groundwater data, and prepare well diagrams and geologic logs. Drilling of borings will be done by hollow stem augers and conventional rotary methods. These drilling techniques utilize hollow stem augers with a cutting head attached or fluid rotary methods with a blade or tri-cone bit to penetrate the formations. Sampling will be performed by split-spoon or continuous core samplers. Drill pipe, augers, and other equipment used below ground will be steam cleaned as discussed in Section 5.10. Static water levels will be taken from each completed well and piezometer following installation.

Drilling of borings for extraction well and deep monitoring well installations will be performed using fluid rotary drilling methods. Surface casing will be installed to isolate deeper water-bearing units from shallower saturated zones prior to completion of the borings for the deep monitoring wells. Surface casing will be installed using fluid rotary drilling methods to isolate the deep saturated zone from the shallower saturated zones.

5.1.1 Soil Sampling Equipment

Sampling equipment used in conjunction with the drilling techniques discussed above is described in this section. Sampling techniques for surface soils are discussed in Section 5.4.2 Samples will be taken continuously using a 2-in. ID, 2-ft long split-spoon sampler or 5-ft long continuous core sampler.

A split spoon is a small diameter sampling device driven into the soil with a drive hammer. It is frequently used inside hollow stem augers or other types of casing. The sample is representative of the materials encountered, but is disturbed. It will be used for chemical and physical soil samples. This sampling device will be used with fluid rotary drilling and/or hollow stem augers.

A continuous core sampler is a sampling device that allows for continuous sampling when drilling with hollow stem augers. It is a 5 ft sample tube with a cutting shoe that extends below the auger cutter head. As the augers are advanced the sample enters the sampler barrel. Plastic or steel liners can be used inside the tube to retain the sample. The sample is representative of the materials encountered, but is disturbed. It will be used for chemical and physical soil samples.

5.1.2 Protection of Lower Aquifers

Isolator casing will be installed to reduce the potential for contamination of deep saturated zone by dense non-aqueous phase liquids (DNAPL) migrating downward via the borehole. Isolator casings will be used when drilling to reach the deeper saturated zone during the installation of the deep monitoring wells.

Isolator casings will be installed using fluid rotary drilling; boreholes will have a minimum annular space of 2-in. between the isolator casing and the formation. Isolator casings will be grouted using a cement bentonite grout, as specified in Section 5.2.1.6.

The isolator casing of 10-in. nominal ID threaded or welded steel will be installed as follows:

- The borehole will be drilled using fluid rotary methods. The isolator casing, open at the bottom, will be installed into the fluid-filled borehole to the bottom of borehole. The isolator casing will then pushed downward two (2) ft or until refusal to seat it into the silty clayey fine sand.
- Cement bentonite grout will be pumped between the isolator casing and the borehole wall via grout pump through rigid (tremie) pipe with a side discharge. Displacement grouting will continue until a steady flow of grout is returned to the surface. Excess grout and displaced drilling fluid will be collected at the ground surface in the mud pit and transferred into drums. Cement bentonite grout will be allowed to set a minimum of 12 hours before resumption of drilling. The grout volume will be measured to confirm that the calculated grout volume was installed. The drilling fluid contained within the isolator casing will be pumped out or displaced by pumping fresh drilling fluid via pump through rigid (tremie) pipe or drill rods. Displaced drilling fluid will be collected at the ground surface in the mud pit and transferred into drums.

5.1.3 Geological Logs

The strata encountered during drilling will be described in detail, using the USACE drilling log form (Eng Form 1836). The log will provide a record of sample collection location, depth, and drilling procedures. At a minimum, the log will contain the following information:

- Heading Information. (Included will be project name and number, site number, boring number, personnel responsible for drilling and logging the boring, ground surface elevation and coordinates, if available, and date started and completed).
- Depths recorded in feet and tenths of feet.
- Detailed soil description including:
    - Unified Soil Classification Symbol
    - Major soil component
    - Secondary components and estimated percentages
    - Classification
    - Color
    - Consistency/density
    - Moisture content (e.g. dry, moist, wet)
    - Texture
    - Depth/elevation interval
    - Depth/elevation of observed strata changes
    - Presence and general orientation of observed fractures
- Depth at which groundwater is first encountered, depth to static groundwater level, and changes in groundwater level with depth.
- Sampling method.

- Sample drive and recovery.
- Sample numbers.
- Blow counts, hammer weight, and length of fall.
- Total depth of hole.
- Field screening results.
- Equipment details including type of drill rig, and type and size of drill bit.

Boring descriptions will be determined from geological logs or from characterization of cuttings and drill action, where samples are not taken. The USACE drilling log form (Eng Form 1836) is shown in Appendix A. It will be used to log all soil boring, extraction well, monitoring well, and piezometer boreholes.

5.1.4 Borehole Abandonment

All borings not completed as monitoring wells will be abandoned by filling with a cement bentonite grout, as described in Section 5.2.1.6. After the grout has been allowed to solidify for at least 12 hours, any settlement depression will be filled to the ground surface with additional cement bentonite grout or neat cement.

5.2 WELLS AND PIEZOMETERS

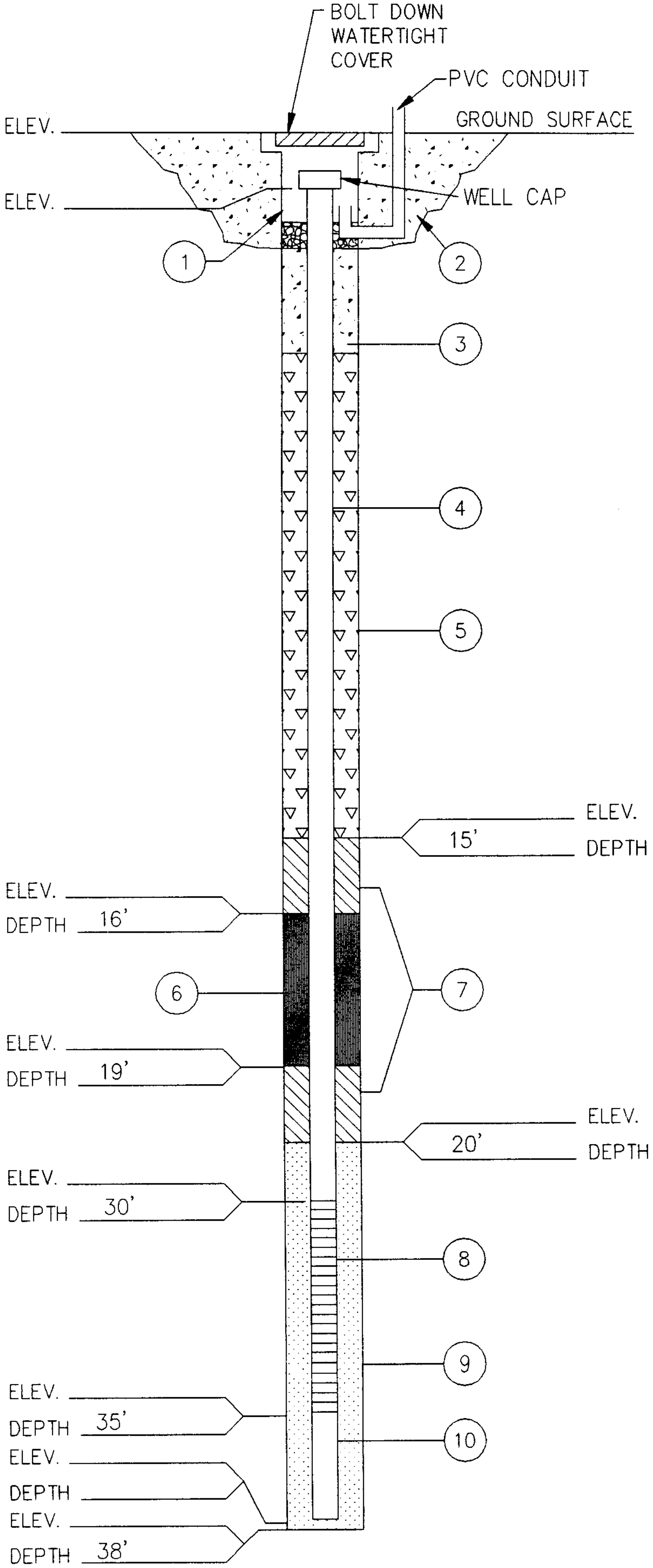
5.2.1 Shallow and Intermediate Extraction Wells

5.2.1.1 Drilling and Installation

Shallow and intermediate extraction wells shall be installed in borings dedicated for that purpose. Borings will be drilled with fluid rotary methods. Shallow extraction wells will be installed at the base of the first saturated zone and intermediate extraction wells will be installed at the base of the second saturated zone. The exact depth and location of the extraction wells will be determined in the field based on lithology and field data. Typical schematics for shallow and intermediate extraction wells are shown in Figures 5-1 and 5-2. (These large diameter of the extraction wells, as seen on Figures 5-1 and 5-2, are designed for the introduction of extra filter media into the well.) Prior to completing construction of the extraction wells, the borehole should be flushed with clean, USACE approved potable water through the extraction well casing and/or a tremie pipe to displace remaining drilling fluids. A sufficient volume of clean water should be added to flush all remaining drilling fluids and fines from the boring. Displaced drilling fluids and water will be collected at the ground surface. Flushing of the borehole will continue until water returning from borehole is clear or until directed by Sverdrup.

5.2.1.2 Well Casing

Casing for shallow and intermediate extraction wells shall consist of new, threaded, flush joint, stainless steel Type 304 casing with a nominal 6-in. ID installed from the top of the screen to ground surface. Centralizers will be used to keep the casing centered in the boring. A minimum 18-in. diameter borehole will be drilled using fluid rotary methods.



EXTRACTION WELL CONSTRUCTION INFORMATION

JOB. NO. LHAAP SITE 16 RI/FS

BORING/WELL NO. SHALLOW EXTRACTION WELLS

DATE

CHIEF UNIT WILCOX

1. VAULT
   MATERIAL STEEL
   DIAMETER 24" LENGTH 24"
   LOCKING [✓ YES] NO
2. TYPE OF SURFACE BACKFILL
   CEMENT
3. TYPE OF SURFACE SEAL (IF INSTALLED)
   CEMENT
4. SOLID PIPE TYPE 6" ID SS TYPE 304
   SOLID PIPE LENGTH 29 ft.
   JOINT TYPE SLIP/GLUED/[✓ THREADED]
5. TYPE OF BACKFILL CEMENT BENTONITE GROUT
   HOW INSTALLED – TREMIE
   FROM SURFACE
6. TYPE OF LOWER SEAL (IF INSTALLED)
   BENTONITE CHIPS
7. TYPE OF SECONDARY FILTER PACK
   SUGAR SAND
8. SCREEN TYPE WRAPPED WIRE SS TYPE 304
   SCREEN LENGTH 5 ft.
   SLOT SIZE 0.02 in.
   SCREEN DIAMETER 6 in.
9. TYPE OF PRIMARY FILTER PACK
   SILICA SAND
10. TYPE OF SUMP 6" ID SS TYPE 304

DRILLING METHOD ROTARY

Sverdrup
ENVIRONMENTAL
801 North Eleventh
St. Louis, Missouri 63101

FIGURE 5-1

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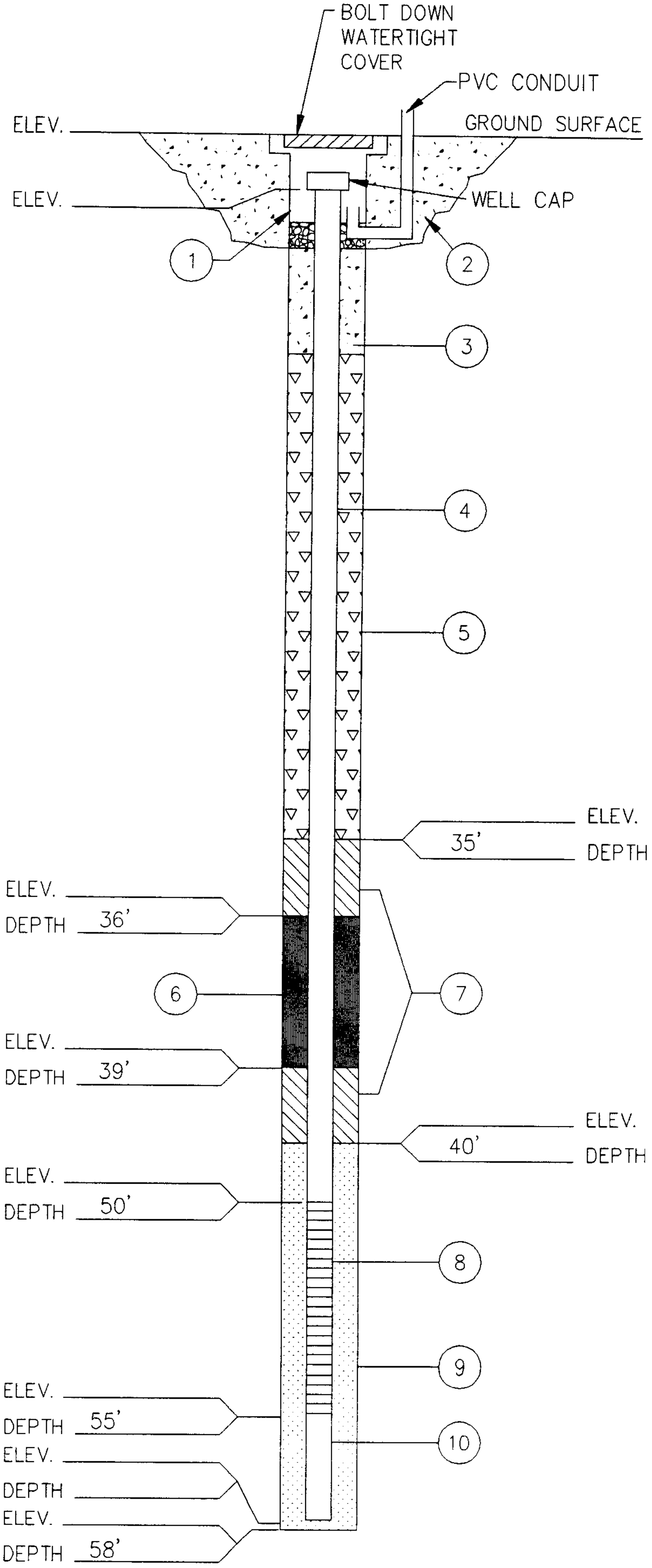

EXTRACTION WELL CONSTRUCTION INFORMATION

JOB. NO. LHAAP SITE 16 RI/FS

BORING/WELL NO. INTERMEDIATE EXTRACTION WELLS

DATE

CHIEF UNIT WILCOX

1. VAULT

MATERIAL STEEL

DIAMETER 24" LENGTH 24"

LOCKING [✓ YES] NO

2. TYPE OF SURFACE BACKFILL

CEMENT

3. TYPE OF SURFACE SEAL (IF INSTALLED)

CEMENT

4. SOLID PIPE TYPE 6" ID SS TYPE 304

SOLID PIPE LENGTH 49 ft.

JOINT TYPE SLIP/GLUED/[✓ THREADED]

5. TYPE OF BACKFILL CEMENT BENTONITE GROUT

HOW INSTALLED – [✓ TREMIE]

FROM SURFACE

6. TYPE OF LOWER SEAL (IF INSTALLED)

BENTONITE CHIPS

7. TYPE OF SECONDARY FILTER PACK

SUGAR SAND

8. SCREEN TYPE WRAPPED WIRE SS TYPE 304

SCREEN LENGTH 5 ft.

SLOT SIZE 0.02 in.

SCREEN DIAMETER 6 in.

9. TYPE OF PRIMARY FILTER PACK

SILICA SAND

10. TYPE OF SUMP 6" ID SS TYPE 304

DRILLING METHOD ROTARY

Sverdrup
ENVIRONMENTAL
801 North Eleventh
St. Louis, Missouri 63101

FIGURE 5–2

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5.2.1.3 Well Screen

Screens for shallow and intermediate extraction wells shall consist of new, threaded, flush joint, stainless steel Type 304 6-in. ID continuous wire-wrapped screen. The screen will have a slot size of 0.02 in. The screen for the shallow extraction wells shall have a length of 5 ft. Screens will have a 3 ft sump consisting of new, threaded, flush joint, stainless steel Type 304 6-in. ID well casing and bottom plug.

5.2.1.4 Filter Packs

A primary filter pack shall be placed in the annulus between the well screen and the borehole from the bottom of the hole to approximately 10 ft above the top of the screen. The primary filter pack material shall be clean, well washed, well graded silica sand conforming to the requirements of ASTM C33 and be compatible with the screen slot size. The primary filter pack material will be placed with a slow, continuous stream. Continuous depth soundings of the bottom of the hole will be taken to monitor the level of the sand and detect any bridging of sand. The primary filter pack material will be either bagged or purchased from a batch plant. The size and thickness of the primary filter pack may be adjusted in the field based on the borehole stratigraphy.

A 1-ft thick secondary filter pack shall be placed in the annulus between the well casing and the borehole, above the primary filter pack prior to installation of the bentonite seal. An additional 1-ft thick secondary filter pack shall be placed in the annulus between the well casing and the borehole, above the bentonite seal prior to installation of the grout. Placement of the secondary filter pack above the bentonite seal assists in preventing infiltration of the grout into the bentonite seal. The secondary filter shall be installed in the same manner as the primary filter pack. The secondary filter material shall be clean silica sand with 100 % passing the No. 30 U.S. Standard sieve.

5.2.1.5 Bentonite Seal

An approximately 3 ft thick bentonite seal will be placed in the annulus between the well casing and the borehole, above the first secondary filter pack. This will be accomplished by installing pellets or chips via a tremie pipe or by dropping them directly into the annulus. Bentonite pellets or chips will be hydrated with reagent grade water and allowed to hydrate for approximately 45 minutes before proceeding with the well installation.

5.2.1.6 Grout

A cement bentonite grout will be used to fill the annulus between the bentonite seal/secondary filter pack and the top of the ground, as well as for borehole abandonment. The cement bentonite grout mixture will consist of a mixture of Portland type cement, bentonite powder, and USACE approved potable water in the proportions of not more than 7 gal of water per 94 lbs (1 bag) of Portland type cement per 6 lbs of bentonite powder. Grouting will be accomplished in an appropriate manner for the specific application. Grout will be pumped through a tremie or poured into the annulus. The quantities of grout used will be recorded in the field log book.

5.2.1.7 Surface Completions

Shallow and intermediate extraction wells shall have surface completions consisting of a flush mount well vault, concrete pad, and steel guard posts. Construction of surface completions will comply with USACE requirements as well as requirements of the USEPA, September 1986, "RCRA Ground Water Monitoring Technical Enforcement Guidance Document".

A protective, steel flush mount well vault and a buried 4-in. PVC schedule 40 conduit for pump controls shall be installed over the well casing. The well vault shall be centered around the well casing. The bottom of the protective well vault will be backfilled with clean pea gravel. The protective well vault shall have a locking access plate to prevent entry of rainwater and unauthorized personnel. A 4 ft by 4 ft by 6 in. concrete pad will be poured and centered around the protective casing at the ground surface, and will be sloped away from the protective casing to promote drainage. A brass survey marker, to be obtained from USACE, will be set into the concrete pad.

Four concrete filled steel guard post with a minimum OD of 4 in. shall be equally spaced and radially located 4½ ft from the center of the well. These guard post shall be placed and set in concrete 3 ft below the ground surface, with 4 ft extending above the ground surface. The guard post will be primed and painted with "traffic yellow" paint.

5.2.2 Shallow and Intermediate Monitoring Wells

5.2.2.1 Drilling and Installation

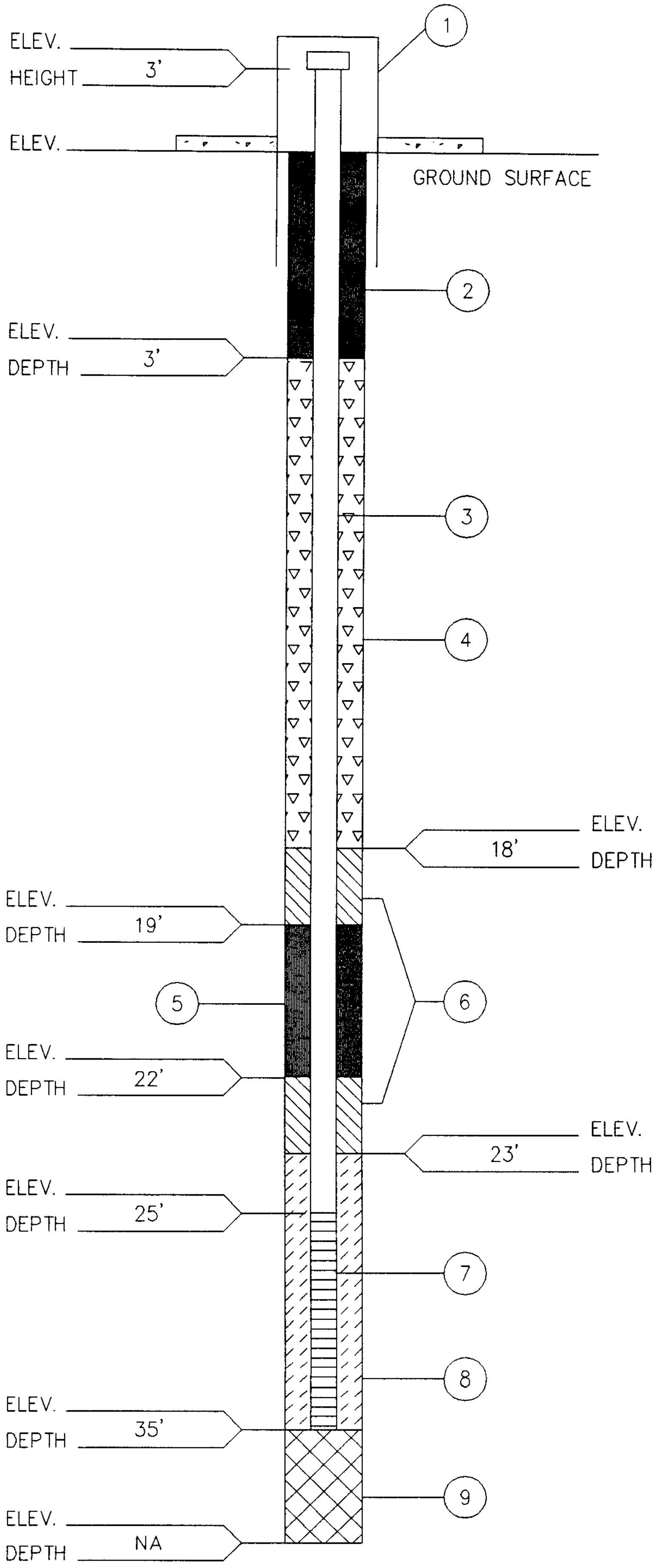
Shallow and intermediate monitoring wells shall be installed in borings dedicated for that purpose. Borings will be drilled with hollow stem auger methods. Shallow monitoring wells will be installed such that the base of the shallow well screen will correspond to the base of the first saturated zone. The intermediate monitoring wells will be installed such that the base of the well screen for these wells will correspond to the base of the second saturated zone. The exact depth and location of the monitoring wells will be determined in the field based on lithology and field data. Typical schematics for shallow and intermediate monitoring wells are shown in Figures 5-3 and 5-4.

5.2.2.2 Well Casing

Casing for shallow and intermediate monitoring wells shall consist of new, threaded, flush joint, stainless steel Type 304 casing with a nominal 4-in. ID installed from the top of the screen to approximately 3 ft above the ground surface. Centralizers may be used to keep the casing centered in the boring. A minimum 8-in. diameter borehole will be drilled using hollow stem auger methods.

5.2.2.3 Well Screen

Screens for shallow and intermediate monitoring wells shall consist of new, threaded, flush joint, stainless steel Type 304 4-in. ID continuous wire-wrapped screen. The screen will have a slot size of 0.01 in. The screen for the shallow monitoring wells shall have a length of 10 ft. The screen for the intermediate monitoring wells shall consist of two 5 ft long threaded sections. If site



MONITORING WELL CONSTRUCTION INFORMATION

JOB. NO. LHAAP SITE 16 PHASE III RI/FS

BORING/WELL NO. SHALLOW MONITORING WELLS

DATE ____________

CHIEF UNIT WILCOX

1. PROTECTIVE CASING [✓ YES] NO

   LOCKING [✓ YES] NO

2. TYPE OF SURFACE SEAL (IF INSTALLED) CEMENT

3. SOLID PIPE TYPE 4" ID SS TYPE 304

   SOLID PIPE LENGTH 35 ft.

   JOINT TYPE SLIP/GLUED/[✓ THREADED]

4. TYPE OF BACKFILL CEMENT BENTONITE GROUT

   HOW INSTALLED – TREMIE FROM SURFACE

5. TYPE OF LOWER SEAL (IF INSTALLED) BENTONITE CHIPS

6. TYPE OF SECONDARY FILTER PACK SUGAR SAND

7. SCREEN TYPE WRAPPED WIRE SS TYPE 304

   SCREEN LENGTH 10 ft.

   SLOT SIZE 0.010 in.

   SCREEN DIAMETER 4 in.

8. TYPE OF PRIMARY FILTER PACK SILICA SAND

9. TYPE OF BACKFILL NA

10. DRILLING METHOD HSA

WATER LEVEL ____________ DATE ____________

*ALL DEPTHS MEASURED FROM GROUND SURFACE

Sverdrup
ENVIRONMENTAL
801 North Eleventh
St. Louis, Missouri 63101

FIGURE 5-3

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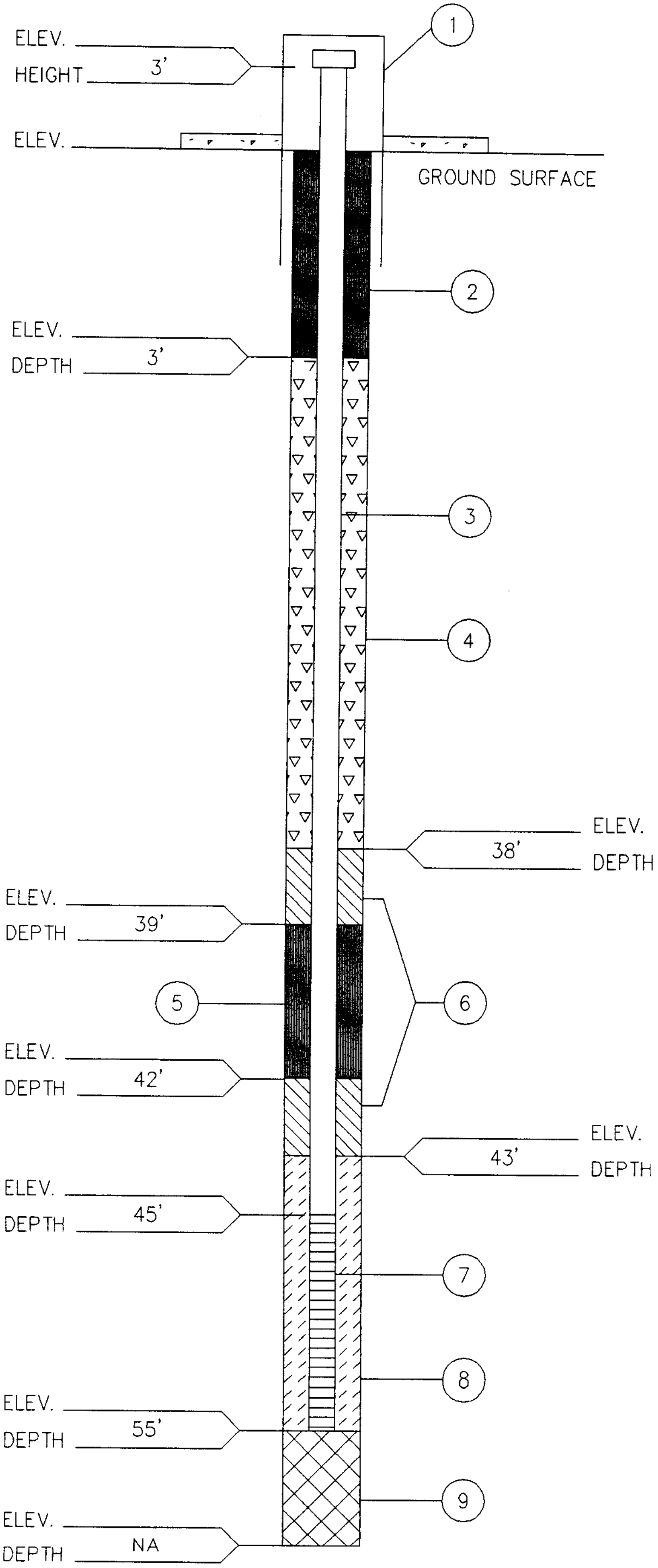


MONITORING WELL CONSTRUCTION INFORMATION

JOB. NO. LHAAP SITE 16 PHASE III RI/FS

BORING/WELL NO. Intermediate Monitoring Wells

DATE

CHIEF UNIT WILCOX

1. PROTECTIVE CASING [✓ YES] NO

   LOCKING [✓ YES] NO

2. TYPE OF SURFACE SEAL (IF INSTALLED)
   CEMENT

3. SOLID PIPE TYPE 4" ID SS TYPE 304

   SOLID PIPE LENGTH 45 ft.

   JOINT TYPE SLIP/GLUED/[✓ THREADED]

4. TYPE OF BACKFILL CEMENT BENTONITE GROUT

   HOW INSTALLED – TREMIE

   FROM SURFACE

5. TYPE OF LOWER SEAL (IF INSTALLED)
   BENTONITE CHIPS

6. TYPE OF SECONDARY FILTER PACK
   SUGAR SAND

7. SCREEN TYPE WRAPPED WIRE SS TYPE 304

   SCREEN LENGTH 2, 5–ft Sections ft.

   SLOT SIZE 0.010 in.

   SCREEN DIAMETER 4 in.

8. TYPE OF PRIMARY FILTER PACK
   SILICA SAND

9. TYPE OF BACKFILL NA

10. DRILLING METHOD HSA

WATER LEVEL ______ DATE ______

*ALL DEPTHS MEASURED FROM GROUND SURFACE

Sverdrup
ENVIRONMENTAL
801 North Eleventh
St. Louis, Missouri 63101

FIGURE 5–4

characteristics dictate a need for other more appropriate sizing, the USACE will be notified prior to well installation. Screens will have a bottom plug consisting of new, threaded, flush joint, stainless steel Type 304 4-in. ID.

5.2.2.4 Filter Packs

A primary filter pack shall be placed in the annulus between the well screen and the borehole from the bottom of the hole to approximately 2 ft above the top of the screen. The primary filter pack material shall be clean, well washed, well graded silica sand conforming to the requirements of ASTM C33 and be compatible with the screen slot size. The primary filter pack material will be placed with a slow, continuous stream. Continuous depth soundings of the bottom of the hole will be taken to monitor the level of the sand and detect any bridging of sand. The primary filter pack material will be either bagged or purchased from a batch plant. The size and thickness of the primary filter pack may be adjusted in the field based on the borehole stratigraphy.

A 1-ft thick secondary filter pack shall be placed in the annulus between the well casing and the borehole, above the primary filter pack prior to installation of the bentonite seal. An additional 1-ft thick secondary filter pack shall be placed in the annulus between the well casing and the borehole, above the bentonite seal prior to installation of the grout. Placement of the secondary filter pack above the bentonite seal assists in preventing infiltration of the grout into the bentonite seal. The secondary filter shall be installed in the same manner as the primary filter pack. The secondary filter material shall be clean silica sand with 100 % passing the No. 30 U.S. Standard sieve.

5.2.2.5 Bentonite Seal

An approximately 3 ft thick bentonite seal will be placed in the annulus between the well casing and the borehole, above the first secondary filter pack. This will be accomplished by installing pellets or chips via a tremie pipe or by dropping them directly into the annulus. Bentonite pellets or chips will be hydrated with reagent grade water and allowed to hydrate for approximately 45 minutes before proceeding with the well installation.

5.2.2.6 Grout

A cement bentonite grout will be used to fill the annulus between the bentonite seal/secondary filter pack and the top of the ground, as well as for borehole abandonment. The cement bentonite grout mixture will consist of a mixture of Portland type cement, bentonite powder, and USACE approved potable water in the proportions of not more than 7 gal of water per 94 lbs (1 bag) of Portland type cement per 6 lbs of bentonite powder. Grouting will be accomplished in an appropriate manner for the specific application. Grout will be pumped through a tremie or poured into the annulus. The quantities of grout used will be recorded in the field log book.

5.2.2.7 Surface Completions

Shallow and intermediate monitoring wells shall have surface completions consisting of a locking protective cover, concrete pad, and steel guard posts. Construction of surface completions will comply with USACE requirements as well as requirements of the USEPA, September 1986, "RCRA Ground Water Monitoring Technical Enforcement Guidance Document".

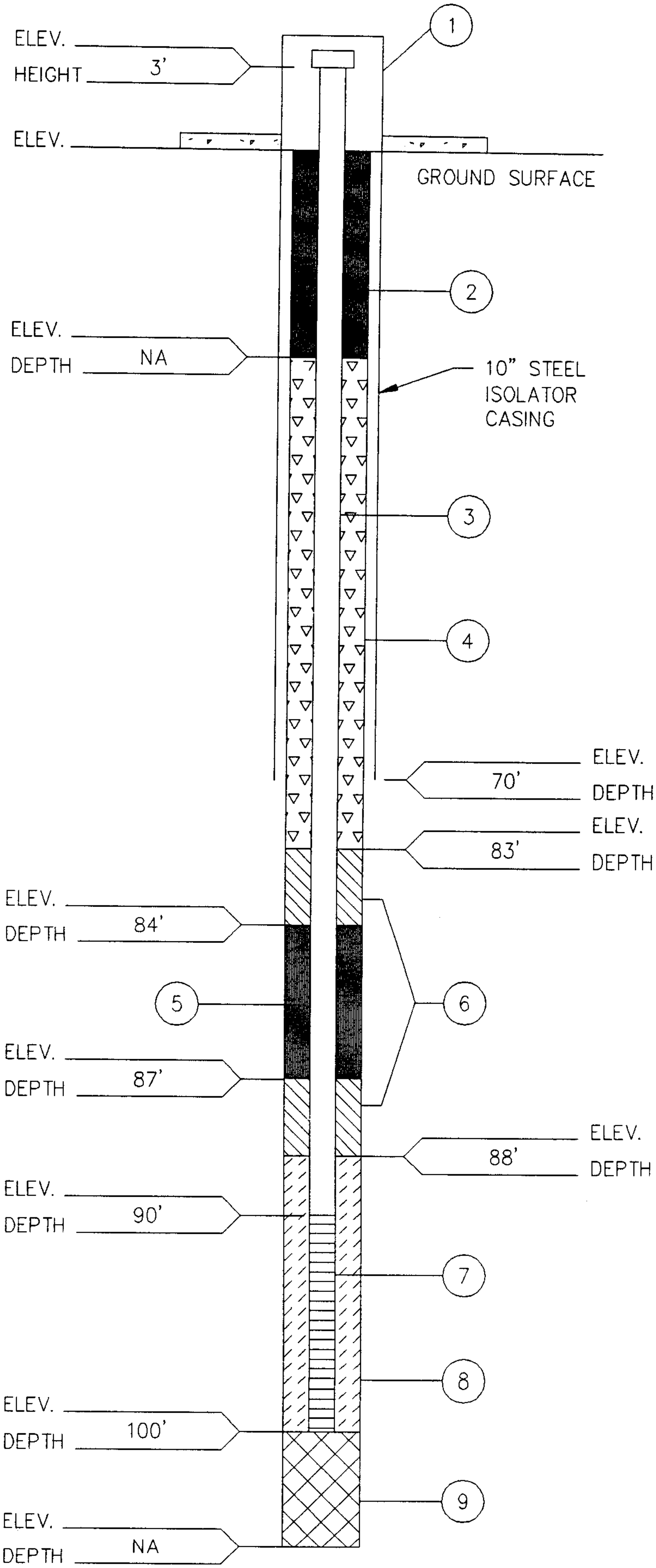
Approximately 3 ft of well casing will be left above ground and enclosed in a protective steel casing. The protective casing will extend below the ground surface and be anchored in concrete. The protective casing have a locking cover to prevent entry of rainwater and unauthorized personnel. A 4 ft by 4 ft by 6 in. concrete pad will be poured and centered around the protective casing at the ground surface, and will be sloped away from the protective casing to promote drainage. A drainhole will be drilled near the base of the protective casing. A brass survey marker, to be obtained from USACE, will be set into the concrete pad.

Four concrete filled steel guard post with a minimum OD of 4 in. shall be equally spaced and radially located 4½ ft from the center of the well. These guard post shall be placed and set in concrete 3 ft below the ground surface, with 4 ft extending above the ground surface. The protective casing and guard post will be primed and painted with "traffic yellow" paint.

5.2.3 Deep Monitoring Wells

5.2.3.1 Drilling and Installation

Deep monitoring wells shall be installed in borings dedicated for that purpose. Borings will be drilled with fluid rotary methods. Deep monitoring wells will be installed in the upper portion of the third saturated zone, approximately 100 ft below ground surface, to evaluate if contamination is present in this saturated zone. The exact depth and location of the monitoring wells will be determined in the field based on lithology and field data. Typical schematic for deep monitoring wells is shown in Figure 5-5.



MONITORING WELL CONSTRUCTION INFORMATION

JOB. NO. LHAAP SITE 16 PHASE III RI/FS

BORING/WELL NO. DEEP MONITORING WELLS

DATE

CHIEF UNIT WILCOX

1. PROTECTIVE CASING [✓ YES] NO

LOCKING [✓ YES] NO

2. TYPE OF SURFACE SEAL (IF INSTALLED) CEMENT

3. SOLID PIPE TYPE 4" SS TYPE 304

SOLID PIPE LENGTH 90 ft.

JOINT TYPE SLIP/GLUED/[✓ THREADED]

4. TYPE OF BACKFILL CEMENT BENTONITE GROUT

HOW INSTALLED – TREMIE FROM SURFACE

5. TYPE OF LOWER SEAL (IF INSTALLED) BENTONITE CHIPS

6. TYPE OF SECONDARY FILTER PACK SUGAR SAND

7. SCREEN TYPE PREPACKED WRAPPED WIRE SS TYPE 304

SCREEN LENGTH 10 ft.

SLOT SIZE 0.010 in.

SCREEN DIAMETER 4 in.

8. TYPE OF PRIMARY FILTER PACK SILICA SAND

9. TYPE OF BACKFILL NA

10. DRILLING METHOD ROTARY

WATER LEVEL ______ DATE ______

*ALL DEPTHS MEASURED FROM GROUND SURFACE

Sverdrup
ENVIRONMENTAL
801 North Eleventh
St. Louis, Missouri 63101

FIGURE 5-5

5.2.3.2 Well Casing

A protective isolator casing of 10-in. nominal ID threaded or welded steel shall be installed from the surface to a depth of approximately 70 ft using rotary drilling methods for each of the deep monitoring wells. The isolator casing shall extend approximately 3½ ft above the ground surface. A minimum 14-in. diameter hole will be drilled using conventional rotary methods. Upon reaching the top of the silty clayey fine sand as determined by boring logs from adjacent wells, the isolator casing shall be pushed 2 ft to seat it in the silty clayey fine sand. The isolator casing will be grouted by placing grout between isolator casing and borehole via grout pump through rigid (tremie) pipe with a side discharge. Drilling fluid within the isolator casing will be pumped out or displaced by pumping fresh drilling fluid via tremie pipe or drill rods. Displaced drilling fluids will be collected at the ground surface. Drilling fluid will be changed after the installation of the isolator casing.

A minimum 8-in. diameter boring shall be drilled using fresh drilling fluid to complete the borehole. Casing for the deep monitoring wells shall consist of new, threaded, flush joint, stainless steel Type 304 casing with a nominal 4-in. ID installed from the screen to approximately 3 ft above the ground surface. Centralizers may be used to keep the casing centered in the boring.

5.2.3.3 Well Screen

Screens for deep monitoring wells shall consist of new, threaded, flush joint, stainless steel Type 304 4-in. ID, prepacked, continuous wire-wrapped screen. The screen will have a slot size of 0.01 in. The screen for the deep monitoring wells shall have a length of 10 ft. If site characteristics dictate a need for other more appropriate sizing, the USACE will be notified prior to well installation. Screens will have a bottom plug consisting of new, threaded, flush joint, stainless steel Type 304 4-in. ID.

5.2.3.4 Filter Packs

A primary filter pack shall be placed in the annulus between the well screen and the borehole from the bottom of the hole to approximately 2 ft above the top of the screen. The primary filter pack material shall be clean, well washed, well graded silica sand conforming to the requirements of ASTM C33 and be compatible with the screen slot size. The primary filter pack material will be placed with a slow, continuous stream. Continuous depth soundings of the bottom of the hole will be taken to monitor the level of the sand and detect any bridging of sand. The primary filter pack material will be either bagged or purchased from a batch plant. The size and thickness of the primary filter pack may be adjusted in the field based on the borehole stratigraphy.

A 1-ft thick secondary filter pack shall be placed in the annulus between the well casing and the borehole, above the primary filter pack prior to installation of the bentonite seal. An additional 1-ft thick secondary filter pack shall be placed in the annulus between the well casing and the borehole, above the bentonite seal prior to installation of the grout. Placement of the secondary filter pack above the bentonite seal assists in preventing infiltration of the grout into the bentonite seal. The secondary filter shall be installed in the same manner as the primary filter pack. The secondary filter material shall be clean silica sand with 100 % passing the No. 30 U.S. Standard sieve.

5.2.3.5 Bentonite Seal

An approximately 3 ft thick bentonite seal will be placed in the annulus between the well casing and the borehole, above the first secondary filter pack. This will be accomplished by installing pellets or chips via a tremie pipe or by dropping them directly into the annulus. Bentonite pellets or chips will be hydrated with reagent grade water and allowed to hydrate for approximately 45 minutes before proceeding with the well installation.

5.2.3.6 Grout

A cement bentonite grout will be used to fill the annulus between the bentonite seal/secondary filter pack and the top of the ground, as well as for the isolator casing. The cement bentonite grout mixture will consist of a mixture of Portland type cement, bentonite powder, and USACE approved potable water in the proportions of not more than 7 gal of water per 94 lbs (1 bag) of Portland type cement per 6 lbs of bentonite powder. Grouting will be accomplished in an appropriate manner for the specific application. Grout will be pumped through a tremie or poured into the annulus. The quantities of grout used will be recorded in the field log book.

5.2.3.7 Surface Completions

Deep monitoring wells shall have surface completions consisting of a locking protective cover, concrete pad, and steel guard posts. Construction of surface completions will comply with USACE requirements as well as requirements of the USEPA, September 1986, "RCRA Ground Water Monitoring Technical Enforcement Guidance Document".

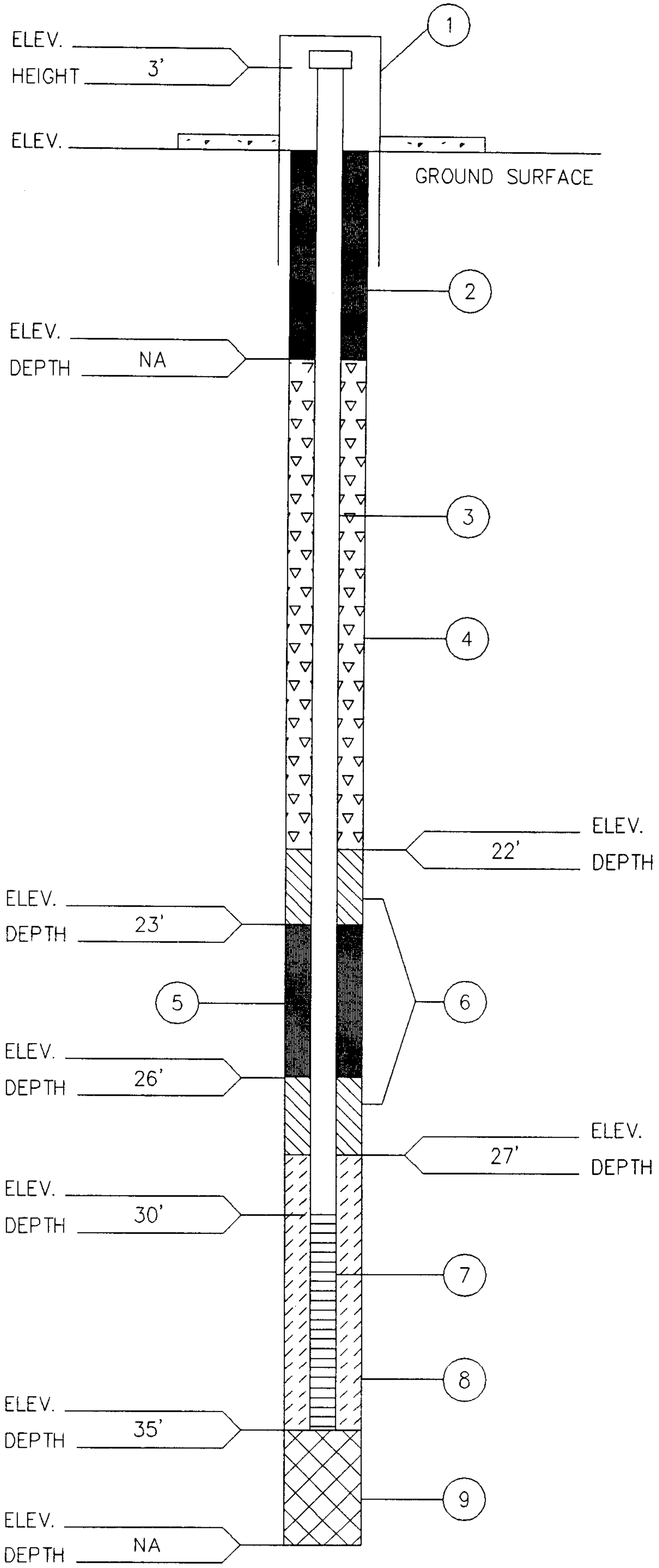
Approximately 3 ft of well casing shall be left above ground and enclosed in a protective steel casing. Approximately 3½ ft of the isolator casing shall be left above ground and serve as the protective casing. A locking cover to prevent entry of rainwater and unauthorized personnel will be installed on top of the protective casing. A 4 ft by 4 ft by 6 in. concrete pad will be poured and centered around the protective casing at the ground surface, and will be sloped away from the protective casing to promote drainage. A drainhole will be drilled near the base of the protective casing. A brass survey marker, to be obtained from USACE, will be set into the concrete pad.

Four concrete filled steel guard post with a minimum OD of 4 in. shall be equally spaced and radially located 4½ ft from the center of the well. These guard post shall be placed and set in concrete 3 ft below the ground surface, with 4 ft extending above the ground surface. The protective casing and guard post will be primed and painted with "traffic yellow" paint.

5.2.4 Shallow and Intermediate Piezometers

5.2.4.1 Drilling and Installation

Shallow and intermediate piezometers shall be installed in borings dedicated for that purpose. Borings will be drilled with hollow stem auger methods. Shallow piezometers will be installed at the base of the first saturated zone and intermediate piezometers will be installed at the base of the second saturated zone. The exact depth and location of the piezometers will be determined in the field based on lithology and field data. Typical schematics for shallow and intermediate piezometers are shown in Figures 5-6 and 5-7.



PIEZOMETER CONSTRUCTION INFORMATION

JOB. NO. LHAAP SITE 16 PHASE III RI/FS

BORING/WELL NO. SHALLOW PIEZOMETERS

DATE

CHIEF UNIT WILCOX

1. PROTECTIVE CASING YES [✓ NO]

LOCKING [✓ YES] NO

2. TYPE OF SURFACE SEAL (IF INSTALLED)
NONE

3. SOLID PIPE TYPE PVC SCHEDULE 40

SOLID PIPE LENGTH 30 ft.

JOINT TYPE SLIP/GLUED/[✓ THREADED]

4. TYPE OF BACKFILL High Solids Bentonite Grout

HOW INSTALLED – TREMIE
FROM SURFACE

5. TYPE OF LOWER SEAL (IF INSTALLED)
BENTONITE CHIPS

6. TYPE OF SECONDARY FILTER PACK
SUGAR SAND

7. SCREEN TYPE PVC SCHEDULE 40

SCREEN LENGTH 5 ft.

SLOT SIZE 0.010 in.

SCREEN DIAMETER 2 in.

8. TYPE OF PRIMARY FILTER PACK
SILICA SAND

9. TYPE OF BACKFILL NA

10. DRILLING METHOD HSA

WATER LEVEL ______ DATE ______

*ALL DEPTHS MEASURED FROM GROUND SURFACE

Sverdrup
ENVIRONMENTAL
801 North Eleventh
St. Louis, Missouri 63101

FIGURE 5–6

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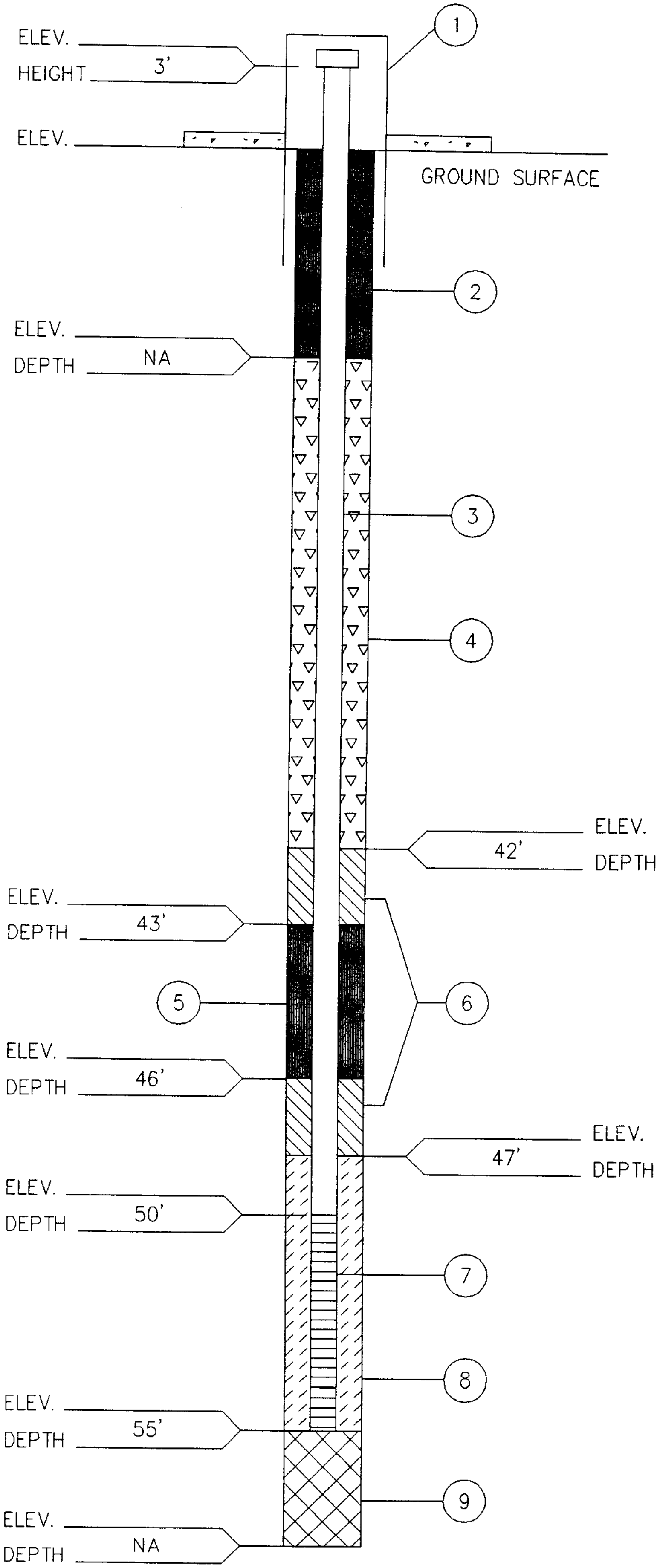


PIEZOMETER CONSTRUCTION INFORMATION

JOB. NO. LHAAP SITE 16 PHASE III RI/FS

BORING/WELL NO. INTERMEDIATE PIEZOMETERS

DATE

CHIEF UNIT WILCOX

1. PROTECTIVE CASING YES [✓ NO]

LOCKING [✓ YES] NO

2. TYPE OF SURFACE SEAL (IF INSTALLED) NONE

3. SOLID PIPE TYPE PVC SCHEDULE 40

SOLID PIPE LENGTH 50 ft.

JOINT TYPE SLIP/GLUED/[✓ THREADED]

4. TYPE OF BACKFILL High Solids Bentonite Grout

HOW INSTALLED – TREMIE FROM SURFACE

5. TYPE OF LOWER SEAL (IF INSTALLED) BENTONITE CHIPS

6. TYPE OF SECONDARY FILTER PACK SUGAR SAND

7. SCREEN TYPE PVC SCHEDULE 40

SCREEN LENGTH 5 ft.

SLOT SIZE 0.010 in.

SCREEN DIAMETER 2 in.

8. TYPE OF PRIMARY FILTER PACK SILICA SAND

9. TYPE OF BACKFILL NA

10. DRILLING METHOD HSA

WATER LEVEL ______ DATE ______

*ALL DEPTHS MEASURED FROM GROUND SURFACE

Sverdrup
ENVIRONMENTAL
801 North Eleventh
St. Louis, Missouri 63101

FIGURE 5-7

p:\sve_proj\000187\do-01\workplan\figures\fig_5-7

5.2.4.2 Well Casing

Casing for shallow and intermediate piezometers shall consist of new, threaded, flush joint, PVC Schedule 40 casing with a nominal 2-in. ID installed from the top of the screen to approximately 3 ft above the ground surface. A minimum 6-in. diameter borehole will be drilled using hollow stem auger methods.

5.2.4.3 Well Screen

Screens for shallow and intermediate piezometers shall consist of new, threaded, flush joint, PVC Schedule 40 casing 2-in. ID machine slotted screen. The screen will have a slot size of 0.01 in. The screen for the piezometers shall have a length of 5 ft. If site characteristics dictate a need for other more appropriate sizing, the USACE will be notified prior to well installation. Screens will have a bottom plug consisting of new, threaded, flush joint, PVC Schedule 40 casing 2-in. ID.

5.2.4.4 Filter Packs

A primary filter pack shall be placed in the annulus between the well screen and the borehole from the bottom of the hole to approximately 2 ft above the top of the screen. The primary filter pack material shall be clean, well washed, well graded silica sand conforming to the requirements of ASTM C33 and be compatible with the screen slot size. The primary filter pack material will be placed with a slow, continuous stream. Continuous depth soundings of the bottom of the hole will be taken to monitor the level of the sand and detect any bridging of sand. The primary filter pack material will be either bagged or purchased from a batch plant. The size and thickness of the primary filter pack may be adjusted in the field based on the borehole stratigraphy.

A 1-ft thick secondary filter pack shall be placed in the annulus between the well casing and the borehole, above the primary filter pack prior to installation of the bentonite seal. An additional 1-ft thick secondary filter pack shall be placed in the annulus between the well casing and the borehole, above the bentonite seal prior to installation of the grout. Placement of the secondary filter pack above the bentonite seal assists in preventing infiltration of the grout into the bentonite seal. The secondary filter shall be installed in the same manner as the primary filter pack. The secondary filter material shall be clean silica sand with 100 % passing the No. 30 U.S. Standard sieve.

5.2.4.5 Bentonite Seal

An approximately 3 ft thick bentonite seal will be placed in the annulus between the well casing and the borehole, above the first secondary filter pack. This will be accomplished by installing pellets or chips via a tremie pipe or by dropping them directly into the annulus. Bentonite pellets or chips will be hydrated with reagent grade water and allowed to hydrate for approximately 45 minutes before proceeding with the well installation.

5.2.4.6 Grout

A high solids bentonite grout will be used to fill the annulus between the bentonite seal/secondary filter pack and the top of the ground, as well as for borehole abandonment. The high solids bentonite grout mixture will consist of a mixture of granular bentonite, bentonite powder, and USACE approved potable water. The proportions of the mixture are 100 lbs granular bentonite and 50 lbs powdered bentonite per 100 gal of water. Grout mixture may be adjusted in filed to facilitate mixing and placement. Grouting will be accomplished in an appropriate manner for the specific application. Grout will be pumped through a tremie or poured into the annulus. The quantities of grout used will be recorded in the field log book.

5.2.4.7 Surface Completions

Shallow and intermediate piezometers shall have surface completions consisting of a 4 ft by 4 ft by 6 in. coarse gravel pad and a locking plug. Prior to placement of the gravel pad, additional quantities of grout will be added periodically to the borehole annuals as required to account for grout shrinkage so that no subsidence of the gravel pad will occur. This will prevent the gravel pad from becoming a receptor for surface water. Approximately 3 ft of casing will be left above ground and topped with a locking plug.

5.2.5 Development

No sooner than 48 hours nor longer than 7 days after completion of any well or piezometer, development of the well or piezometer by pumping and/or surging, or any other method in compliance with applicable regulations, without the use of acids or dispersing agents shall be performed. Any pumping shall be at a rate approximately equal to or greater than the anticipated purging/sampling rate. Development will consist of a minimum of 3 well volumes, including filter pack volume, and shall continue until pH, temperature, and conductivity readings taken on the development water have stabilized over four consecutive readings. These parameters will be considered stabilized if, for four consecutive readings, temperature is ± 1°C, pH is ± 0.2 units, and conductance is ± 10% of the previous reading. No water or other liquid may be introduced into the well during development other than formation water from that well. If a well bails or pumps "dry" during development prior to removing the required volume, the well will be allowed to recover so that the required minimum development volume can be removed. The development process will be supervised and all reading and observations recorded in the field by a geologist or engineer. Groundwater will be disposed of in accordance with the "Comprehensive Investigation Derived Waste Management Plan", June 1996.

At a minimum, the following data will be recorded by the geologist or engineer during well development:

- Date and time well development was started.
- Initial static water level.
- Volume of water removed.
- Color and turbidity.
- Temperature, pH, and conductance.
- Date and time well development was completed.
- Well development methods and equipment used.

5.2.6 Acceptance

It is the responsibility of the drilling agency to drill and install a well or piezometer which meets the criteria outlined in Section 5.2. If a well is not constructed of the proper materials by the proper methods, that well shall not be accepted by the USACE.

The following criteria will be used to determine the acceptability of the monitoring well installation:

- Borings must be constructed and casing installed plumb and true to line. The alignment of the well screen and casing is unacceptable unless a straight 10-foot length of PVC pipe can pass freely down the length of the well. The OD of the PVC pipe shall be 1 in. smaller than the ID of the well casing.
- Filter packs and screened intervals will not be cemented.
- Casing and screen must not be collapsed, broken, damaged, obstructed, or contaminated during installation.
- All casing, screens, grout, and filter packs will be set to depths as directed by the contractor.

If the above well acceptance criteria are not met for a particular well, the well will be abandoned following the procedures detailed in Section 5.2.8. A replacement well will then be drilled and installed hydraulically upgradient from the abandoned well by at least 10 feet horizontal distance.

5.2.7 Schematics and Reports

A construction diagram will be prepared for each well and piezometer and will contain all pertinent information concerning the well. Data recorded on each diagram will include the following:

- Project name/number
- Well or piezometer number
- Installation date
- Depth, thickness and Unified Soil Classification System of each soil stratum
- Depth of static groundwater level and time and date of measurement
- Total depth of boring and completed well

- Depths of screened interval
- Description of well construction materials, including length, diameter, material and manufacturer
- Depths of filter pack, seal, separation sand, and grout
- Type and source of filter pack, seal, and separation sand
- Volumes used of filter pack, granular bentonite, separation sand; and Portland type cement, bentonite powder, and water in grout mixture
- Nominal borehole diameter
- Riser pipe height

For each well or piezometer, a drilling log, a construction diagram, and a State of Texas Well Report will be prepared, as shown in Appendix A.

5.2.8 Abandonment

Wells or piezometers to be abandoned due to construction problems or because they are no longer needed will be backfilled in the following manner:

- Construction materials will be removed.
- The hole will be overdrilled.
- The hole will be filled with a bentonite grout using a tremie pipe from the bottom of the boring to the top or poured into the open hole depending which is appropriate for the specific application.
- Any settlement depression will be filled to the ground surface with additional grout or neat cement.

A State of Texas Plugging Report, shown in Appendix A, will be prepared for each abandoned well.

5.3 GROUNDWATER MEASUREMENTS

5.3.1 Groundwater Level Measurements

Once the well or piezometer is completed, both the water level and bottom of well will be measured to the nearest 0.01 ft. Additionally, the collection of water levels in existing wells may be required. Measurements will be made from a notch or mark on the north side of the top of the casing and recorded in the field logbook and other appropriate forms. An electronic probe will be used to establish equilibrium water levels. Depth to the bottom of well or piezometer will also be measured. The probe will be decontaminated between wells and piezometers as described in Section 5.10.

5.3.2 Slug Tests

Slug tests will be performed to estimate the hydraulic properties of individual strata. The purpose of this test is to measure the hydraulic conductivity of the water-bearing units, taking into account bedding planes, fractures, and other discontinuities. Slug tests will be conducted using the recovery test analytical method introduced by Bouwer and Rice (1976) or an equivalent method. The rising head method will be used; it is preferred over falling head tests for unconfined water-bearing units in which the well screen is placed across the potentiometric surface elevation. In addition, the test data is generally less disturbed when the slug is quickly removed from a stabilized water column as compared to the sudden insertion of the slug into the water column.

Water level data from the slug tests will be collected using a pressure transducer placed beneath the water column near the bottom of the well and connected to a data logger set to record data on a logarithmic sampling schedule. The transducer cable will be firmly attached to the top of the well casing, such that it will be minimally disturbed during introduction and removal of the slug. A slug will be constructed using a length of PVC pipe, filled with sand to allow it to sink into the water column. The pipe will be sealed on both ends using slip caps. An eyebolt will be secured into the top cap, from which nylon rope can be attached. The nominal OD of the slug will be 1-in. less than the ID of the well to be tested. The slug will be of sufficient length to displace a large enough volume of water to successfully complete the test.

After the pressure transducer has been secured within the well, the PVC slug will be lowered into the well until it is fully submerged within the water column. The data logger will be monitored until the potentiometric surface returns to equilibrium. The slug will be removed from the water column while simultaneously starting to record potentiometric data with the data logger. The data logger will be monitored as the potentiometric elevation within the well increases and returns to equilibrium, at which time the test is complete.

5.4 SAMPLING

5.4.1 Sediment Sampling

Sediment samples will be taken by a stainless steel or inert push tube or equivalent. After extraction from the tube, volatile samples will be collected and containerized first. The upper six inches of sediment will be composited and placed in glass jars with teflon-lined lids for chemical testing. Sample locations will be accessed as dictated by field conditions (small boat, wading, etc.).

At a minimum, the following information will be recorded in a bound field logbook for each sediment sample collected:

- date and time of collection
- sample location
- sample number
- weather conditions
- depth of water (if applicable)
- depth of sample collection and recovery
- number of cores collected to obtain adequate sample volume
- sample type (duplicate, split, field blank if applicable)
- FID or PID readings
- visual observation of sediment (color, layers, USCS description, etc.)
- instrument calibration check
- sampler's name and personnel present
- remarks on any special problems or observations

The samples will be logged into the chain of custody, packed in iced coolers. The coolers will be secured with custody seals and packing tape. Coolers will be shipped by overnight carrier to a contract laboratory and/or the SWD Lab. Sediment samples from Site 16 will be analyzed for VOCs, high explosives, metals, and anions.

5.4.2 Surface Water Sampling

Water samples will be collected directly into the sampling bottle where practical. A Kemmerer sampler, a plexiglass Van Dorn sampler, polypropylene dipper or an equivalent, will be used if the pond/lake sampling point is not accessible from the shore. If water samples are to be collected from drainage ditches and the ditches are dry, sampling will be done after a rainfall event when the ditches contain water.

At a minimum, the following information will be recorded for each surface water sample collected:

- date and time of collection
- sample location
- sample number
- weather conditions
- FID or PID readings (if applicable)
- total depth of water (if feasible)
- depth of sample collection
- approximate distance to point of sampling from bank or shore
- sample type (duplicate, split, field blank if applicable)
- collection method (Kemmerer Sampler, direct immersion, etc.)
- temperature, conductance, and pH of water
- sample preparation and preservation (HNO_3, etc.)
- instrument calibration check
- sampler's name and personnel present
- presence of oil sheen or layers on water (if applicable)
- remarks on any special problems or observations

The samples will be logged into the chain of custody, packed in iced coolers. The coolers will be secured with custody seals and packing tape. Coolers will be shipped by overnight carrier to a contract laboratory and/or the SWD Lab. Surface water samples from Site 16 will be analyzed for VOCs, high explosives, metals, and anions.

5.4.3 Soil Sampling

Soil samples from borings will be taken using a split spoon or continuous core samplers, as discussed in Sections 5.1.1. Shallow soil samples will be taken with a clean, stainless steel hand auger equipment.

The volatile soil sample will be collected and containerized first. Samples taken for volatile analysis will not be composites, but discrete samples with as little disturbance as possible. For each soil sample, a composite of the remaining sample interval will then be made for additional laboratory analysis.

Samples will be placed in pre-cleaned glass jars with Teflon-lined caps. Each sample shall consist of two jars of soil. The samples will be taken at discrete depths from borings and as composites for shallow soil samples. At a minimum, the following information will be recorded in a bound field logbook for each sediment sample collected:

- date and time of collection
- sample location
- sample number
- weather conditions
- depth of water (if applicable)
- depth of sample collection and recovery
- number of cores collected to obtain adequate sample volume
- sample type (duplicate, split, field blank if applicable)
- FID or PID readings

- visual observation of sediment (color, layers, USCS description, etc.)
- instrument calibration check
- sampler's name and personnel present
- remarks on any special problems or observations

The samples will be logged into the chain of custody, packed in iced coolers. The coolers will be secured with custody seals and packing tape. Coolers will be shipped by overnight carrier to a contract laboratory and/or the SWD Lab. Soil samples from Site 16 will be analyzed for VOCs, high explosives, metals, anions, pesticides, PCBs, and dioxins/furans.

5.4.4 Groundwater Sampling

Groundwater samples for laboratory chemical analysis will be collected from the wells only. Groundwater samples from the wells will be collected no sooner than seven days after well development. The eleven existing wells will also be sampled during Phase III activities. All groundwater samples will be collected from each well with a dedicated stainless steal bailer.

At a minimum, the following information will be recorded in a bound field logbook for each groundwater sample collected:

- date and time of collection
- climatic conditions with ambient air temperature
- well identification number
- sample number

- name of collector
- water level and time of measurement
- total depth and diameter of well
- depth of water column and minimum purge volume
- PID or FID readings
- sample type (duplicate, split, field blank if applicable)
- purging and sampling method (bailer, submersible pump, etc.)
- temperature, conductance, and pH of water during purging until stable readings are obtained
- color or turbidity of sample
- volume purged prior to sampling
- four replicate measurements of pH, temperature, and specific conductance
- sample preparation and preservation (HCl, HNO_3, etc.)
- instrument calibration check
- remarks on any special problems or observations

All stainless steel monitoring wells will be purged using either a bailer, or submersible pump that is decontaminated between wells as described in Section 5.10. Following well purging, monitoring wells will then be sampled using a stainless steel bailer. Extraction wells will be purged and sampled using the existing stainless steel pumps installed as part of the groundwater control system.

Upon arrival at the well during any sampling event, the Groundwater Monitoring Well Inspection Form, as shown in Appendix A, will be completed. Completed inspection forms will be delivered to the LHAAP Environmental Quality office, who will review them to determine if wells require maintenance.

Prior to sampling, the stagnant water within the well will be removed (three well volumes) so that fresh formation water can enter. The Groundwater Sampling Field Data Form shown in Appendix A contains the formula used to calculate the volume of water to be purged. If a well pumps or bails pumps dry before yielding three volumes, it will be considered purged and ready for sampling as soon as a sufficient volume of water recharges back into the well to allow all sample jars to be appropriately filled. If, after removing three volumes of water, pH, temperature, and conductance have not stabilized, additional water will be removed until parameters stabilize. These parameters will be considered stabilized if, for four consecutive readings, temperature is ± 1°C, pH is ± 0.2 units, and conductance is ± 10% of the previous reading. Handling and disposal of purge water will be conducted in accordance with the "Comprehensive Investigation Derived Waste Management Plan", June 1996.

The well will be sampled within 24 hours of purging unless the well was pumped or bailed dry. In this case the well will be sampled when a sufficient volume of water recharges into the well to allow all sample jars to be appropriately filled. The sampling crew will record the recharge rate, date, time, rate of purging, and any unusual conditions noted with this operation. Dedicated sampling equipment will be used to sample wells. If the equipment becomes heavily contaminated it will be decontaminated prior to sampling using the procedures described in Section 5.10.

Extraction wells will be sampled with a stainless steel pump. Each sample bottle will be filled directly from the sample port, a common container will not be used to fill sample bottles. Monitoring wells will be sampled with a stainless steel bailer. The bailer will be slowly lowered into the well. Each sample bottle will be filled directly from the bailer. A common container will not be used to fill sample bottles. Sampling equipment and containers will be kept from ground contact, and may be laid on plastic sheets on the ground. Where practical and appropriate, upgradient monitoring wells will be sampled before downgradient wells.

Samples of groundwater for chemical analysis are collected and containerized in order of volatilization sensitivity as listed below:

- Volatile Organics
- Total Organic Halogens
- Total Organic Carbon
- Extractable Organics (Including Explosives)
- Total Metals
- Dissolved Metals
- Phenols
- Anions
- Total Hardness
- Field parameters

The sequence of operations for groundwater sampling will be as follows:

- Purge slow-recharging wells (if any) at the outset of the sampling day.
- Purge and sample other wells.
- Sample slow rechargers, if possible.
- Preserve the samples.
- Package and ship the samples to the laboratory.

The samples will be logged into the chain of custody, packed in iced coolers. The coolers will be secured with custody seals and packing tape. Coolers will be shipped by overnight carrier to a contract laboratory and/or the SWD Lab. Groundwater samples from Site 16 will be analyzed for VOCs, high explosives, metals, and anions. Additionally, samples from three wells (16WW16, 16EW01, and 16WW36) anticipated to have the highest levels of contamination will be analyzed for pesticides, PCBs, and dioxins/furans.

5.5 LOCATION SURVEYS

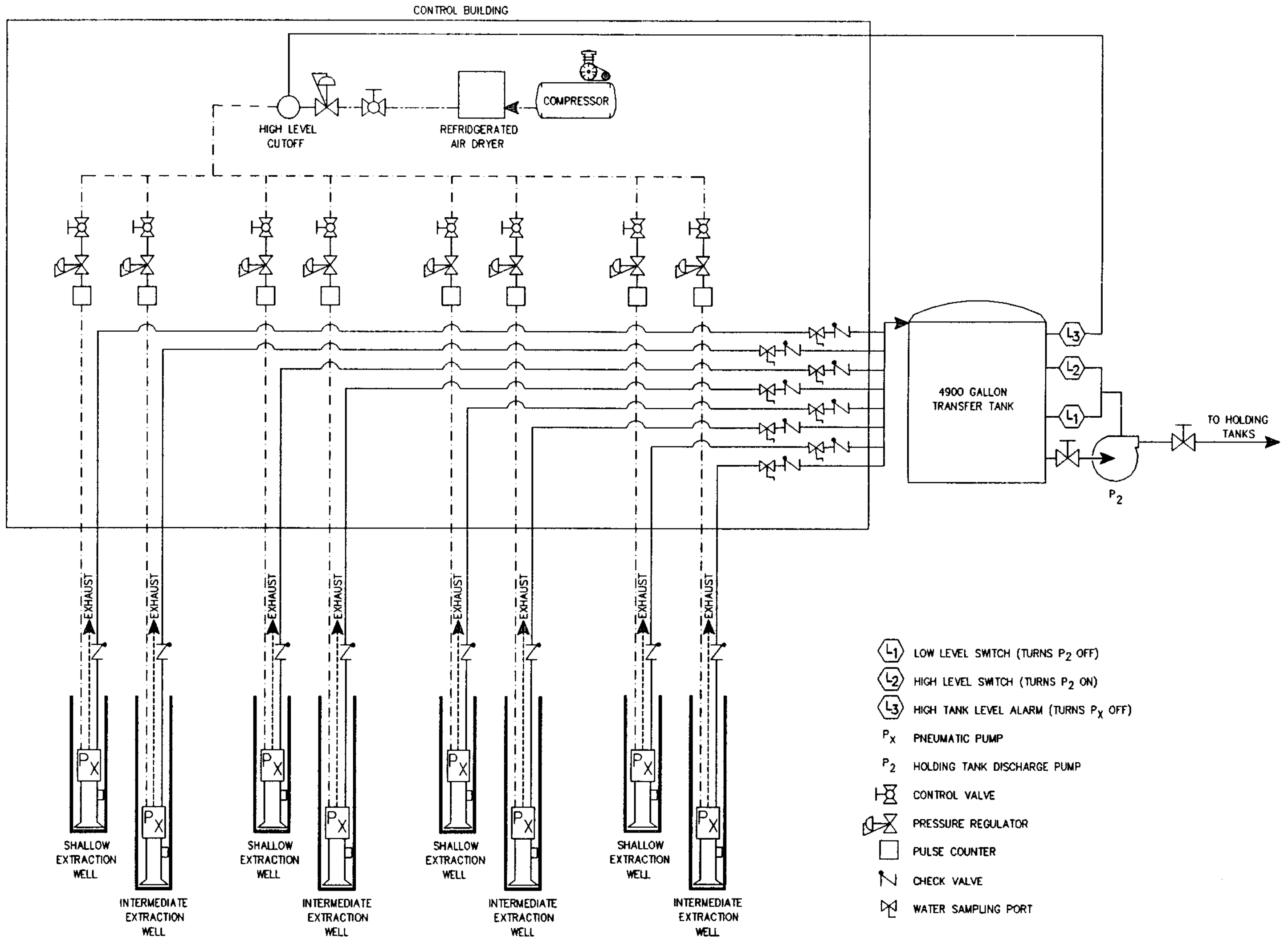
New soil borings, extraction wells, monitoring wells, and piezometers, as well as shallow soil sample locations will be physically located by survey. Additionally, the course of Harrison Bayou from Avenue Q to the furthest downstream surface water and sediment sample location will be defined by survey. The survey subcontractor will be required to meet or exceed a Third Order Class 1 survey, with an accuracy of 1 in 10,000. This accuracy equates to approximately 0.01 foot horizontally and vertically. The surveyor will install a reference notch or mark on the north side of the top of casing for all new extraction wells, monitoring wells, and piezometers. The subcontractor will use bench marks set from approved established control monuments in the area. Horizontal control will be in accordance with North American Datum (NAD) 1983, and vertical control will be referenced to the National Geodetic Vertical Datum (NGVD), 1929.

5.6 INSTALLATION OF GROUNDWATER CONTROL SYSTEM

The primary components and control equipment to be used as part of the groundwater control system will include pneumatic submersible pumps and ancillary equipment, piping, and hardware similar to the existing groundwater control system presently operating at Site 16. A schematic diagram of the Site 16 groundwater control system design is depicted in Figures 5-8. Specific equipment is discussed below.

5.6.1 Extraction Pumps

The pumps for each of the six additional extraction wells are positive air displacement pneumatic groundwater pumps similar to the QED® HammerHead™ pumps presently operating in the two existing extraction wells, 16EW01 and 16EW02. The pumps will be manufactured of stainless-steel and brass and have an internal float system that will maintain a given drawdown. The pumps will constantly react to changes in well yield, pumping at the highest specified design rates possible and shutting down automatically when the groundwater levels drop below pumping levels. Three pump connections will be required for installation: 1) pump air supply fitting, 2) liquid (groundwater) discharge fitting, and 3) pump air exhaust fitting. A stainless-steel cable attachment loop will be provided for suspension of the pump with a cable connected to the top of the well structure. Each pump will be capable of a maximum flow rate of approximately 10 gpm with a maximum lift of 300 ft of water.



US Army Corps
of Engineers
Tulsa District

Sverdrup
ENVIRONMENTAL

SITE 16 PHASE III RI/FS WORK PLAN
SYSTEM CONTROL SCHEMATIC DIAGRAM
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

DWN: PTS/SJB
DES.: JBN
CHKD: PTS
APPD:
DATE: FEB 997
REV.:
PROJECT NO.: 000187
FIGURE NO.: 5-8

s: \sve_proj\000187\do-01\workplan\figures\fig_5-8

5.6.2 Storage Tanks

The existing 5000-gal HDPE tank will be incorporated into the system as a temporary transfer tank for the outlying extraction wells. This tank is positioned adjacent to the extraction wells and control building so that the extraction pumps discharge directly to the tank. The existing electric transfer pump will then transfer the water from the transfer tank to large capacity tanks. The transfer tank will have secondary containment.

5.6.3 Piping

The pressurized air line and discharge hose to and from the pneumatic pumps in the existing system consist of nominal 3/8 in. ID and 5/8 in. ID diameter tubing, respectively. Piping and tubing from the extraction wells to the equipment building and to the 5,000-gal HDPE transfer tank, from the transfer tank to the transfer pump housed in the control building, and from the transfer pump to the large capacity tanks will be sized accordingly. All piping and/or tubing to and from the extraction wells will be placed underground within a 6-inch PVC secondary containment conduit, with at least a minimum of 1 ft of backfill cover. All piping for the additions to the groundwater control system will be constructed of material compatible with chlorinated solvents. Where piping reaches the ground surface at the concrete floor of the equipment building, piping will be protected from damage by covering with additional conduits. Exposed piping may need to be heat traced for freezing weather conditions. Required tracing will be 115 volt AC power and have an explosion proof ground fault interrupter circuit.

5.6.4 System Controls

The existing groundwater control system presently operating at Site 16 was designed to accommodate additional extraction wells. Thus, the groundwater control system will incorporate many of the existing components already present on site. System components presently on site which would be incorporated into the new groundwater control system include:

- Air compressor with a refrigerated air dryer
- 2 Positive air displacement pneumatic pumps
- 2 Air pressure regulators and pulse counters
- Pneumatic high level cutoff control
- 5,000-gal HDPE transfer tank

A schematic diagram of the eight extraction wells is depicted in Figure 5-8. This diagram shows how the existing system components will be incorporated into the new groundwater control system. Each of the recommended and existing pneumatic pumps are equipped with an internal float control which regulates pump operation thus requiring limited external controls. System controls will consist of a pneumatic high level shutoff valve attached to the main air line leaving the air tank. This shutoff valve will stop the flow of air to the manifold feeding the extraction pumps if the transfer tank experiences a high level fault condition. From this shut-off valve, the air line is connected to a manifold which directs the air to each pneumatic pump. The air line to each pneumatic pump is equipped with a pressure regulator and shut-off valve to control air flow and individual pump operation. Each air line also has a pulse meter which counts the number of pulses of pressurized air that flows through the meter. This can be used to calculate the extraction rate of each of the pumps by monitoring the number of times a pump has discharged over a period of time and multiplying by the discharge volume of the pump (0.8 gallons/discharge for the existing pumps).

The air compressor presently on site consists of a Curtis Toledo two stage compressor equipped with a 115/230/1/60-NEMA 1 HP motor and is rated at 6.8 SCFM. Ancillary equipment associated with the air compressor includes an 80-gal horizontal tank, electronic tank drain, low oil shutoff, motor starter, air cooled aftercooler, and refrigerant air dryer. This air compressor will be used as part of the expanded groundwater control system.

The extraction well pumps proposed for incorporation into the recommended groundwater control system are described in Section 5.6.1. Discharge lines from each pump contain three valves: two check valves and a sampling port. The check valves eliminate the back flow of discharge water into the sampling port or extraction well. One of the check valves is located on the discharge from the extraction pump within each well vault to preclude water from backing up into the well.

The present 5,000-gal HDPE transfer tank will be incorporated into the new system if hydraulic head restraints preclude the extraction pumps in outlying extraction wells from discharging directly into the large capacity tanks. The transfer tank is positioned adjacent to the outlying wells and will use the existing transfer pump and controls to transfer water to the main holding tank. The transfer tank is fitted with a manual valve on the discharge line located near the bottom of the tank which is connected to the existing transfer pump. The capacity of the transfer tank is monitored by the two level actuated switches. A third level actuated switch shuts off the compressed air supply to the pneumatic pumps if the upper level actuated switch fails.

5.7 Site Access Improvements

A bulldozer will be used to regrade and repair existing roads, clear recent deadfall, and place fill dirt and/or gravel. Fill dirt and gravel will be trucked in from a clean, offsite barrow site as need to complete improvements. New roads will be construct only to access new well locations. These will be constructed using fill dirt and/or gravel placed on top of a geotextile base where need. All improvements will be done in such a manner as to minimize the impact to the existing site conditions.

5.8 Groundwater Model Data

To supplement the data for the groundwater model, a study of Harrison Bayou will be performed. Measurement of the bayou's width, depth, bed (sediment) thickness, and bed composition will be made at select locations along the bayou. The width of the bayou will be measured with a fiberglass or steel measuring tape. The depth of the bayou will be measured using a measuring stick. A metal probe will be used to measure the thickness of the bed material. A stainless steel sediment sampler will used to recover a sample of the bed material. The material will be described following the method outlined for detailed soil description in Section 5.1.3. All data will recorded in a field log book.

5.9 Feasibility Study Data Compilation

An evaluation of the groundwater control system will be performed by the collection of water level data on a weekly basis for a period of 12 months. A bi-weekly check of the extraction well system will also be performed during this 12 month evaluation. Groundwater samples will be collected and submitted for laboratory analysis form each of the eight extraction wells and 12 monitoring wells after 2½ and 5 months of system operation. Samples will be analyzed for VOCs and high explosives. Water level measurements and sampling procedures will be performed as described in previous sections.

5.10 Decontamination

5.10.1 Drilling Equipment

Drilling equipment (augers, bits, well casing, split spoons, continuous samplers, rods, and tools) will be steam cleaned or hot water pressure cleaned prior to use in each boring. A decontamination station will be established for the washing of drilling and sampling equipment. This station may be located onsite or nearby in order to serve several sites. Waste wash water will be collected and disposed of in accordance with the "Comprehensive Investigation Derived Waste Management Plan", June 1996.

5.10.2 Well Casing

Casing and screens used in monitoring well construction will remain in the factory-sealed containers until use. These materials will be placed on a clean, dry tarp or on blocks during assembly. If contact with the ground does occur, the affected sections will be cleaned with potable water.

5.10.3 Sampling Equipment

Non dedicated submersible pumps will be cleaned between uses at different well locations. Any heavily contaminated dedicated bailers will be cleaned or replaced after sampling. The sampling equipment will be transported in sealed, clean containers, and care will be taken to avoid contamination. Sampling equipment will be washed with a non-phosphate detergent, tap water, distilled water, in that order, allowed to air dry, and sealed back into clean containers.

5.11 Field Screening

Each soil sample collected from soil borings and hand auger borings will be initially screened for volatile organics using a photoionization detector (PID) or a flame ionization detector (FID). Samples will be screened immediately upon opening or extruding the sample. PID or FID readings, including none detected, will be recorded in the field log books and noted in the boring logs.

Instantaneous air monitoring will be conducted during all drilling and groundwater sampling activities using a PID or FID, and a combustible gas meter. Integrated sampling will be conducted on a selected basis using sampling pumps and collection media, or passive dosimeters. Air monitoring procedures are described in the SSHP.

Monitoring equipment will be properly calibrated and used according to manufacturer's instructions. Copies of the owner manuals will be kept on-site for reference on the proper calibration, operation, and troubleshooting of equipment.

The calibration of each brand of detector will be according to manufacturers instructions. One hundred (100) ppm isobutylene will be used for calibration of the PIDs. One hundred (100) ppm methane concentration in air will be used to calibrate the FIDs. Calibration of all PIDs or FIDs will be performed daily by attaching the calibration gas to the detector probe and adjusting the span setting or calibrate adjust knob, respectively, to get the desired concentration value on the display. All calibrations of the detectors will be documented in the field logbook. At a minimum, the following information will be recorded:

- Date and time of calibration
- Type and concentration of calibration gas
- Calibration and span settings (include reference gas listed as ppm of isobutylene, methane, etc.)

Once calibration is complete, measurements will be taken by placing the probe near the sample or in the atmosphere of interest and allowing sufficient time for the air to be drawn through and readings to stabilize (usually 5 - 10 seconds).

Triple gas meters will be calibrated according to manufacturer instructions as needed. Adequate operation of the instrument will be checked prior to each use. In a normal atmosphere, the % LEL should equal 0 and the % oxygen should equal 20.9. If readings other than these are obtained, the meter will be checked and calibrated. Pentane is used for % LEL calibration, while clean atmospheric air is used to adjust % oxygen. All calibrations and adjustments will be noted in a field logbook.

The triple gas meter continuously monitors three parameters and has alarm settings for each. The meter will be placed in the work atmosphere and left on during those times when use of a triple gas meter is required or is appropriate. The meters are of the passive type, but if confined space measurements are required, a sample pump and tubing will be attached to the meter to turn it into an active monitoring device.

5.12 Investigation Derived Waste

The "Comprehensive Investigation Derived Waste Management Plan", June 1996. developed as a separate document, should be referred to as a guide to the handling, staging, characterization, and disposal of IDW for the RI at LHAAP

SECTION 6.0 FEASIBILITY STUDY

6.1 Development and Screening of Alternatives

During the process of developing and screening alternatives, Sverdrup will be conducting the following activities:

- Developing specific remedial action objectives acceptable to the EPA and the TNRCC using all RI generated data. This will be very important as it will set the goals of the Feasibility Study (FS).
- Developing a range of general response actions
- Identifying areas or volumes of the media to be treated, contained and/or subjected to institutional controls
- Identifying, screening, and documenting technologies
- Assembling a number of alternatives depending on the site type and characteristics
- Screening the remedial action alternatives, if necessary, on the basis of effectiveness, implementability, and cost
- Preparing an alternatives array document.

The information developed during these two activities [developing and screening of alternatives] will be used in assembling remedial technologies into alternatives for either the site as a whole or for a specific operable unit. At some sites, a number of potential remedial options will be developed early in the RI/FS process. In such cases, these options will be screened to narrow the list of options that will be evaluated in detail. The screening process will be necessary for two reasons. First, it will streamline the feasibility study process. Second, it will ensure that the most promising alternatives will be considered. During the screening process, ARARs will be given specific attention.

The information available at the time of screening will be used to identify and distinguish any differences among the various alternatives. If screening takes place, the technical memorandum will present the alternatives in such a manner that each alternative will be evaluated with respect to its effectiveness, implementability, and cost and document the rationale for screening out any alternatives. The retained alternatives will be judged as the best or most promising while retaining a range of alternatives broad enough to satisfy requirements of CERCLA and the NCP. These alternatives will be subjected to further consideration and analysis. Alternatives that are screened out will not receive further consideration unless additional information indicates that further evaluation is warranted.

In the event that there are only a limited number of viable alternatives for a particular site, the alternative screening process will be either minimize or eliminated.

6.2 Detailed Analysis of Alternatives

The nine evaluation criteria developed to address statutory requirements, as well as the technical and policy considerations that have proven to be important for selecting from among the remedial alternatives. These evaluation criteria will serve as the basis for conducting the detailed analyses of alternatives during the FS and for subsequently selecting an appropriate site remedy. The criteria are:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Short-term effectiveness
- Reduction of toxicity, mobility, or volume
- Implementability
- Cost
- State acceptance
- Community acceptance.

The detailed analysis process will include an evaluation of each alternative against the nine criteria. Sverdrup will submit a memorandum summarizing the results of the comparative analysis. In addition, a draft FS report will be submitted for review and approval. The report, as adopted or modified, will provide a basis for remedy selection. It will document the development and analysis of remedial alternatives. The final FS report will be bound with the final RI report. Following completion of the RI/FS report and confirmation that there is sufficient information to support the selection of a preferred alternative, the process of remedy selection will begin.

SECTION 7.0 BASELINE RISK ASSESSMENT

A baseline risk assessment will be conducted during the RI. The baseline risk assessment will be used to determine whether, in the absence of remedial action, a particular site poses a substantial danger to public health and welfare and the environment. There will be two separate inquires: human health and the environment. The human health evaluation will address: all exposure pathways for each medium of concern; toxicity values for carcinogenic and noncarcinogenic effects; and the cancer and/or hazard index for each chemical of concern. The environmental evaluation will address any critical habitats affected by site contamination and any species affected by the contamination.

The baseline risk assessment process is cumulative in nature: the components of the assessment build on one another. The following documents will be utilized in planning the conduct of the baseline risk assessment, EPA's *Superfund Human Health Evaluation Manual, Superfund Exposure Assessment Manual*, and *Superfund Environmental Evaluation Manual*, and the Integrated Risk Information System (IRIS) and Public Health Risk Evaluation Data Base.

Activities associated with the Baseline Risk Assessment will include:

- Contaminant identification and documentation
- Exposure assessment and documentation
- Toxicity assessment and documentation
- Risk characterization
- Environmental evaluation

The risk assessment shall identify contaminants of concern and potential routes of exposure, evaluate migration pathways, and define the types of adverse health and/or environmental effects associated with chemical exposures for both present and future risks. The risk assessment report shall include discussions of sensitive populations, fate and transport assessments, toxicological and epidemiological studies applied in the risk assessment, assumptions made in developing exposure scenarios including the reasonable maximum exposure (RME), and any uncertainties associated with any of the data, assessments, studies, toxicities, or assumptions used in developing the risk assessment. All exposure scenario evaluated in the risk assessment will assume a future land use scenario of residential.

SECTION 8.0 SCHEDULE OF DELIVERABLES

8.1 Schedule of Deliverables

The schedule for delivery of work items to the Technical Manager is in calender days and is shown in Table 8-1.

Table 8-1
Schedule for Workplan Submittals

Submittals	Schedule	Number of Copies
Resistivity Survey Plan Letter	2 weeks after Delivery Order Award	1
Phase III RI/FS Work Plan (Preliminary Draft)	28 days after Delivery Order Award	7 (For COE Review)
Phase III RI/FS Work Plan (Draft Final)	7 days after A-E receipt of COE comments on Preliminary Draft.	21
Phase III RI/FS Work Plan (Final)	7 days after A-E receipt of regulatory comments on Draft Final.	21
Extraction Well Six Month Cumulative Data	14 days after data collected in the field.	2
Data Summary/Validation Report	197 days after fieldwork is completed.	15
Data Review Meeting Presentation Materials	During the fourth week following receipt of the Data Summary/Validation Report	Transparencies and handouts, as needed.
RI and FS Reports (Draft)	334 days after the Data Review meeting	11
RI and FS Reports (Draft Final)	7 days after the receipt of the Army comments on Draft RI/FS Report	20
RI and FS Reports (Final)	14 days after the receipt of regulator comments on Draft Final RI/FS Report.	20
Options:		
Modeling Report	150 days after data review meeting	15
Preliminary Draft Risk Assessment Report	180 days after data review meeting	10 COE review
Draft Risk Assessment Report	21 days after receipt of Preliminary Draft Risk Assessment Report	15 Army review
Revised Draft Risk Assessment Report	40 days after receipt of Draft Risk Assessment Report	20

APPENDIX A
FORMS

GROUNDWATER MONITORING WELL INSPECTION FORM
Longhorn Army Ammunition Plant

WELL NUMBER:__________________
DATE:________________________
TIME:________________________
INSPECTED BY:__________________

Directions: Indicate conditions with a yes, no, or n/a for non applicable. Explain conditions in comments section.

PHYSICAL CONDITION OF WELL

1. ____ Outer Well Casing
2. ____ Surface Pad
3. ____ Erosion around well pad
4. ____ Bumper Poles
5. ____ Locking Cap
6. ____ Lock
7. ____ Grout inside well
8. ____ Grout outside well
9. ____ Weephole
10. ____ Inside cap

COMMENTS:____

CONDITION OF AREA SURROUNDING WELL (10 ft. radius)

1. ____ Vegetation
2. ____ Poison Ivy
3. ____ Fireants
4. ____ Debris
5. ____ Indication of herbicide usage
6. ____ Indication of pesticide usage
7. ____ Wasps, spiders, snakes, etc.

COMMENTS:____

CONDITION OF DEDICATED PUMP OR BAILER

1. ____ Pump Removed?

If yes answer remaining questions.
____Corrosion visible?
____Tubing condition?
Describe pump condition. ________________________________

GROUNDWATER SAMPLING
FIELD DATA FORM

PROJECT NAME: DATE:

SAMPLING POINT: TIME:

SAMPLED BY: WEATHER:

TOP OF CASING ELEVATION: ____________________ FEET

DEPTH TO STATIC WATER LEVEL: ____________________ FEET

DEPTH TO WELL BOTTOM: ____________________ FEET

HEIGHT OF WATER COLUMN, H = ____________________ FEET

DIAMETER OF WELL CASING, D = ____________________ FEET

VOLUME OF WATER COLUMN, $\pi \text{ X } H \text{ X } \frac{D^2}{4} \text{ X } 7.48 =$ ____________________ GALLONS

VOLUME OF WATER EVACUATED: ____________________ __________ GALLONS

DID WELL READILY RECOVER? __________ YES __________ NO.

METHOD OF EVACUATION: ____________________

METHOD OF SAMPLING: ____________________

SAMPLE TEMPERATURE: __________ °C __________ °F

SAMPLE pH: ____________________

SAMPLE SPECIFIC CONDUCTANCE: ____________________ umhos/cm

SAMPLE COLOR: ____________________

SAMPLE TURBIDITY: ____________________ HIGH

____________________ MODERATE

____________________ LOW

SAMPLE ODOR: ____________________

OTHER OBSERVATIONS: ____________________

ADDITIONAL COMMENTS ON METHODOLOGY, ETC.:

Hole No.

020956

DRILLING LOG

DIVISION

INSTALLATION

SHEET
OF SHEETS

1. PROJECT

2. LOCATION [illegible]

3. DRILLING AGENCY

4. HOLE NO. [illegible]

5. NAME OF DRILLER

6. DIRECTION OF HOLE
☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.

7. THICKNESS OF OVERBURDEN

8. DEPTH DRILLED INTO ROCK

9. TOTAL DEPTH OF HOLE

10. SIZE AND TYPE OF BIT

11. DATUM FOR ELEVATION SHOWN [illegible]

12. MANUFACTURER'S DESIGNATION OF DRILL

13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN | DISTURBED | UNDISTURBED

14. TOTAL NUMBER CORE BOXES

15. ELEVATION GROUND WATER

16. DATE HOLE | STARTED | COMPLETED

17. ELEVATION TOP OF HOLE

18. TOTAL CORE RECOVERY FOR BORING %

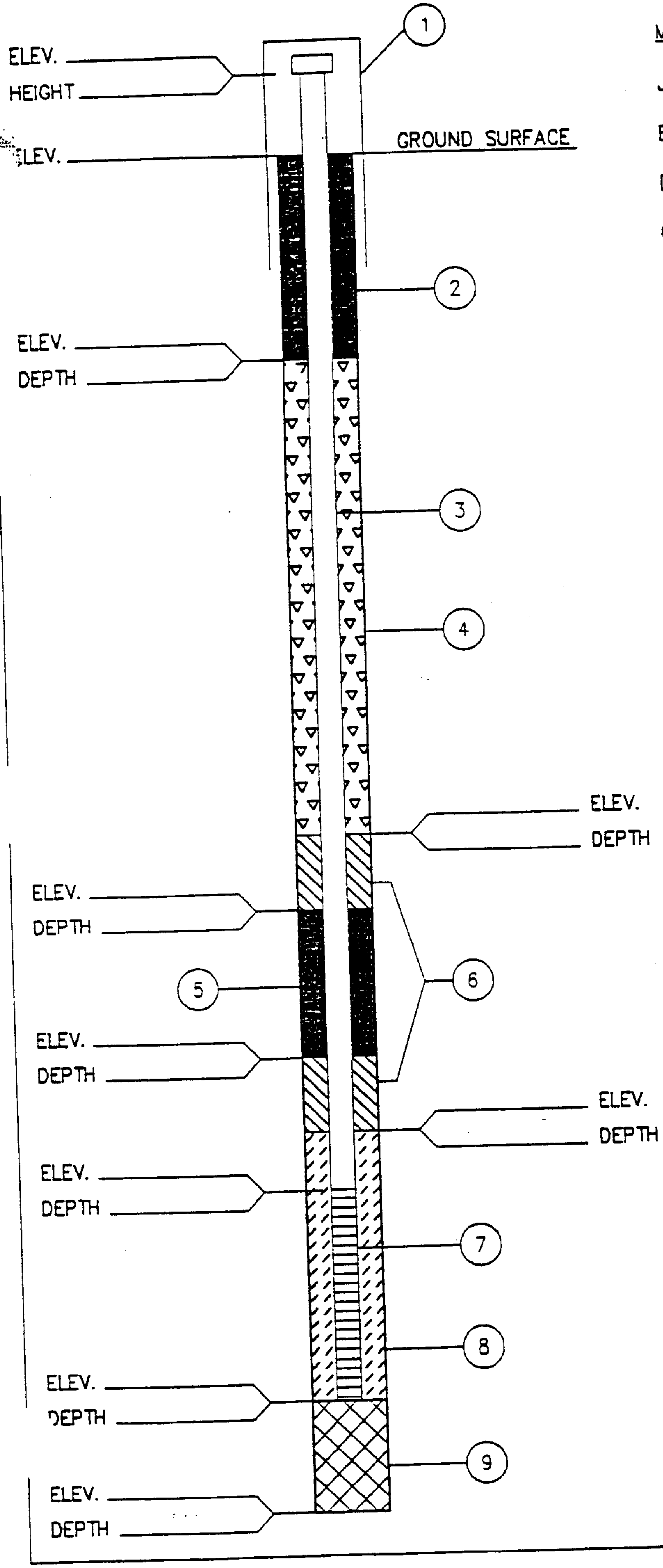
19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS [illegible] d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS [illegible] g

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT

HOLE NO.



MONITORING WELL CONSTRUCTION INFORMATION

JOB. NO. 020957

BORING/WELL NO. ____

DATE ____

CHIEF UNIT ____

1. PROTECTIVE CASING YES NO

   LOCKING YES NO

2. TYPE OF SURFACE SEAL (IF INSTALLED)

   ____

3. SOLID PIPE TYPE ____

   SOLID PIPE LENGTH ____ ft.

   JOINT TYPE SLIP/GLUED/THREADED

4. TYPE OF BACKFILL ____

   HOW INSTALLED – TREMIE

   FROM SURFACE

5. TYPE OF LOWER SEAL (IF INSTALLED)

   ____

6. TYPE OF SECONDARY FILTER PACK

   ____

7. SCREEN TYPE ____

   SCREEN LENGTH ____ ft.

   SLOT SIZE ____ in.

   SCREEN DIAMETER ____ in.

8. TYPE OF PRIMARY FILTER PACK

   ____

9. TYPE OF BACKFILL ____

10. DRILLING METHOD ____

WATER LEVEL ____ DATE ____

*ALL DEPTHS MEASURED FROM GROUND SURFACE

020958

Please use black ink.

Send original copy by certified mail to: Texas Water Commission, P.O. Box 13087, Austin, Texas 78711

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

State of Texas
WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711

1) OWNER ____________ (Name) ADDRESS ____________ (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL: County ____________ , ____________ miles in ____________ (NE, SW, etc.) direction from ____________ (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:

Section No. ________ Block No. ________ Township ________ Abstract No. ________ Survey Name ________

Distance and direction from two intersecting section or survey lines ____________

☐ SEE ATTACHED MAP

3) TYPE OF WORK (Check): ☐ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Domestic ☐ Industrial ☐ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check): ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other ________

6) WELL LOG:

Date Drilling:

Started ____________ 19 ____

Completed ____________ 19 ____

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
	Surface	

7) BOREHOLE COMPLETION:

☐ Open Hole ☐ Straight Wall ☐ Underreamed

☐ Gravel Packed ☐ Other ____________

If Gravel Packed give interval . . . from ________ ft. to ________ ft.

From (ft.)	To (ft.)	Description and color of formation material

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casting Screen
			From	To	

9) CEMENTING DATA [Rule 287.44(1)]

Cemented from ________ ft. to ________ ft. No. of Sacks Used ________

________ ft. to ________ ft. No. of Sacks Used ________

Method used ____________

Cemented by ____________

10) SURFACE COMPLETION

☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]

☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]

☐ Pitless Adapter Used [Rule 287.44(3)(B)]

☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:

Static level ________ ft. below land surface Date ________

Artesian flow ________ gpm. Date ________

12) PACKERS: Type Depth

13) TYPE PUMP:

☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder

☐ Other ____________

Depth to pump bowls, cylinder, jet, etc., ________ ft.

14) WELL TESTS:

Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated

Yield: ________ gpm with ________ ft. drawdown after ________ hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☐ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? ________ Depth of strata ________

Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME ____________ (Type or print) WELL DRILLER'S LICENSE NO. ____________

ADDRESS ____________ (Street or RFD) (City) (State) (Zip)

(Signed) ____________ (Licensed Well Driller) (Signed) ____________ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. ________ Located on map ________

WWD-012 (Rev. 05-18-90)

TEXAS WATER COMMISSION COPY

Please use black ink.

File WHITE COPY with:

Texas Water Commission
P.O. Box 13087
Austin, Texas 78711
Phone (512) 371-6259

State of Texas

PLUGGING REPORT

(This form must be completed and filed with the TWC within 30 days following the date the well is plugged as required by current statutory law.)

020959

Texas Water Well Drillers Board
P.O. Box 13087
Austin, Texas 78711
Phone (512) 371-6299

A. Well Identification and Location Data

1) Owner ______ (Name) Address ______ (Street or RFD) (City) (State) (Zip)

2) Owner's Well Number ______

3) Location of Well: County ______ miles in ______ (N.E., S.W., etc.) direction from ______ (Town)

Driller or other person performing the plugging operations must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:

Section No. ______ Block No. ______ Township ______

Abstract No. ______ Survey Name ______

Distance and direction from two intersecting section lines or survey lines: ______

☐ See Attached map.

B. Historical Data on Well To Be Plugged (if available)

4) Driller ______ License Number ______ City ______

5) Drilled ______ 19___; 6) Diameter of hole ______ inches; 7) Total depth of well ______ feet.

C. Current Plugging Data

8) Date well plugged ______, 19______.

9) Sketch of well: Using space at right, show method of plugging the well including all casing and cemented intervals.

10) Name of Driller or other person actually performing the plugging operations ______

______;

if a water well driller plugged the well, give the driller's license no. ______.

11) Casing and cementing data relative to the plugging operations:

Diameter (inches)	Casing Left in Well	
	From (feet)	To (feet)

Cement Plug(s) Placed in Well		Sack(s) of cement used
From (feet)	To (feet)	

D. Validation of Information Included in Form

I hereby certify that this well was plugged by me (or under my supervision) and that all of the statements herein are true and accurate to the best of my knowledge and belief.

Company or Individual's Name ______ (Type or Print)

Address ______ (Street or RFD) (City) (State) (Zip)

(Signed) ______ (Person performing plugging operations) (Signed) ______ (Owner of Well)

For TWC use only
Well No. ______
Location on map ______

WWD-009 (Rev. 07/27/88)

TEXAS WATER COMMISSION'S COPY

020960

Sverdrup

Final Sample and Analysis Plan
for the
Site 16 Phase III Remedial Investigation/Feasiblity Study and Groundwater Treatability Study
at the
Longhorn Army Ammunition Plant (LHAAP)
Karnack, Texas

Submitted to
U.S. Army Corps of Engineers
Tulsa District
CONTRACT NO. DACA56-96-R-0027
Delivery Order No. 1

Prepared by
Sverdrup Environmental, Inc.
St. Louis, Missouri

August 1997

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LIST OF ACRONYMS and ABBREVIATIONS

ASTM- American Society of Testing Materials

BS- Blank Spike

BSD- Blank Spike Duplicate

COC- Chain of Custody

Chem and IH- Chemistry and Industrial Hygiene Section

DQOs- Data Quality Objectives

FS- Feasibility Study

HTRW-CX- Hazardous, Toxic, and Radioactive Waste-Center of Expertise

LCS- Laboratory Control Samples

LCSD- Lab Control Sample Duplicate

LHAAP- Longhorn Army Ammunition Plant

MS- Matrix Spike

MSD-Matrix Spike Duplicate

%R- Percent Recoveries

QA- Quality Assurance

QC- Quality Control

RPD- Relative Percent Difference

RI- Remedial Investigation

SAP- Sampling and Analysis Plan

SSHP- Site Safety and Health Plan

Sverdrup- Sverdrup Environmental, Inc.

SWD Lab- USACE Southwestern Division Laboratory

USACE- U.S. Army Corps of Engineers, Tulsa District

USEPA- U.S. Environmental Protection Agency

VOCs- Volatile Organic Compounds

020964

LIST of FIGURES

LIST of TABLES

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SECTION 1.0 - INTRODUCTION

1.1 GENERAL

The purpose of this Sampling and Analysis Plan (SAP) is to document the procedures required to ensure that all data obtained from the Phase III Remedial Investigation/Feasiblity Study (RI/FS) activities at the Site 16 (Old Landfill) at Longhorn Army Ammunition Plant (LHAAP) are of acceptable quality and detail the process for completing the task outlined in the Work Plan. Quality Assurance (QA) is the Government activity required to assure desired and verifiable levels of quality in all aspects of an investigation. Quality Control (QC) is the functional mechanism to achieve quality data. The QA program, administered by the Government, will ensure that the QC program will result in high quality data. This document will describe the QA/QC procedures for each aspect of the investigations which will meet the data quality objectives (DQOs) of this project and the process for completing the task outlined in the Work Plan. Procedures in this SAP came from Chemical Data Quality Management for Hazardous Waste Remedial Activities, ER-1110-1-263 (Ref. 2), a Corps of Engineers regulation, with additional guidance from Development of an RFI Work Plan and General Considerations for RCRA Facility Investigations, SW-87-001 (Ref. 3), and Minimum Chemistry Data Reporting Requirements for DERP and Superfund HTW, CEMRD-EO-GC Considerations (Ref. 1). DQOs in this SAP came from Data Quality Objectives for Superfund, EPA540-R-93-071 (Ref. 4).

1.2 REPORT ORGANIZATION

This document discusses the data quality procedures and techniques to be used in the investigation at LHAAP. The study will be accomplished through the sampling and analysis of soil, surface soil, sediment, surface water, and groundwater.

Section 2.0 discusses the DQOs for this project; Section 3.0 discusses field operations; Section 4.0 discusses sample handling and testing; Section 5.0 discusses sample integrity; Section 6.0 discusses data reduction, validation and reporting; Section 7.0 discusses audits; Section 8.0 presents corrective actions and Section 10.0 presents references.

1.3 PROJECT QA/QC ORGANIZATION

A quality program has been developed to insure the integrity of the sample methods for both field and analytical procedures for the Phase III RI.

1.3.1 Quality Control Personnel

Program personnel will be responsible for monitoring and reviewing procedures used in each stage of the work to ensure that data generated in the course of execution of the work plan is accurate, complete, precise, and representative of the site studied. An individual on each field crew will be designated as the Quality Control Officer and will be responsible for the proper execution of field QC, as discussed in Section 3.5 of this report.

1.3.2 Quality Assurance Personnel

Quality assurance will be performed by the U.S. Army Corps of Engineers, Tulsa District (USACE), Geotechnical Branch, and the Chemistry and Industrial Hygiene Section (Chem and IH). The Chem and IH Section reports to the Chief of the Geotechnical Branch and will be responsible for performance and system audits of this investigative program, data validation, ongoing reviews of QA procedures, and coordination of QA training for project personnel. Data validation reports will be prepared by Sverdrup Environmental, Inc. (Sverdrup). USACE will add the sections on comparability (based on the QA samples as discussed in section 2.5). USACE will make final decisions regarding data validity and useability based on data received from Sverdrup and comparability study.

1.3.3 Laboratory

Analytical testing and quality control testing will be performed by laboratories selected by Sverdrup. QA testing will be performed by the USACE Southwestern Division Laboratory (SWD Lab). Details on SWD Lab organization, responsibilities, and key personnel are contained in the USACE SWD lab's QA/QC Plan, which is on file in the USACE office. Samples taken by Sverdrup will be sent to their laboratories, with the exception of the QA samples, which will be sent to SWD Lab. If sampling should be performed by USACE field crews, SWD Lab will receive shipments of samples from the field, which it will pass on to its contract laboratories. Either SWD Lab or a separate contract lab will analyze the QA samples. All analytical laboratories used for this work will be validated by the Hazardous, Toxic, and Radioactive Waste-Center of Expertise (HTRW-CX). The validation process involves review of their laboratory quality management manual, laboratory performance on audit sample analyses, and an on-site inspection. This validation process is discussed in detail in Appendix C of ER-1110-1-263 (Ref. 2).

SECTION 2.0 - DATA QUALITY OBJECTIVES

The DQOs of this project have been chosen to meet the goals of site characterization, risk assessment, and remedial design. DQOs are qualitative and quantitative statements which specify the quality of data required to support decisions made during remedial response activities. These DQOs will be used to develop a plan to be used throughout the RI/FS process. Data developed during the study will be used to determine the presence and lateral and vertical extent of contamination in the soil and groundwater, as well as the rate of migration. The evaluation of this data will be used to screen remedial alternatives and to begin remediation. The level of quality required of the collected data to be used for these intended purposes is such that it meets U.S. Environmental Protection Agency (USEPA) "definitive data" standards as defined in "Data Quality Objectives Process for Superfund Interim Final Guidance," USEPA 540-R-93-071, September 1993 (Ref. 4). The method-specific DQOs for precision, accuracy, and sensitivity have been established for each measurement parameter based on prior knowledge of the specific measurement system used and method validation studies employing replicate analyses, spikes, standards, calibrations, recoveries, control charts, and project specific requirements. The minimum internal data reporting requirements (from Ref. 2) which will be required of all analytical laboratories includes the following:

- Sample identification numbers cross-referenced with laboratory ID's and QC sample numbers.

- Problems with arriving samples noted on an appropriate form.
- Each analyte reported as an actual value or less than a specified quantitation limit as listed in Appendix B Tables B.3 to B.6.
- Dilution factors, extraction dates, and analysis dates are reported.
- QC samples to be included as laboratory blanks, surrogate spikes, matrix spikes, laboratory control spikes laboratory duplicates, field duplicates, and field blanks.

The data developed from the investigations described in this SAP will meet the objectives discussed below with respect to precision, representativeness, accuracy, completeness, and comparability. The majority of this data will be developed in the laboratory from the analysis of field samples and the remainder will be measured in the field.

2.1 ACCURACY

Accuracy measures the bias in a measurement system and is very difficult to measure for the entire data collection activity. Potential sources of error are the sampling process, field contamination, preservation, handling, sample matrix, sample preparation and analysis techniques.

Accuracy objectives for laboratory performance are expressed as percent recoveries (%R) of a known concentration of reference material added to a field sample matrix or a standard matrix. Every batch of samples analyzed shall include matrix spikes (MS/MSD), laboratory control samples (LCS) and surrogate spikes (for organic analyses only). Matrix spike results are used to evaluate the ability of the analytical method to measure the analytes of interest in the actual sample matrix and to verify analyses are conducted within control limits. Laboratory control sample results are used in conjunction with matrix spike results to verify analyses are conducted within control limits when matrix spike recoveries are out of control. Surrogate spike compounds will be added to every sample analyzed for organic parameters. Surrogate spike recoveries are used to provide method performance indicators with respect to each individual sample matrix analyzed for organic compounds. Matrix spike and laboratory control samples will be analyzed at a frequency of one per analytical batch or every 5% of samples, whichever is more frequent. If sample volumes are not sufficient to conduct MS/MSD analyses, a blank spike/blank spike duplicate sample (BS/BSD) or a lab control sample duplicate (LCSD) will be prepared and analyzed.

Analytical accuracy will be assessed through the use of known QC samples and spiked samples and will be presented as a percent recovery. Accuracy determined by percent recovery is calculated as follows:

$$Percent\ Recovery = \frac{(C_2 - C_1)}{C_0} \times 100\%$$

where C_0 = amount of analyte added to the sample matrix,
C_1 = amount of analyte present in the unspiked sample matrix (equal to zero for the standard matrix), and
C_2 = amount of spiked material recovered in the analysis.

2.2 PRECISION

Precision is a measure of the degree of reproducibility of an analytical value and is used as a check on the quality of the sampling and analytical procedures. Precision is determined by analyzing replicate samples. The significance of a precision measurement depends on whether the sample is a field replicate, lab replicate, or a matrix spike replicate. Field replicates are taken at the rate of 10% or one per batch (each daily shipment of samples from a site), whichever is greater. Precision of the analytical method, at each stage, is determined by calculation of a relative percent difference (RPD) between duplicate analytical recoveries of a sample component, relative to the average of those recoveries:

$$RPD = \frac{|C_2 - C_1|}{(C_2 + C_1)/2} \times 100\%$$

where C_1 = analyte concentration in the sample,
C_2 = analyte concentration in the sample replicate, and
$|\ |$ = an absolute value (It is customary to express RPD as a positive number).

These calculations are usually performed on MS/MSD samples. If sample volumes are not sufficient to conduct MS/MSDs, calculations will be performed on BS/BSD samples or LCS/LCSDs.

Precision will be further evaluated by comparing the analytical results of the field sample with its quality control duplicate sample. Multiplicative factors shall be used to determine the significance of differing concentration values. For water samples, should the field sample and its QC duplicate samples differ in value by greater than a factor of 2, minor disagreement between the values exists. If the values differ by a factor greater than 5, a major disagreement between the values exists. For soil and sediment samples, the factors shall be 5 and 10, respectively. In the special case where one or both sample results are less than 5 times the reported detection limit, a difference of ± 3 times the reported detection limit is used as the evaluation criteria.

Most importantly, data found in disagreement are examined to determine if the disagreement is an isolated occurrence or if any trends exist. Trends may indicate systematic errors made in sampling, handling, or analytical procedures or may also indicate the selection of an inappropriate protocol. If a trend exists, associated data are evaluated carefully to determine their validity. The significance, or impact, upon data quality will be discussed in the laboratory Data Validation Report as outlined in Section 6.3.

2.3 COMPLETENESS

The overall project completeness is a comparison between the total number of measurements made which are judged to be valid to the number of measurements planned. The results will be calculated following data validation and reduction. Completeness *C* is determined by:

$$C = \frac{P_1}{P_0} \times 100\%$$

where P_1 = number of valid measurements
P_0 = number of planned measurements

A value of 90% or higher is the goal. For values less than 90%, problems in the sampling or analytical procedures will be examined and possible solutions explored.

2.4 REPRESENTATIVENESS

Representativeness expresses the degree to which sample data accurately and precisely represent actual site conditions. The determination of the representativeness of the data will be performed by:

- Comparing actual sampling procedures and chain of custody forms to those described in the work plan,
- Identifying and eliminating nonrepresentative data in site characterization activities,
- Evaluating holding times and condition of samples on arrival at the laboratory,
- Examining blanks for cross contamination.

Representativeness is a qualitative determination. The representativeness objective of this work plan is to eliminate all nonrepresentative data.

2.5 COMPARABILITY

Comparability is a qualitative measure of the confidence with which one data set can be compared to another. These data sets include data generated by different laboratories performed under this work plan, data generated by laboratories in previous investigative phases, data generated by the same laboratory over a period of several years, or data obtained using differing sampling techniques or analytical protocols. The comparability objectives of this work plan are (1) to generate consistent data using standard test methods; and (2) to salvage as much previously generated data as possible. Comparability will be evaluated by comparing the QA sample analyzed by an independent laboratory to its field replicate. Multiplicative factors shall be used to determine the significance of differing concentration values. For water samples, should the field sample and its QA duplicate samples differ in value by greater than a factor of 2, minor disagreement between the values exists. If the values differ by a factor greater than 5, a major disagreement between the values exists. For soil and sediment samples, the factors shall be 5 and 10, respectively.

The USACE Tulsa District will prepare a USACE Chemical Quality Assurance Report (CQAR), which includes comparison of field/QA sample results. The USACE CQAR will be included as an Appendix to the final Data Validation Report.

2.6 SENSITIVITY

Sensitivity is a general term which refers to the calibration sensitivity and analytical sensitivity of a piece of equipment. Calibration sensitivity is the slope of the calibration curve evaluated in the concentration range of interest. Analytical sensitivity is the ratio of the calibration sensitivity to the standard deviation of the analytical signal at a given analyte concentration. The detection limit, which is based on the sensitivity of the analysis, is the smallest reported concentration in a sample within a specified level of confidence. Quantitation limits represent the sum of all of the uncertainties in the analytical procedure plus a safety factor. The detection limit is a part of the quantitation limit. Quantitation limits are given in Appendix B Tables B.3 to B.6.

2.7 FIELD MEASUREMENTS

Field measurements will be performed to Level I standards. These will include measurements of pH, temperature, conductance, and turbidity on groundwater samples. Precision on field measurements will be assessed by four replicate measurements to determine reproducibility. These consecutive readings should be ± 1°C for temperature, ± 0.2 units for pH, ± 10% for conductance, and ± 10% for turbidity.

SECTION 3.0 - FIELD OPERATIONS

This section provides an outline of field activities included in the Phase III RI and have been detailed in the Work Plan. Field activities include: surface and subsurface sampling of soils, sediment and surface water sampling, installation of piezimeters, monitoring wells and extraction wells, groundwater sampling, decontamination, waste disposal, other field procedures, and field QA/QC.

To further investigate potential contamination with volatile organic compounds (VOCs), high explosives, and metals, the Phase III RI/FS and Groundwater Treatability Study includes the following:

- Installation of six extraction wells
- Installation of twenty monitoring wells
- Installation of eight piezometers
- Collection of soil samples from four borings during the installation of monitoring wells
- Collection of five sediments and five surface water samples
- Collection of ten surface soil samples
- Collection of thirty-seven groundwater samples from the twenty-six newly installed wells and eleven existing wells
- Feasibility study data compilation

Each of these field activities is designed to obtain site-specific data to best characterize both the physical and chemical characteristics for Site 16. Sampling and analyses described in this plan of investigation will be performed in accordance with the procedures outlined in the Work Plan and Site Safety and Health Plan (SSHP).

3.1 COLLECTION OF SUBSURFACE SOIL SAMPLES

A total of sixteen soil samples will be collected from four soil borings during the installation of intermediate monitoring wells 16WW28, 16WW32, 16WW36, and 16WW38. The proposed locations of these intermediate monitoring wells are shown on Figure 3-1. Four soil samples will be collected from each boring at depth intervals of 0 - ½ ft, 1 - 3 ft, 5 - 7 ft, and 14 - 15 ft. These soil samples will be analyzed for VOCs, high explosives, metals, anions, pesticides, PCBs, and dioxins/furans. Soil samples will not be collected if the desired depth interval(s) are in or below a saturated zone.

3.2 COLLECTION OF SURFACE SOIL SAMPLES

Ten shallow soil samples will be collected from the proposed locations on Figure 3-1. Surface soil samples will be collected form a depth interval of 0 - ½ ft. These surface soil samples will be analyzed for VOCs, high explosives, metals, pesticides, PCBs, and dioxins/furans.

3.3 COLLECTION OF SEDIMENT AND SURFACE WATER SAMPLES

The investigations at Site 16 will include the collection of five sediment and five surface water samples to confirm previous sampling results at the site. The proposed locations are shown on Figure 3-1. These samples will be analyzed for VOCs, high explosives, metals, and anions.

3.4 COLLECTION OF GROUNDWATER SAMPLES

A total of thirty-seven groundwater samples will be collected form the twenty-six newly installed wells and from the eleven existing wells shown on Figure 3-1. All groundwater samples will be analyzed for VOCs, high explosives, metals, and anions. Additionally samples form 16WW16, 16EW01, and 16WW36 will be analyzed for pesticides, PCBs, and dioxins/furans.

3.5 FEASIBILITY STUDY DATA COMPILATION

An evaluation of the groundwater control system will be performed by the collection of groundwater level data on a weekly basis for a period of 12 months. A bi-weekly check of the extraction well system will also be performed during this 12 month evaluation. Groundwater samples will be collected and submitted for laboratory analysis form each of the eight extraction wells and 12 monitoring wells following 2½ and 5 months of system operation. Samples will be analyzed for VOCs and high explosives.

3.6 FIELD QUALITY ASSURANCE QUALITY CONTROL PROCEDURES

QA/QC samples for groundwater, surface soils, subsurface soils, sediments, and surface waters will be used to verify that the sampling and analytical techniques are being performed properly. QC samples are taken in the field and analyzed with the field samples by the same laboratory. QA samples are analyzed by SWD Lab to check the performance of the contract laboratory. QC samples required for soils and water sampling include travel blanks, equipment blanks, and replicates. QA samples also include replicates. QA/QC samples are described below.

Figure 3-1 Phase III Site Plan

3.6.1 Travel Blanks

Travel blanks consist of American Society of Testing Materials (ASTM) Type II reagent water sealed into a sample vial in the field. The blank is not opened again until it is received in the laboratory. One travel blank will be prepared for each shipment of water samples containing volatiles, all of which are shipped in the same cooler to the laboratory each day. Travel blanks measure cross contamination during shipment and contamination sources contacted during shipment. They are only analyzed for volatiles.

3.6.2 Equipment Blanks

Equipment blanks for water or soil samples will consist of ASTM Type II water which has been poured over or through non-dedicated sampling equipment such as augers, knives, spoons, or bailers. They will be shipped in the cooler with the associated samples from the site. Equipment blanks will be prepared and preserved in the same manner as a water sample. Equipment blanks measure the effectiveness of equipment decontamination. Equipment blanks are taken at a rate of one for every twenty samples and are analyzed for the same constituents as the associated soil or water samples.

3.6.3 Replicate Samples

Replicate samples or splits are extra samples as identical as possible to the original. They may consist of a composite or as a series of grab samples from the same source. Every tenth sample is taken in triplicate. One of each set of these replicates will be sent to SWD Lab as an audit sample

(QA sample) for the contract laboratory, and the other two samples will be sent to the contract analytical lab as a field sample and a QC sample, each with a unique sample number. In cases where only sufficient sample exists for a duplicate set, every fifth sample is a duplicate. This duplicate alternates as a QC and QA sample.

SECTION 4.0 - SAMPLE HANDLING AND TESTING

4.1 SAMPLE NUMBERING SYSTEM

Sample numbers are assigned by the project manager and are unique to each site. Sample numbers identify the site, well or boring, and type of blank or replicate. Sample numbers are assigned as follows:

LHss - xx - yy ( ) - bb [comments]

where:

LH = Longhorn Army Ammunition Plant
ss = Unit Site Number
xx = Sample Type
where:
- *WW* = Monitoring Well (Group 1, 2, & 5)
- *EW* = Extraction Well
- *SS* = Shallow/Surface Soil
- *SB* = Soil Boring
- SD = Sediment
- SW = Surface Water

yy = Location Number
( ) = Depth range of sample or matrix type
where:
- (*zz - zz*) = Depth range, in feet below ground surface
- (*Water*) = Water
- (*000.0*) = Depth of soil sample, the number assigned represents the upper-most depth of the particular sample depth interval

bb = QA/QC Modifier, when needed
where:
- *QA* = QA field replicate sample for USACE Laboratory analysis
- *QC* = QC field replicate of contract Laboratory analysis
- *TB* = Trip Blank
- *EB* = Equipment Rinsate

The sample designated for MS (matrix spike) and MSD (matrix spike duplicate) will be noted in the comment section of the chain-of-custody form.

As an example, a QA split from the 5 to 7 ft depth interval of the first soil boring at Site 16 would be LH16-SB-01(5-7)-QA. The modifications were made to the USACE numbering system so that the "ss-xx-yy" portion of the number can be used as location numbers for all sampling points in the text and the figures of the RI report. As an example, the third surface soil sample location at Site 16 would be labeled as 16-SS-03. This numbering scheme provides a number that not only gives the unit area and type of sample, but also provides a unique number from all other previous investigation sample numbers at LHAAP.

4.2 PREPARING SAMPLES

When samples are taken in the field, they will be preserved according to Appendix Table B.1. They will be then placed in a ice cooler in styrofoam inserts which have cutouts to accommodate the jars. The cooler will be filled with ice and the chain of custody form and field data form will be placed inside in a zip-lock plastic bag placed on top of the ice. The cooler will be filled with ice and the chain of custody form and field data form will be placed inside in a zip-lock plastic bag and taped to the under side of the cooler lid. The cooler will be wrapped with strapping tape, and a chain-of-custody seal is placed on the strapping. The samples will be then delivered to the shipper. Samples collected for chemical analysis will be shipped on the day they are sampled, if possible, but in no event kept onsite longer than 48 hours.

If samples are anticipated to arrive at SWD Lab on Friday or the weekend, SWD Lab will be contacted 7 days prior to shipment to ensure they will have personnel available to receive the sample shipments. SWD Lab's telephone number is (214) 905-9130. If the SWD lab will not have personnel available, samples will be held until delivery on Tuesday. Samples kept onsite will be stored in sealed coolers and will be chilled to 4 °C.

4.3 RECEIVING SAMPLES

After the ice coolers are received at the laboratory, the samples are logged in, the COC is signed, and a cooler receipt form is filled out. This form documents the condition of the samples as received. The samples are checked for breakage or leakage and the temperature of the ice bath is checked. If the temperature exceeds 4 °C or if any other problems are noted, this information is recorded on the COC and the District office is notified of the problem. Samples are repackaged and shipped to contract laboratories using similar procedures as described in Section 4.2.

4.4 LABORATORY PROCEDURES

Laboratory analytical procedures come from the following source: USEPA (SW 846 and EPA-600, Refs. 6 and 8), and Standard Methods (Ref. 1). Analytical methods from these sources are given in Appendix B Table B.1 and B.2. Quantitation limits are given in Appendix Tables B.3 through B.6. Quantitation limits, however, are dependent on the concentration of the components in the matrix to be analyzed.

SECTION 5.0 - SAMPLE INTEGRITY

The quality of analytical data is suspect if the integrity of the sample cannot be ensured. Integrity includes the procedures and written records which, when taken together, verify that the sample is as represented.

5.1 SECURITY

Security involves procedures which ensure sample integrity. Security is required until final disposal of the sample after laboratory analysis is complete. Aspects of sample security are discussed below.

5.1.1 Security of the Well and Samples in the Field

Each well will have a locking cap and keys will be given out only to those authorized to access the wells. Samples, once taken, will be in the possession of the sampling crew or secured in the field office. QA and QC samples will be taken, which, when analyzed, will also document the integrity of the sample.

Each member of the drilling/sampling crew will don a new pair of gloves before drilling/sampling each soil boring/sampling location. The person taking the samples will wear disposable plastic gloves and will change them between each sampling interval. Used gloves will be bagged and disposed of in a manner which meets RCRA guidelines, as discussed in the "Comprehensive Investigative Derived Waste Management Plan", June, 1996.

5.1.2 Security of the Sample in the Lab

Samples will be stored in a secure area in the laboratory with limited access to authorized laboratory personnel. Upon receipt of the ice cooler, laboratory personnel will check the temperature of the ice bath, the condition of the samples, and the accuracy of the accompanying paperwork.

5.2 CUSTODY

Custody consists of formal records which document integrity. These records are described below.

5.2.1 Chain of Custody Form

The chain of custody (COC) form is a record which describes the sample, the date, time, and method of sampling, and the analyses requested, with specific analyte and analytical method number included. The COC will also have the name and telephone number of the USACE Chem and IH point of contact, Ms. Yolane Hartsfield, (918) 669-7072. It has spaces for signatures of those receiving and relinquishing the samples. The form is normally signed by the individual preparing the samples for shipment and the receiving individual at the laboratory. The individual preparing the samples for shipment maintains a copy. The original COC is incorporated into the hard copy laboratory report, where it is placed on file. An example of this form is given in Appendix A.

5.2.2 Laboratory Traffic Report

Samples which are sent from SWD Lab to a contract lab are sent with this form. It is a laboratory COC form which gives the sampling date, the analyses to be performed and the date the results are needed. Because various fractions of the sample might be sent to several contract labs, the original COC cannot be used. The traffic reports are incorporated into the hard copy laboratory reports.

5.2.3 Bill of Lading

A bill of lading (bus bill or air bill) documents receipt of the samples by the carrier. It is not possible for the carrier's representative to sign the COC since it is sealed in the ice cooler. Bills of lading are maintained by Sverdrup and submitted to USACE Tulsa District with the laboratory data documentation.

5.2.4 Cooler Receipt Form

The cooler receipt form is completed by the laboratory and documents the condition of the samples as received by the lab. This form is available in the hard copy laboratory report.

5.3 SAMPLE TRACKING AND IDENTIFICATION

The following subsections outline the documentation, in addition to the items listed in Section 5.2, required to demonstrate sample integrity.

5.3.1 Field Log Book

The field log book is a bound record with consecutively numbered pages, kept by the drilling/sampling crew(s), in which sampling information is recorded with water-proof ink. It is taken to the sample sites to record necessary sampling data and other items of interest. The full name and corresponding initials of each field crew will also be recorded. It is used in the field to record preservation and preparation procedures for shipment. It is also used to record equipment calibration and decontamination of sampling equipment. The information for the COC and field data form comes from the field log book. The field log book is discussed in detail in section 5.5.1 of the Work Plan.

5.3.2 Field Data Form

Field data forms transmit necessary information about the sample to the lab. Field measurements such as pH, conductance, and water levels as well as problems with the location or the sample are noted on this form. Field data forms are taken for all sampling events. Blank field data forms are shown in Appendix A.

5.3.3 Sample Labels

Labels on each jar contain the well or boring number or surface sample location, the sample number, preservation (if any), the analysis to be performed, and the sampler's initials. Examples are provided in Appendix A.

SECTION 6.0 - DATA REDUCTION, VALIDATION, AND REPORTING

6.1 ANALYTICAL DATA

6.1.1 Field Data

Field data from the Site 16 investigation shall consist of data obtained from purged groundwater events. The field data collected will be composed of the following parameters: pH, conductivity, and temperature. The field data for the purge water collected prior to sampling of each well during purge events will be presented in the Remedial Investigation/Feasibility Study Report.

6.1.2 Laboratory Data

Laboratory data are produced at the contract laboratory, which generates a laboratory report containing the analytical data, field and quality control duplicate data comparisons, and lab quality control data. USACE Tulsa District performs a QA validation and generates a summary report, which is submitted to the project staff. Laboratory deliverables include the following:

a. Case narratives which discuss QC deficiencies and other problems encountered during analyses.

b. Results of field samples, laboratory blanks, surrogate spikes, surrogate recoveries, matrix spikes, laboratory control samples, laboratory duplicates, matrix spike duplicates, relative percent differences, field duplicates, and field blanks.

c. Sample identification numbers will be cross-referenced with laboratory ID's and QC sample numbers. Table(s) which cross reference field samples with associated method blanks, matrix spikes and matrix spike duplicate samples.

d. Legible copies of the fully executed chain-of-custody forms and cooler receipt forms on which the laboratory has documented the condition of the samples on arrival.

e. Each analyte will be reported as an actual value or less than a specified quantitation limit. Actual sample results, sample quantitation limits, and practical quantitation limits will be reported in tabular format. Data qualifiers will be used to address sample/analytical anomalies associated with an analyte.

f. Soil samples will be reported on a dry weight basis with moisture content. Dilution factors, extraction data, and analysis dates will also be reported.

Calibration and internal standards information, raw data (which includes equipment/analyst worksheets/logbooks, mass spectra, GC/MS tuning calibrations, chromatographs, sample extraction volumes, etc.), and all instrumentation graphs and traces will be available from the laboratory, if needed.

6.2 TECHNICAL DATA

Technical data refers to data of several types, such as groundwater flow calculations, stratigraphic maps generated from geologic and geophysical field data, isopleth profiles of contaminants, and groundwater models. Technical data will be reduced, validated, and reported by the project staff.

6.3 DATA VALIDATION REPORT

Validation procedures will follow appropriate Functional Guidelines for Data Validation (USACE, USEPA federal, or USEPA regional) based upon project objectives to accomplish this task. Data validation reports will address a detailed discussion of the DQOs (Section 2.0); accuracy, precision, completeness, and representativeness of each analysis. The following evaluation procedures will be included:

- Review of laboratory testing methods, detection limits, holding times, data qualifiers, etc.
- Review of data summaries and reports for transcriptional and typographical errors.
- Review to compare the data against the field and trip blanks to detect contamination from sampling.
- Review to compare field sampling duplicates.
- Review of laboratory QC including laboratory blanks, spike recovery, and duplicates.
- Review of chain-of-custody forms to evaluate sample receipt data, damaged sample containers, etc.
- Qualify unusable data as rejected and attach appropriate qualifiers to usable data.
- The report shall conclude whether or not the data is suitable for its intended purpose and meets the data quality objectives as specified in this SAP. Identification of specific data results which should be rejected or qualified as estimated will be

summarized in the report conclusion for each parameter.

- ASCII or DBASE format data files, submitted per Table B.7, "Guidance for Submittal of Data of Electronic Media for the USACE HTRW Project Database."

Data reports will be provided to USACE in permanently-bound volumes arranged by type of chemical parameter and sampling episode.

6.4 USACE CHEMICAL QUALITY ASSURANCE REPORT

The USACE CQAR, which will address comparability and contain the comparison of the field sample(s) and its (their) quality assurance duplicate sample(s), will also include a review of the contractor's report and a judgement as to the suitability of the data. This complete report shall constitute acceptance or rejection of the data.

SECTION 7.0 - AUDITS

Audits, which are QA procedures designed to meet the data quality objectives discussed in Section 3, are of two basic types as discussed below. Table 7.1 gives the audit elements for the LHAAP RI.

7.1 SYSTEMS AUDITS

A systems audit is a qualitative evaluation of all components of a project to determine if each component is properly performed. Systems audits are generally performed at the outset of investigations and periodically during the life of a project. Systems audits for office and field work will be performed by the USACE, and system audits for laboratory work will be performed by the HTRW-CX Lab. These audits consist primarily of site inspections.

7.2 PERFORMANCE AUDITS

Performance audits are quantitative evaluations of the components of a project. These consist of audit samples to be checked by HTRW-CX as a part of the laboratory validation process, QA replicates taken as a part of the sampling process and analyzed by SWD Lab, and laboratory QA procedures as specified by the analytical method.

TABLE 7.1 AUDIT ELEMENTS FOR LHAAP REMEDIAL INVESTIGATIONS

ELEMENT	BY / FREQUENCY
Laboratory site inspection	MRD Lab at laboratory selection and then every 18 months
Field inspections	USACE at least monthly at first less frequently thereafter
Technical data inspections	USACE as needed
Laboratory check samples	HTRW-CX Lab at laboratory selection and then every 18 months
Analysis of field replicates	SWD Lab every 10 samples
Lab QA summary report	SWD Lab one for each lab report

SECTION 8.0 - CORRECTIVE ACTION

8.1 FIELD ACTIVITIES

Field activities which are improper will be corrected as quickly as possible. The inspector or crew chief will be responsible to see that corrective action is initiated and documented whenever the error has the potential to compromise the quality of the data being generated or whenever there is a possibility that the error might be repeated.

8.2 FIELD DATA

Corrective action for poor field data quality (as determined by replicate measurements or prior expectation) consists of remeasurement until four successive readings agree within reasonable limits. Examples of frequently made measurements and limits to which they should agree include:

- pH - Measurements should agree within 0.2 pH unit.
- Conductance - Measurements should agree within 10 percent.
- Depth and water level measurements - Readings should agree within 0.01 ft.

If remeasurement is not successful, then instrument calibration and operation and the user's technique will be evaluated.

8.3 LABORATORY

Laboratory corrective action is described in the analytical method for that analysis.

8.4 IMPLEMENTING AND REPORTING

Corrective action should be initiated at the lowest level possible. Corrective action which involves correcting a mistake for little potential of repetition need not be reported as long as the error was not reported. For example, an erroneous water level measurement, such as 40 ft in a 30 ft well, would be corrected by making several additional readings which agreed with each other and looked reasonable. It would not be necessary to report this error.

Corrective action involving a potentially repetitive error or one which had been reported should be documented in writing. For example, an erroneous water level measurement due to a low battery in the water level indicator, should be documented because previous suspect water levels may need to be flagged and/or checked. The corrective action report would state the nature of the problem and the potential ramifications as well as what actions have been taken. In this case, the corrective action would be to replace the battery and check the last several days of readings taken using the indicator. This report will be sent to the project manager.

SECTION 9.0 - REFERENCES

1. U. S. Army Corps of Engineers, August 1989, "Minimum Chemistry Data Reporting Requirements for DERP and Superfund HTW Projects", CEMRD-ED-GC Memorandum.

2. U. S. Army Corps of Engineers, January 1990, "Chemical Data Quality Management for Hazardous Waste Remedial Activities", ER-1110-1-263.

3. U. S. Environmental Protection Agency, 1987, "Development of an RFI Work Plan and General Considerations for RCRA Facility Investigations", SW-87-001.

4. U. S. Environmental Protection Agency, September 1993, "Data Quality Objectives Process for Superfund", EPA540-R-93-071.

APPENDIX A
FORMS

C.O.C. ID: ____________

CHAIN OF CUSTODY RECO -- SVERDRUP ENVIRONMENTAL, Inc.

age: __ of __

Project #: ____________
Project Name: ____________
Location: ____________
Lab_ID/Lab: ____________
Lab Phone/Contact: ____________
Field Contact: ____________
Field Batch: ____________
Report Results to: ____________
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments:

						EPA METHOD and PREPARATION/EXTRACTION ID												
Sampler(s)	Matrix/ Type	Date	Time	**Sample-ID**	# of bottles													<--*Pres./Filt.* NOTES

Relinquished by:	**Date/Time**	**Received by:**	**Date/Time**	**Lab Instructions:**

021000

EAGLE PICHER
ENVIRONMENTAL SERVICES
36 B.J. TUNNELL BLVD. - MIAMI, OK 74354
1-800-331-7425

Specially Cleaned Sample Container

LOT #:

DATE: TIME: COLLECTED BY:

SAMPLING SITE:

SAMPLE TYPE:
☐ Grab ☐ Composite ☐ Other ____________________

TESTS REQUIRED:

PRESERVATIVE

CUSTODY SEAL

Person Collecting Sample ______________________________ Sample No.____________
(signature)

Date Collected ______________________________ Time Collected____________

CUSTODY SEALS

GROUNDWATER SAMPLING
FIELD DATA FORM

PROJECT NAME: DATE:

SAMPLING POINT: TIME:

SAMPLED BY: WEATHER:

TOP OF CASING ELEVATION: ____________ FEET

DEPTH TO STATIC WATER LEVEL: ____________ FEET

DEPTH TO WELL BOTTOM: ____________ FEET

HEIGHT OF WATER COLUMN, H = ____________ FEET

DIAMETER OF WELL CASING, D = ____________ FEET

VOLUME OF WATER COLUMN, $\pi X H X \frac{D^2}{4} X 7.48 =$ ____________ GALLONS

VOLUME OF WATER EVACUATED: ____________ ______ GALLONS

DID WELL READILY RECOVER? ____________ YES ____________ NO

METHOD OF EVACUATION: ____________

METHOD OF SAMPLING: ____________

SAMPLE TEMPERATURE: ________ °C ________ °F

SAMPLE pH: ____________

SAMPLE SPECIFIC CONDUCTANCE: ____________ umhos/cm

SAMPLE COLOR: ____________

SAMPLE TURBIDITY: ____________ HIGH

____________ MODERATE

____________ LOW

SAMPLE ODOR: ____________

OTHER OBSERVATIONS: ____________

ADDITIONAL COMMENTS ON METHODOLOGY, ETC.:

LONGHORN AAP
RINSATE WATER SAMPLES
PARAMETER SHEET
FY - 92

CONTAINERS		PARAMETERS	EPA METHOD	PRESERVATIVES
NO.	SIZE		NO./SHIP	
GLASS			{7}	
1	w/m jar	pH, Conductivity, & Temp. (4 sets)	*****	dispose
2	1 liter	Semi-Volatiles	8270	Brim full & 4°C
2	1 liter	Explosives	8330	Brim full & 4°C
2	1 liter	Herbicides, Pesticides & PCB's (2,4-D & 2,4,5-TP)	8150/8080	4°C
1	1 liter	Nitrate	353.1	4°C
PLASTIC			[1]	
1	1 liter	Total Metals (Ag, As, Ba, Cd, Cr, Hg, Ni, Pb, Sb, Se & Tl)	6010/7041/7060 7470/7740/7841	pH<2 w/HNO_3
VIALS			{3}	
3	40 ml vials	Volatile Organics	8240	4 drops HCl, n/a, n/b & 4°C

LH/RB/PAR/27JAN92

One rinsate sample should be taken for every (20) soil samples. The rinsate must be taken on the actual piece of equipment used to obtain the soil sample, (split spoon, auger, knife, etc.) and should have the same I.D. as the corresponding boring/depth number taken with that equipment.

APPENDIX B
ANALYTICAL TABLES

Table B.1
Test Method, Containers, Preservatives, and Holding Times for Water Samples

Parameter	EPA Method[1]	Required Containers[2]	Required Preservative	Maximum Holding Times (measured from sample collection)	
				To Extraction	To Analysis
VOCs	8260A[3]	2x40 ml VOA vial	cooled to 4°C, HCl, pH<2, 0.008% $Na_2S_2O_3$ if residual Cl is present	N/A	14 days
Pesticide/PCBs	8080A or 8081[4]	2x1L AG	cooled to 4°C	7 days	40 days
Metals[5] (except Hg)	6010A[5]	1L P,G	cooled to 4°C, HNO_3, pH<2	N/A	180 days
Hg	7470A	same container as Metals	cooled to 4°C, HNO_3, pH<2	N/A	28days
Explosives	8330	2x1L AG	cooled to 4°C	7 days	40 days
Dioxins/Furans	8290	2x1L AG	cooled to 4°C, 0.008% $Na_2S_2O_3$	7 days	40 days
Common Anions[6]	300.0[6]	1x1L P,G	cooled to 4°C	N/A	28 days
Nitrate/Nitrite	353.1	250 ml P,G	cooled to 4°C, H_2SO_4, pH<2	N/A	28 days

[1] USEPA SW-846 or USEPA 600/4-79-020 methods, most current version acceptable to USACE.

[2] All containers will have Teflon-lined caps or septa. G-glass; AG-Amber glass; P,G-HDPE or glass; B.R.-Boston round

[3] Samples are prepared using method 5030A.

[4] Samples are prepared using method 3150B or 3520B.

[5] Total Metals are prepared using method 3005A and analyzed using method 6010A except for Hg using 7470A. If PQL requirements for Cd, Sb, As, Se, Pb, or Tl cannot be met, they are determined using 7131A, 7041, 7060A, 7740A, 7421, & 7841 respectively.

[6] Common anions include: chloride & sulfate.

Table B.2
Test Methods, Containers, Preservatives, and Holding Times for Solid Samples

Parameter	EPA Method[1]	Required Containers[2]	Required Preservative	Maximum Holding Times (measured from sample collection)	
				To Extraction	To Analysis
VOCs	8260A[3]	2x4 oz G	cooled to 4°C no headspace	N/A	14 days
Pesticide/PCBs	8080A or 8081[4]	8 oz CWM	cooled to 4°C	14 days	40 days
Metals[5] (except Hg)	6010A[5]	8 oz CWM	cooled to 4°C	N/A	180 days
Hg	7471A	include w/ Metals container	cooled to 4°C	N/A	28 days
Explosives	8330	8 oz CWM	cooled to 4°C	14 days	40 days
Dioxins/Furans	8290	8 oz CWM	cooled to 4°C	14 days	40 days

(1) USEPA SW-846 or USEPA 600/4-79-020 methods, most current version acceptable to USACE.

(2) All containers will have Teflon-lines caps or septa. G-glass, CWM-clearwide mouth glass jars.

(3) Samples are prepared using method 5030A.

(4) Samples are prepared using method 3540B, 3541, or 3550A. Methods 3540B and 3541 are the preferred methods if complex sample matrices are anticipated.

(5) Total Metals are prepared using method 3050A and are analyzed using method 6010A except for Hg using 7471A. If PQL requirements for Cd, Sb, As, Se Pb, or Tl cannot be met, they are determined using 7131A, 7041, 7060A, 7740A, 7421, & 7841 respectively.

Table B.3
Recommended Quantitation Limits (PQL) for Volatile Organic Compounds in Soil and Water by Method 8260A

CONSTITUENT	MATRIX (WATER) (µg/l)	MATRIX (SOIL/SEDIMENT) (µg/kg)
acetone	5	20
acrolein	20	100
acrylonitrile	20	100
benzene	1	5
bromobenzene	1	5
bromochloromethane	1	5
bromodichloromethane	1	5
bromoform	1	5
bromomethane	2	10
2-butanone	5	20
n-butylbenzene	1	5
sec-butylbenzene	1	5
tert-butylbenzene	1	5
carbon disulfide	1	5
carbon tetrachloride	1	10
chlorobenzene	1	5
chlorodibromomethane	5	5
chloroethane	2	10
chloroform	1	5
chloromethane	2	10
2-chlorotoluene	1	5
4-chlorotoluene	1	5
dibromochloromethane	1	5
1,2-dibromo-3-chloropropane	4	10
1,2-dibromoethane	1	5
dibromomethane	2	10
1,2-dichlorobenzene	1	5
1,3-dichlorobenzene	1	5
1,4-dichlorobenzene	1	5
1,4-dichloro-2-butene	1	5
dichlorodifluoromethane	1	15
1,1-dichloroethane	1	5
1,2-dichloroethane	1	5
1,1-dichloroethene	1	5
cis-1,2-dichloroethene	1	5
trans-1,2-dichloroethene	1	5
1,2-dichloropropane	1	5
1,3-dichloropropane	1	5
2,2-dichloropropane	1	15
1,1-dichloropropene	1	5

Table B.3
Recommended Quantitation Limits (PQL) for Volatile Organic Compounds in Soil and Water by Method 8260A

CONSTITUENT	MATRIX (WATER) (µg/l)	MATRIX (SOIL/SEDIMENT) (µg/kg)
cis-1,3-dichloropropene	5	5
trans-1,3-dichloropropene	1	5
1,4-dioxane	200	1000
ethylbenzene	1	5
ethyl methacrylate	5	5
hexachlorobutadiene	1	5
2-hexanone	5	20
iodomethane	5	5
isobutyl alcohol	200	1000
isopropylbenzene	1	5
p-isopropyltoluene	1	5
methacrylonitrole	20	100
methylene chloride	1	5
methyl iodide	5	5
methyl methacrylate	5	50
4-methyl-2-pentanone	5	20
naphthalene	1	5
pentachloroethane	10	10
propionitrile	20	100
n-propylamine	1	5
n-propylbenzene	1	5
stryene	1	5
1,1,1,2-tetrachloroethane	1	5
1,1,2,2-tetrachloroethane	1	5
tetrachloroethene	1	5
toluene	1	5
1,2,3-trichlorobenzene	1	5
1,2,4-trichlorobenzene	1	5
1,1,1-trichloroethane	1	5
1,1,2-trichloroethane	1	5
trichloroethene	1	10
trichlorofluoromethane	2	10
1,2,3-trichloropropane	1	15
1,2,4-trimethylbenzene	1	5
1,3,5-trimethylbenzene	1	5
vinyl acetate	5	20
vinyl chloride	0.4	10
o-xylene	1	5
m-xylene*	1	5
p-xylene*	1	5

*These isomers cannont be separated by all laboratories utilizing this method.

Table B.4
Recommended Quantiation Limits (PQL) for Pesticide Analysis in Soil and Water by Method 8080

CONSTITUENT	MATRIX WATER (ug/l)	MATRIX SOIL/SEDIMENT (ug/kg)
aldrin	0.4	63
α-BHC	0.3	47
β-BHC	0.6	94
γ-BHC	0.9	142
δ-BHC	0.4	63
chlordane	0.5	221
4,4'-DDD	1.1	173
4,4'-DDE	0.4	63
4,4'-DDT	1.2	189
dieldrin	0.2	31
endosulfan I	1.4	221
endosulfan II	0.4	63
endosulfan sulfate	6.6	1040
endrin	0.4	95
endrin aldehyde	2.3	363
heptachlor	0.08	47
heptachlor epoxide	0.05	1310
methoxychlor	8	2840
toxaphene	0.6	3790
arochlor-1016	0.4	158
arochlor-1221	0.4	158
arochlor-1232	0.4	158
arochlor-1242	0.4	158
arochlor-1248	0.4	158
arochlor-1254	0.4	158
arochlor-1260	0.4	158

Table B.5
Recommended Quantitation Limits (PQL) for Explosives Analysis in Soil and Water by Method 8330

CONSTITUENT	MATRIX (WATER) (μg/l)	MATRIX (SOIL/SEDIMENT) (μg/kg)
2-Am-DNT	---	---
4-Am-DNT	---	---
1,3-DNB	0.25	250
2,4-DNT	0.55	250
2,6-DNT	0.45	260
HMX	0.50	2200
NB	0.80	260
2-NT	0.70	250
3-NT	0.50	250
4-NT	0.50	250
RDX	0.85	1000
Tetryl	0.70	650
1,3,5-TNB	0.55	250
2,4,6-TNT	0.55	250

Table B.6
Recommended Quantiation Limits (PQL) for other Analyses in Soil and Water

CONSTITUENT	MATRIX WATER (mg/l)	MATRIX SOIL/SEDIMENT (mg/kg)
Metals		
aluminum	0.200	20.0
antimony	0.004*	6.0
arsenic	0.010	1.0
barium	0.200	20.0
beryllium	0.0005*	0.5
cadmium	0.0008*	0.5
calcium	5.000	500.0
chromium	0.010	1.0
cobalt	0.050	5.0
copper	0.025	2.5
iron	0.100	10.0
lead	0.003	0.3
magnesium	5.000	500.0
manganese	0.015	1.5
mercury	0.0002	0.1
nickel	0.040	4.0
potassium	5.000	500.0
selenium	0.005	15.0
silver	0.010	1.0
sodium	5.000	500.0
strontium	0.050	10.0
thallium	0.0014*	1.0
vanadium	0.050	5.0
zinc	0.020	2.0
Common Anions		
chloride	2.0	---
nitrate	0.1	0.2
sulfate	2.0	---

* The laboratory will report down to the IDLs for antimony, beryllium, cadmium, and thallium since the PQLs were equal to the MCLs.

TABLE B-7

GUIDANCE FOR SUBMITTAL OF DATA ON ELECTRONIC MEDIA FOR THE TULSA DISTRICT HTRW PROJECT DATABASE

1. Required files, file formats, and data element descriptions are attached.

2. ASCII data may be submitted on 3.5" dos formatted diskettes or on 8mm tape using the UNIX TAR or CPIO utilities. Tape labels should include blocking factors and the UNIX command used to create the tape. If a compression utility is used, an executable of the utility should be provided.

2. All dates should be in the format YYMMDD. (920623 rather than 06/23/92).

3. The sample numbering system detailed in the work plan should be followed. As a minimum, all samples id's should contain at least three four character strings, with an additional two characters for qa and qc samples.

4. Data elements in each record may be separated by a ¦ or other special character. Padding data fields with blanks is neither required nor desired. Optionally, data may be submitted positionally. Positional data files must be acommpanied by a key indicating the beginning column for each data element.

6. All depth measurements should be expressed as positive numbers.

7. A diskette containing the following information is enclosed.

TULSADB.FIL	This document in WordPerfect 5.1 format
VALIDS.LST	A WP51 file containing a listing of the values contained in the List_Domain table of the Oracle database. The numbers in the left column equate to the numbers in the DOMAIN column of the wordperfect tables in this document.
ANALYTES	A WP51 file containing the CAS number and other accepted abbreviations. This is the information contained in the ANALYTE table of the Oracle database.

8. Point of Contact for electronic data submissions is Karla Fleming (918)-669-7157.

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
RESULTS TABLE	Analytical results for one or more analytes obtained from a single extraction and testing event. Each record provides the analytical results for a single analyte.		
analysis_method	Code identifying the analysis method used. This code, along with the lab_sample_id and run_number will link back to the appropriate test table record.	char 10	121200
result_flag	A coded value qualifying the analytical results field. Indicates whether the result was undetected, detected above or below the detection limit.	char 5	121700
detection_limit	Minimum detectable quantity of a parameter based on laboratory conditions, analytical method, or field conditions. This should account for any dilutions done on sample other than the normal dilutions called for in the analytical method.	numeric	
lab_sample_id	The sample id assigned by the performing laboratory, used with analysis method to link to cl_sample_id in the tests table.	char 20	
measured_value	Value for a given parameter (analytical result) reported in units consistent with the units of measurement code.	numeric	
review_qualifier	Coded values that are assigned during chemistry data validation (for example EPA qualifiers).	char 5	

value_cas	The Chemical Abstract Services identifier for the analyte being reported. A code from the Analyte Domain Table is used for physical properties and compounds that do not have assigned CAS numbers.	char 12	
value_uom	Units of measure used to report the measured value.	char 10	121600
qc_expected_result	The target value for a QC sample. Typically equal to the amount of standard spiked into the sample.	numeric	
run_number	Run number of the analysis if more than one run was made.	integer	
value_confidence	Confidence value associated with the reported measured value (eg: measured value plus or minus confidence interval).	integer	

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
SAMPLE TABLE	Information regarding a water, soil or environmental sampling event. Each record provides data about the sampling of one environmental medium at one sampling location.		
sample_id	PTXss-hhhh-xaaa-bb The sample numbering system detailed in the work plan should be followed. As a minimum, all samples id's should contain at least three four character strings, with an additional two characters for qa and qc samples.	char 20	
loc_code	Unique identification assigned to each sampling location. Usually this is the same as the hhhh portion of the sample id. Links the sample table to the Location table.	char 10	
sample_date	Date that a sample was collected, field test performed, or a quality control sample created. Format is YYMMDD.	YYMMDD	
top-depth	Distance in feet from the surface elevation to the top of the sample.	numeric	
bottom_depth	Lower depth in feet at which a soil sample is collected for analysis, relative to ground surface.	numeric	
field_lot_number	The lot number is used to group together all field samples associated with or judged against a particular set of QC samples. This field is combined with the sample date for lot correlation.	char 19	
matrix	A code indicating the media sampled.	char 3	120900

method	A code identifying the method used to collect a sample.	char 4	120800
qc_code	Identifies a QC sample type.	char 8	121000
sample_time	Time of day that a sample is collected, a field measurement is made or a quality control sample is created. Use 24 hour clock. Format is HHMMSS. Option field during testing of GIS. Will be a required field on future investigations.	HHMMSS	
collector	Name of the person who obtained the sample or created the quality control sample. Optional	char 24	
witness	Name of the person who witnessed the sampling or creation of the control sample. Optional.	char 24	
contractor	Identifier of the contractor performing the sampling event.	char 5	
remarks	Any remarks about the sample. Optional field	char 40	

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
TESTS TABLE	Information relating a single sampling event to one or more sample extraction and analysis events. Each record describes a single extraction and analysis event for one environmental sample at one location.		
analysis_date	Date than analysis was performed. Format is YYMMDD.	YYMMDD	
analysis_time	Time that analysis was performed. Use a 24 hour clock, no colons. HHMMSS . For initial submissions this field is not being required, however we expect to make it mandatory in the future.	HHMMSS	
analysis_method	A code representing the method used to analyze for a given analyte.	char 6	121200
basis	A code indicating whether test results are reported on a wet or dry basis.	char 1	121400
cl_sample_id	The sample id assigned by the laboratory performing the test. This field links to the lab_sample_id in the results table.	char 20	
dilution_factor	A number representing the adjustment of the sample concentration. A dilution factor of 1 indicates no adjustment.	numeric	
extract_date	Date extraction was performed. Format is YYMMDD.	YYMMDD	
extract_method	A code representing the method used to extract or prepare a sample for a particular analysis.	char 6	121300
extract_time	Time extraction was performed expressed as HHMMSS using a 24 hour clock.	HHMMSS	

lot_control	The batch designator of an autonomous group of environmental samples and associated quality control samples analyzed by a test. This is equivalent to the EPA SW-846 concept of "analytical batch".	char 10	
pl_sample_id	This field will be the same as the sample_id in the sample table if the laboratory received the sample from the field. If the sample was received from another laboratory, this field will contain the sample identification assigned by the sending laboratory. This field links the test table to the sample table.	char 20	
lab_code	A code identifying the analytical laboratory performing the analysis of a sample.	char 4	
run_number	Run number of the analysis. Not required if only one run is reported.	integer	

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
LOG_RUN	General information about a logging run which is a collection of data by a logging tool.		
inspector	Name of the inspector on the job.	char 5	
loc_code	The location code identifying the well	char 10	Location Table
log_equip	A code indicating the type of log.	char 7	122300
lrsequency	Number of the logging run in the sequence of runs.	integer	
reference	Name of the place where the geophysical log is stored.	char 24	
remarks	Any remarks regarding the logging run.	char 240	
run_date	Date on which the logging run was performed.	integer	YYMMDD
svc_company	Code for the company performing the logging operation.	char 5	Contractor Table
tool_type	The type of geophysical tool used.	char 7	122400
witness	Name of witness to the logging run.	char 24	

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
BOREHOLE	Information about a borehole. The borehole table acts as an adjunct to the location table and a prerequisite to any well information tables.		
const_method	A code identifying the method used to construct the borehole.	char 2	121800
depth	Total depth of the borehole.	numeric	
deviation_code	A code identifying the direction of the deviation.	char 4	123500
diameter	Diameter of the borehole expressed in inches.	numeric	
drill_company	A code identifying the contractor drilling the borehole.	char 5	Contractor Table
start_date	Drilling start date	YYMMDD	
end_date	Date drilling was completed.	YYMMDD	
Loc_code	A code identifying the surveyed location at which the borehole was drilled.	char 10	Location Table

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
LOCATION	Information defining the general area where samples are to be taken.		
class	A code describing the location such as CH for channel, SW for surface water, WL for well, BH for borehole etc.	char 2	123200
loc_code	The unique identifier assigned to a location where samples are taken.	char 10	Location Table
coord_uncertainty	Resolution of the coordinate	char 1	123400
descript	Any additional information to describe a sampling or measuring location in text format. Example: "Monitoring well 10 feet NE of building 624.	char 240	
establish_company	Code for the organization which establishes a sampling or measuring location. Typically the primary contractor.	char 5	Contractor Table
establish_date	The date construction of a sampling or measuring location was completed.	YYMMDD	
latitude	Latitude coordinate. Optional	numeric	
longitude	Longitude coordinate. Optional	numeric	
easting	Easting coordinate. SPCS 1983 Texas Central	numeric	
northing	Northing coordinate. SPCS 1983 Texas Central	numeric	
proximity	A code indicating whether the sampling location is on or off a military base. Not required for Pantex.	char 1	123300
scode	SWMU code associated with this location.	char 12	SWMU Table

surface_elevation	Elevation of ground surface for groundwater, soil or sediment sampling. Elevation of water surface for water sampling. Report in mean feet above sea level.	numeric	
survey_id	Survey license number.	Char 12	
survey method	A code indicating the method of survey used. Examples : survey, GPS, digitized, grid estimate.	char 4	124900

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_ANNULUS			
descript	Any comments or a description of the annulus interval.	char 10	
diameter	The diameter of the annulus expressed in inches.	numeric	
fill_volume	The volume of material used to fill the annulus interval expressed in cubic inches.	numeric	
loc_code	The code used to identify the location of the annulus interval. This code also serves as a key to the well_construction table.	char 10	Location Table
material	A code identifying the material used as fill in the annulus interval.	char 3	122000
top_depth	The depth in feet from the surface elevation.	numeric	

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_CASING	Information about the casing.		
inner_diameter	Inside diameter of the casing in inches.	numeric	
loc_code	The location identifier of the well being described. This value serves as a key to both the location and well_construction tables.	char 10	Location Table
material	A code indicating the type of casing material used.	char 15	123600
outer_diameter	Outside diameter of the casing in inches.	numeric	
segment_count	Number of casing segments. All segments must be of equal length.	integer	
segment_len	The length of the segments in feet.	numeric	
top_depth	The depth in feet from the surface elevation to the top of the casing.	numeric	

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_CENTRALIZERS			
depth	Depth in feet from the surface elevation to the well centralizers.	numeric	
loc_code	A code identifying the well location. Links this table to the Location table and the well construction table.	char 10	Location Table

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
TEST_PIT	Information about a test pit.		
loc_code	Identifies a surveyed location which can be associated to the test pit.	char 10	Location Table
tarea	Total calculated area of this test pit.	numeric	
tvol	Total estimated volume of test pit expressed in cubic yards.	integer	

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_CONSTRUCTION	General information about the construction of a well.		
completion_method	A code describing the method used to complete the well or the nature of the openings that allow water to enter the well.	char 2	120300
cover_type	A code for the type of cover placed on top of the well.	char 1	125500
geo_complete_zone	A code for the general hydrologic description of the well completion zone.	char 2	120400
loc_code	A code identifying the surveyed location of this well.	char 10	Location Table
number_posts	The number of protective posts placed on the pad at the top of the well.	integer	
pad_size	A description (eg. 5 X 4 feet) of the pad placed at the top of the well.	char 10	
pump_equip	A code identifying the type of pump used.	char 3	125600
remarks	Comments on the purpose of the well, construction of the well, or information identifying the geologic formation of the completion.	char 240	
riser_height	The height of the riser in feet above the top of the well.	numeric	
ss_aquifer	A code identifying the sole source aquifer in which the well was completed.	char 4	120500
sump_length	Length of the sump in feet.	numeric	
sump_material	A code for the sump material.	char 3	122200
well_type	A code describing the type of well (water supply, monitoring, etc.)	char 3	120200

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_SCREEN	Information about the well screen.		
diameter	Diameter of the screen in inches.	numeric	
loc_code	A code identifying the location of the well in which the screen is placed. This key serves as a key to the well_construction table.	char 10	Location Table
material	A code for the material used to make the screen.	char 6	121500
percent_open_area	Percent of screen that is open for flow.	numeric	
slot_size	Vertical size of the screen slot opening in inches	numeric	
stype	A code identifying the type of screen being used.	char 3	121900
top_depth	Depth in feet from the ground surface to the top of the screened interval.	numeric	
wslength	Length in feet of the screened interval.	numeric	

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_STATUS	This table is used to track the changes in the status of the well. Each record represents a change in the status of a well. The end date of a status is assumed to be the same as the start date of the subsequent status.		
comments	Historical information relating to the well changes.	char 240	
loc_code	The unique code assigned to identify the well.	char 10	Location Table
start_date	Date on which the specific changes to the well began.	YYMMDD	
wsstatus	Well status code	char 4	120200

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
CORE	Field and/or laboratory information associated with a core or sidewall sample.		
bottom_depth	The depth in feet from the location surface elevation to the bottom of the core.	numeric	
ctype	A code describing the type of core retried based on the standard core barrel sizes.	char 2	125200
diameter	Core diameter in units of inches.	numeric	
loc_code	The location code of the well.	char 10	Location Table
percent_recovered	Total length of core recovered in a core run divided by the total distance of the core run.	numeric	
rock_quality	The rock quality designation is obtained by counting the total number of core pieces greater than 4 inches in length divided by the total length of the core, in NX and larger sized cores.	numeric	
run_number	The number for the core run from which the sample was taken.	integer	
top_depth	The depth in feet from the location surface elevation to the top of the core.	numeric	

021031

Technical Review Committee Meeting
Longhorn Army Ammunition Plant
09 September 1997
Karnack, Texas

1. The following is a list of participants:

Ira Nathan, LHAAP
Rick Michaels, Caddo Lake Institute/NES
Diane Poteet, TNRCC
Loretta Turner, Tulsa District
Frank Meleton, EAO
Earney Funderburg, OHM
Ruth Culver, Uncertain Audubon Society
Dudley Beene, EAO
Oscar Linebaugh, EAO
Dwight Shellman, Caddo Lake Institute
Yolane Hartsfield, Tulsa District
David Tolbert, LHAAP
Chris Villarreal, EPA
A. G. Imhof
Vic Heister, Tulsa District
Glen Turney, OHM
Jeff Armstrong, AEC
Bob Speight, GCLA
Bryan C. Smith, Radian
Gilbert Baca, OHM
David Bockelmann, Sverdrup

2. The meeting was brought to order by Mr. Ira Nathan. General introductions were made and guests were recognized.

3. Mr. Tolbert called attention to the agenda with August's meeting minutes attached. The minutes were reviewed and accepted.

4. Mr. Tolbert reported that the draft MOA from the Texas Trustees was still under review by Army legal personnel.

5. Mr. Tolbert reported that one written comment on the Group 1 sites had been received.

6. Mr. Turney, OHM, reported that the geotextile liner on Landfill 12 was installed and that OHM was completing cover soil deployment. OHM is at work on the ditches and berms, expecting that work to take two weeks. Topsoil placement on the cap will follow. Currently OHM is on schedule to complete the capping of Landfill 12 (end of October).

7. Mr. Bockelmann, Sverdrup, gave a presentation on the proposed bioremediation treatability pilot study at Site 16 (see attached for overheads/maps). The four step study includes a groundwater analytical study, a bench scale study, a microcosm study, and a field scale pilot study. The presentation was well received, and there was general discussion with questions being addressed by Mr. Bockelmann, assisted by Mr. Tolbert and Mr. Armstrong.

8. There was a general discussion with respect to the Army conducting off-post

sampling. Ms. Culver, Mr. Michaels, and Mr. Shellman offered their perspectives and reasons supporting the proposed activity. Mr. Armstrong relayed to the members the process the Army must follow to secure permission from Army HQ to comply. No consensus was reached.

9. Ms. Hartsfield reviewed the executive summary. Information on each group of sites was given.

10. The next meeting is scheduled for 21 October 1997 in the TNRCC offices in Austin, Texas, beginning at 1000.

11. There being no further business, the meeting was adjourned.

Yolane Hartsfield
Project Manager

AGENDA
Monthly Manager's Meeting
Longhorn Army Ammunition Plant
09 September 1997
10:00 (1000 hours)

Welcome and Opening Remarks

Review of July Monthly Managers' Meeting Minutes

Executive Summary Review

Sverdrup's Presentation on Bioremediation at Site 16

Meeting Adjourned

Monthly Managers' Meeting
Longhorn Army Ammunition Plant
7 August 1997
Longhorn AAP, Karnack, Texas

1. The participants were:

James McPherson, LHAAP
Ira Nathan, LHAAP
David Tolbert, LHAAP
Diane Poteet, TNRCC
Chris Villarreal, EPA
Oscar Linebaugh, EAO
Steve Brunton, Sverdrup
Darrell Hudson, Caddo Lake Institute
Roy Darville, Caddo Lake Institute, ETBU
Bryan C. Smith, Radian
Alexandrine Randriamabefer, Caddo Lake Inst.
Sara Kneipp, Caddo Lake Institute
Loretta Turner, Tulsa District
Yolane Hartsfield, Tulsa District
Ruth Culver, Uncertain Audubon
Wilma Subra, Uncertain Audubon
Cyril Onewokae, IOC
H. L. "Bud" Jones, TNRCC
Dwight Shellman, Caddo Lake Inst.
Dudley Beene, EAO
Becky Gullette, Caddo Lake Institute
Tom Hardaway, Caddo Lake Institute
Dave Bockelmann, Sverdrup
Mike Buttrame, Caddo Lake Institute
Jeff Armstrong, AEC (teleconference)
Cliff Murray, Tulsa District

2. James McPherson opened the meeting, thanked all the participants for attending and welcomed the representatives from the Caddo Lake Institute.

3. The minutes of the previous meeting were reviewed and accepted.

4. Mr. Tolbert stated that the MOU/MOA with the Texas Trustees had been received and forwarded up the Army chain of command. James McPherson noted that he had responded to the Texas Trustees informing them that the documentation had been forwarded up the chain of command. He explained to them why the proposed meeting has been postponed. Mr. Onewokae stated that he had taken the Army lead with Army legal since Lonestar AAP is also a part of the Trustees' MOU/MOA scope.

5. At Site 16, Mr. Bockelmann reported that all the monitoring wells, extraction wells, and piezometers are installed and wells have been sampled. Results are pending. He stated that Sverdrup should be ready to start pumping within two weeks. Expected flow rate from the extraction wells has been revised downward from 10 gpm to 5.5-6 gpm (total system deliverability for this time of year).

6. Slurry water from BG No. 3 continues to be treated at the GWTP. Expect completion of slurry water treatment within 2 weeks. Radian proposed and the team agreed that it would be prudent to flush the plant with potable water after completion of slurry water treatment. Radian will run the plant for 2 8-hour tours using potable water prior to initiating treatment of groundwater.

7. The meeting was turned over to Ms. Hartsfield to review the Executive Summary.

8. Group 1 Sites. The public meeting for the Group 1 Sites was scheduled for the evening of 7 August to inform the public about the Army's "no further action" plan for the Group 1 Sites. We continue to maintain the schedule for submission of the ROD by 30 September 1997.

9. Group 2 Sites. Schedule of activities for the investigative effort at the Group 2 sites is forthcoming per Mr. Murray, technical manager. Mr. Tolbert noted that soil samples collected from Site 29 had been sent to WES for analysis and pilot study using worms to biodegrade residual explosive compounds in soil. The soil samples were analyzed and found to have explosive compounds concentrations lower than what would be required for the study. Since these samples were collected where historically the highest residual concentrations have been, the pilot study has been canceled.

10. Group 4 Sites. Still awaiting funding. It was noted that if funding is not received this FY, that the contract will be renegotiated and awarded in FY98. Sampling of Goose Prairie Creek in September will include additional samples keyed to ascertaining information about the source of compounds entering into the Creek. There was general discussion about potential sources, generally Group 4 sites with Site 29 from Group 2 included. It was agreed to let members from the Caddo Lake Institute observe the next sampling of Goose Prairie Creek.

11. Group 5 Sites. Sverdrup will incorporate final regulatory comments into document and submit Final SI Report which will be distributed among the LHAAP team.

12. Burning Grounds #3. It was noted that the LTTDs continue to treat source material at a rate of about 22 tph. Mr. Villarreal asked for a copy of the analyses from the testing of the excavation trench soils. Ms. Poteet also wants a copy. Radian to compile and submit through EAO and Tulsa District.

13. Landfill Caps. The capping of Landfills 12 and 16 continue on schedule.

14. Landfill 16. The remedial investigation effort at Landfill 16 continues. Ms. Poteet requested a copy of the final work plan documentation. Mr. Murray said same was forthcoming. Sampling at Harrison Bayou, Goose Prairie Creek, and the Perimeter wells is now scheduled for the first week in September.

15. DERA Sumps. It was noted that the TNRCC regulator has changed and that that has delayed receiving final approval from the TNRCC.

16. Ms. Culver again requested a copy of the DERPMIS. Mr. Tolbert explained that the regulators were still commenting about the status (RCRA vs. CERCLA) of some sites, and that funding has not been available to finalize the document.

17. Mr. Shellman stated that the Caddo Lake Institute has been engaged in sampling Caddo Lake for more than a year, doing mostly water quality parameters. He stated that the Institute wanted

to expand into testing for volatile organic compounds, semivolatile organic compounds, and metals. The Institute is designing protocols now for the lake, are surveying to locate wells around the lake, and will follow up with sampling and analyses. Mr. Shellman reported that the Institute had noted high coliform counts in surface water runoff into Goose Prairie Bayou. Mr. Onewokae asked for copies of the Caddo Lake Institute Protocols and their Sampling and Analysis Plan when it is completed. Mr. Shellman noted that the Institute was interested in joint efforts and offered their help in sample collection. Mr. Jones suggested that split sampling would help to ensure representative and valid results. There was general discussion about off-site sampling. Mr. Armstrong noted that the Army does not sample off-post without DOD and/or Army HQ written permission. Mr. McPherson stated that joint efforts may be possible but would need to work out details on sharing information on sampling protocols and results. Any cooperative efforts would include the TNRCC, EPA, and Texas Trustees.

18. Mr. Murray reported that the sampling data from the May sampling event has been validated.

19. Mr. McPherson responding to a query about excessed property and briefed the team on that on-going effort.

20. The next meeting is scheduled to be held 09 September 1997 at 1000 at LHAAP. There being no further business, the meeting was adjourned.

Yolane Hartsfield
Project Manager

LONGHORN ARMY AMMUNITION PLANT
IRP STATUS SUMMARY

As Of 02 September 1997

PROJECT NAME	PROJECT PHASE	PROJECT STATUS	NEXT MAJOR MILESTONE(S)
Group #1 (Sites 1, 11, XX, and 27)	Remedial Investigation/ Feasibility Study	Remedial Investigation with Risk Assessment Report is complete. RI/Risk Assessment finalized. Public meeting held 7 August at Karnack High School Cafeteria at 1900.	Prepare ROD and Responsiveness Summary. ROD is scheduled to be submitted for signatures 30 September 1997.
Group # 2 (Sites 12, 17, 18, 24, 29, and 32)	Remedial Investigation/ Feasibility Study	Contract awarded April 1997. Work underway on workplan documents.	Submission of contractor work schedule and draft work plan documentation.
Group # 4 Wastewater Sumps and Sites 50 and 60	Remedial Investigation/ Feasibility Study	Scope of work amended to include Sites 50 and 60. Contract negotiated 31 March 1997. Funding withdrawn 28 April 1997.	Anticipated 1st quarter FY98 award.
Group # 5 (Sites 52 and 63)	Site Investigation	-Have received Final Site Characterization Report. Copies circulated to team participants. Sites 52 and 63 site investigation conclusions and recommendations are no further action. -Sites 50 and 60 moved into Group 4 for further investigation as part of Group 4, Phase III, RI/FS effort.	Final Site Investigation Report from Sverdrup due 31 May 1997 received. Awaiting regulator concurrence on recommendations.
Burning Grounds #3 (Group # 2, Sites 18 and 24)	Interim Remedial Action	- Groundwater Treatment Plant is operational. Currently treating slurry water from ICT installation. - The Low Temperature Thermal Desorbers are operating and currently treating source excavation material. Have processed +22,000 cy soils. - Contract modification awarded July 1997.	-Completion of BG3 excavated soils' treatment.

LONGHORN ARMY AMMUNITION PLANT
IRP STATUS SUMMARY

As Of 02 September 1997

PROJECT NAME	PROJECT PHASE	PROJECT STATUS	NEXT MAJOR MILESTONE(S)
Landfill Caps (Group # 2, Sites 12 and 16)	Interim Remedial Action	Work on Landfill 12 Cap underway; completion date scheduled for 12/97. OHM continuing the maintenance and excavation of the borrow source for the coversoil at LF12. Radian continuing to place treated soil at LF16. Completion of Landfill 16 Cap scheduled for 10/98.	- Capping of both landfills scheduled to be complete in November 1998.
Landfill Site 16 Accelerated RI	RI/FS	- Quarterly sampling conducted in Harrison Bayou, Goose Prairie Creek, and the Perimeter wells underway. - Field work underway on RI/FS effort. Monitoring wells, extraction wells, and piezometers are installed and sampled.	- Field work completion by Sverdrup. - Installation of pipeline by Radian.
DERA SUMPS	Removal Action	- Sump contents have been removed and disposed per TNRCC approval. - Sump removal complete. Final report received 22 April 1997.	Awaiting regulatory approval of report.

SCHEDULED MEETINGS AND VISITS TO LHAAP		
Date / Time	**Purpose of Meeting / Visit**	**Location**
09 September 1997/1000	Technical Review Committee Meeting (Monthly Mgrs. Mtg. Immediately Following)	Karnack, Texas

01	Inert Burning Grounds	24	Washout &Unlined Evaporation Pond	60	Former Storage Buildings 411 & 714
11	Suspected TNT Burial Grounds at Ave P&Q	27	South Test Area	XX(54)	Ground Signal Test Area
12	Landfill 12	29	Former TNT Production Area	52	Magazine Area
16	Landfill 16	32	Former TNT Disposal Area	63	Burial Pits
17	Burning Ground 2/Flashing Area	35,46,47,48	Process Wastewater Sumps		
18	Burning Ground 3	50	Former Waste Disposal Facility		

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September 9, 1997

**HAND-DELIVERED
AT LONGHORN TRC MEETING**

Ms. Yolane Hartsfield
Chemistry & Industrial Hygiene
U.S. Army Corps of Engineers
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P.O. Box 61
Tulsa, OK 74121-0061

RE: Longhorn Sampling Observations 9/2/97

Dear Yolane:

I want to thank you and your Tulsa District colleagues for the very high level of cooperation I received during our observation of the sampling of surface waters and wells at Longhorn on September 2. I was accompanied by Rick Michaels of Network Environmental Services, a member of the TRC, and also Mark Taylor, an Environmental Engineer. Both are familiar with the sampling and management of sites like these. They share my appreciation for the way we were accommodated.

Andy Mattioda was both courteous and outgoing in providing explanations of all of the work that his team was doing. I felt that the adherence to quality control procedures was quite professional. All in all, I am very impressed with the people, professionalism and procedures being used by the Tulsa District for Longhorn sampling activities.

There are several other observations which I think should be brought to your attention, and I will take this opportunity to do so.

1. A number of the data loggers, which are supposed to develop storm event activated water sampling and capture, appeared to be inoperative. I did not make detailed notes at the time and may be able to provide more details shortly. However, my recollection was that the data logger at the first stream sampling site in Harrison Bayou had been inoperative for some time. If I recall correctly, the last event sampled was in early August. Since I have been in the Karnack area for the entire month of August, I was aware that there had been multiple significant rain events throughout that month that should have triggered runoff capture events, but those did not appear to have been recorded. Additionally, at the interior road on Starr Ranch, behind the HMX Facility, another data logger seemed to record that the last sampling event had occurred in early July. The same comment applies to this. It may be a good idea to determine whether this instrumentation is being paid for on a daily or monthly basis, since inoperability may affect fees being paid. Additionally, if my observations prove to be accurate, the expenditure of funds for this kind of

equipment is wasted if the equipment is not frequently checked to make sure it is continuously operational.

2. The silt fences at Burning Ground 16 appear to be down in many places. These fences parallel the recently constructed perimeter road. Large percentages of the screen material were either down on the ground, or buried by soil pushed off along the edge of the road, or otherwise rendered ineffective. Consequently, storm events are carrying siltation into the Harrison Bayou lease tract of the Caddo Lake Institute, and/or beyond the perimeter road drainage capture features. Since this is a significant toxic substance management site, containment of water and silt runoff is of special concern.

3. An intact alligator snapping turtle shell, skull, and neck components were picked up in the Harrison Bayou Riparian area, within 50+/- yards of Burning Ground 16. I assumed at the time that it had been picked up by members of the sampling party for testing. On reflection, I neglected to ask. Since the turtle remnants were rather large, they may have been picked up for personal artifact purposes. However, this event suggests that this sort of biological material should be routinely picked up and carefully cared for, to permit tissue material analysis wherever possible. In this case, the turtle was unquestionably an alligator snapping turtle (*Macroclemys temminckii*). The shell itself was approximately 15-18 inches long, 10-12 inches wide, and probably 6-8 inches from top to bottom. The skull was approximately 6 or more inches long (including the beak) and approximately 4 inches wide. (I did not measure these, so the measurements are visual estimates.) This would indicate an animal that might be 10 or more years old, since the species can live to 80+ years and grow to several hundred pounds. What was remarkable was that there was no gross evidence of trauma or other injury to these remnants. Since the shell and beak were found within 50 yards of an active toxic management site, this raises a possibility that the artifacts may bear useful information concerning uptake of contaminants.

I would appreciate it very much if we could discuss at an early date the fate of this particular animal remnant, whether it can be tested at this time and what procedures we should consider for carefully capturing and analyzing any future finds of this type.

4. While on the subject of turtles and other receptors of concern, I would like to request that reptiles and amphibians be included in the species which should be carefully monitored by field testing. I have enclosed a copy of a research proposal prepared by Donald R. Clark, of the Fish & Wildlife Service Office at Texas A&M. It was done in 1995. While it was addressed to the Army Corps of Engineers, Tulsa District, I do not know if it was ever submitted. We met with Dr. Clark and encouraged him to complete this research design, and also provided him with some of the information which he recited. Dr. Clark's paper identifies why that group of animals represents "sentinel species" for assessment of affects of toxic compounds on biota.

The Institute would like to coordinate the conduct of such a study by local scientists who participate in our programs. We believe that it would be possible to redesign the study to permit research of this type at substantially less than the budget provided by Dr. Clark. We feel that this will be possible if the research could be conducted by the Caddo Lake Institute's agency and academic researchers who have been active on Longhorn over the past several years. For example, there was a recent opportunity to conduct this type of sampling when Dr. Fleet and Dr. Rainwater (of

Steven F. Austin University) conducted significant live trapping and inventories of reptiles and amphibians at Longhorn over the last 2 years. Even so, Dr. Fleet has mud snake research scheduled for Longhorn which we hope to support. We believe it would be relatively easy to expand that work to include DNA sampling for the mud snakes, and perhaps other reptiles and amphibians captured in the process.

In particular, Longhorn represents a probable significant habitat for the alligator snapping turtle. That particular turtle is among the large turtles of the world, all of which are considered at significant risk. It is listed as an endangered species by the State of Texas. It is considered as a species of concern by the U.S. Fish & Wildlife Service, although the Service has deferred listing the species as a candidate under the Endangered Species Act on several occasions. Dr. Fleet, during prior research, captured one. The intact skull and shell which I described above was clearly a member of the species, since it bore the distinctive three ridges on its shell and had a massive beak. The Institute's 1995 Biological Inventory of Longhorn noted multiple sightings of this animal by qualified observers. It unquestionably thrives there, although its ecology is poorly understood.

5. The Institute started offsite sampling of Harrison Bayou on September 2. We will attempt to expand that activity, as well as nearby domestic well sampling, as we are able to free up funds for collecting supplies and lab services that meet your QAPP standards. Since it is likely that Longhorn contaminants found near the perimeters were not impeded by the legal property boundaries, and several verbal and written requests have been made for offsite sampling, we feel that the Army should either do so, or underwrite our costs to conduct initial community based sampling.

I hope that you will find our continued participation to have a constructive affect upon the risk management and remediation activities at Longhorn. I am particularly interested in learning more about this "arcane art". The materials which I have now received on the risk assessment only confirm the fact that local scientific study would not only improve the sophistication of local science educators and students, but would also permit them to have increasingly meaningful input to the management of this site.

Again, thank you very much for your open-handed accommodation of our observation activities. We intend to continue that partnership into the future.

Very truly yours,

Dwight K. Shellman, Jr., President
Caddo Lake Institute, Inc.
DKS:atv
enc.

cc: Dr. Carroll L. Cordes (w/ enc.)
Dr. Robert R. Fleet (w/ enc.)
James Neal (w/ enc.)
TRC Members

Research Proposal

To:
U.S. Army Corps of Engineers
Tulsa District

From:
Dr. Donald R. Clark, Jr., Leader Brazos Field Station
Southern Science Center
National Biological Service
c/o Department of Wildlife and Fisheries Sciences
Texas A&M University
College Station, Texas 77843
Phone 409-845-5784 Fax 409-845-5786

Study Title: Environmental Contaminants and Their Effects on Turtles at Caddo Lake, Texas

INTRODUCTION

Caddo Lake has been designated a "wetland of international importance" by the Ramsar Convention, a multi-national ecological agreement. It is one of only 13 such sites in the United States. In addition, Caddo Lake is rated the highest possible classification, Priority I, for a wetland by the U.S. Fish and Wildlife Service.

Recent contaminant sampling of sediments carried out at Caddo Lake in conjunction with a water project indicated elevated levels of lead, mercury, nickel, and zinc at some sites (U.S. Army Corps of Engineers 1994). In 1977 the Texas Water Quality Board reported finding polychlorinated biphenyls (PCBs) up to 115 parts per billion (ppb) in Caddo Lake sediments. In 1982, the Texas Department of Water Resources found 676 ppb PCBs in sediment from the upper portion of Caddo Lake. Also in 1982, the U.S. Army Corps of Engineers, Fort Worth District, found PCBs in sediments at four sampling sites with the highest concentration being 23 ppb in Goose Neck Bayou. In 1985 the Vicksburg District of the Corps found trace amounts of several TNT derivatives in surface waters of Caddo Lake. These findings for 1977 to 1985 are summarized in U.S. Army Corps of Engineers (1994). TNT was manufactured at the Longhorn Army Ammunition Plant (LHAAP) at Karnack, Texas, on the shore of Caddo Lake from 1942 to 1945. Drainage from that facility enters Caddo through Goose Prairie and Harrison Bayous. Chemical testing of soils and ground water at LHAAP in the late 1980s and early 1990s has shown levels of numerous toxic elements and chemicals at several sites high enough to be considered threats to the general environment (U.S. Army Corps of Engineers 1992). These include explosive compounds such as 2,4,6-TNT, 1,3,5-TNB, 2,4-DNT, 2,6-DNT and 1,3-DNB; elements such as barium, cadmium, chromium, lead, mercury, and nickel; and organic chemicals such as vinyl chloride, methylene chloride, trichloroethane, carbon tetrachloride, styrene and benzene. Fish were recently tested for mercury by the Texas State Health Department and found to contain up to 1.5 parts per million (ppm) (G. Heideman, Texas Department of Health, pers. comm). These results for mercury led to the issuance of a health advisory, presently in effect, against eating fish of certain species from Caddo Lake (Tolley 1995).

Possible effects of contaminants on populations of native wildlife species at Caddo Lake have not been investigated, even though knowledge of this kind may be essential to preserving this rich natural heritage. Caddo Lake is widely appreciated and highly valued as an ecologically unique recreational area (Bigony 1994).

OBJECTIVES

This research will (1) measure toxic heavy metals, PCBs, and chlorinated hydrocarbon insecticide residues in turtle populations at Caddo Lake, (2) test for possible genetic damage, (3) determine whether contamination is causing endocrine disruption of reproductive hormones, and (4) evaluate all findings by comparisons with scientific literature to interpret the status of the aquatic turtle community of Caddo Lake.

JUSTIFICATION

Turtles often have been used to assess and monitor chemical contaminants in the environment (Meyers-Schone and Walton 1994). Aquatic turtles are especially attractive for this purpose at Caddo Lake because they are abundant, both in species, and in numbers of individuals. This abundance makes them ecological important because their involvement in the transfer of energy and nutrients in food chains is large scale. Their attractiveness is enhanced by their long life spans and relatively high positions in food chains which help assure exposure to and allow accumulation of chemical contaminants. Because aquatic turtles both produce cleidoic eggs and are hatched, live, and die all within small geographic areas their usefulness in assessing chemical contamination is enhanced. Cleidoic eggs may be usefully sampled if the contaminants under study are lipophylic, and limited geographic movement assures that chemical contamination is representative of the local environment where the turtle is collected. The scientific literature concerning turtles and environmental contaminants is extensive (see review by Meyers-Schone and Walton 1994). Thus freshwater turtles in Caddo Lake constitute excellent receptors of concern (ROCs) in ecological risk assessment terminology.

By selecting three particular species--slider (*Trachemys scripta*), common snapping turtle (*Chelydra serpentina*), and alligator snapping turtle (*Macroclemys temminckii*)--we will take full advantage of turtles' useful characteristics. The slider is the most abundant turtle at Caddo. It eats entirely animal foods when small but adds plant materials to the diet as it gets older. The common snapper is more carnivorous and longer lived than the slider, hence greater mercury concentrations were found in the snapper where the two species occurred together (Meyers-Schone et al. 1993). The slider and common snapper are the two species that have been most often sampled for contaminants (Meyers-Schone and Walton 1994). Because the alligator snapper is more carnivorous, eating mostly fish, and longer lived than the common snapper, we expect to find higher concentrations of bioaccumulative contaminants in it. In addition, the alligator snapper is considered a threatened species by the state of Texas (Texas Parks and Wildlife Department Rules §65.171-65.177), and it has never been sampled for environmental contaminants.

Because turtles serve as sentinel species, this study will greatly augment what is known of the contaminant status of Caddo Lake wildlife, particularly for those forms that feed on fish and other aquatic life. However, there should be concern for these turtle species themselves, because such long-lived species are severely constrained in their ability to respond to chronic disturbances that cause slight increases in mortality (Congdon et al. 1994), and negative impacts of environmental contaminants clearly can constitute such a disturbance. Populations of such species under such conditions may disappear within the span of a single decade. Cagle and Chaney (1950) found that alligator snappers constituted about 4% of the turtles they trapped in 1947. Our study will provide new data on the relative abundance of this important species.

The endocrine disrupting effects on wildlife of numerous environmental contaminants have recently been much publicized (e.g. see Raloff 1994). The list of materials that have such effects include several chlorinated hydrocarbon insecticides, PCBs, octachlorostyrene, synthetic pyrethroids, triazine herbicides, EBDC fungicides, dioxins, furans, metals such as cadmium, lead and mercury, alkyl phenols, and styrene dimers and trimers (Colborn and Clement 1992). We know some of these materials are found in Caddo Lake. In addition the effects of explosives residues, although unknown in this regard, need also to be considered. The best known recent case of reproductive endocrine disruption involved numerous harmful effects in a Florida population of alligators, *Alligator mississippiensis*

(Guillette et al. 1994). It has also been shown in laboratory studies that PCBs applied to shells of incubating eggs can reverse the sex of slider embryos (Bergeron et al. 1994).

Flow cytometry has been used to demonstrate DNA effects related to petrochemical and radioactive pollutants (Bickham 1990). Because numerous other environmental contaminants are known to be mutagenic (e.g. mercury), the application of this technique to samples from Caddo may reveal impacts that we would not otherwise discover.

METHODS

Collecting. Turtles will be collected using baited hoop net traps. Baits will be contained so that trapped turtles may not feed on them. Trapping sites will be located where contamination has been reported and will include LHAAP drainage areas and sites where PCBs and mercury have been reported. Turtles will be sampled from four ecologically similar sites--three contaminated and one that is thought to be relatively uncontaminated. Equivalent trapping effort (i.e. trap-days/site) will be invested at all sites so that species, sex and age composition, and capture rates of samples can be related to contaminant differences. Any sliders or common snappers observed nesting will be allowed to finish then collected for blood sampling. A single egg will be removed from the nest for chemical analysis. We will not otherwise actively search for clutches of eggs. Five blood and 5 egg sample analyses will be allotted for this aspect.

During two consecutive annual sampling seasons (1996-1997), we will attempt to get blood samples from 10 adult turtles (5 female, 5 male) of each species at each site. Because we are unlikely to capture 10 alligator snapping turtles even at a single site much less at all four sites, a total sample of 100 from all turtles trapped is estimated for this proposal. Each "site" will include enough area, perhaps 10 hectares, to allow relocating of traps numerous times. Of these approximately 100 sampled turtles, all will be analyzed for genetic damage and for reproductive hormone ratios, but turtles analyzed for chlorinated hydrocarbons and metals will be limited to 5 per species per site, or 60 total. These samples will be limited to males--if sufficient blood can be obtained from the relatively small male sliders--because males have higher concentrations of bioaccumulative chemicals than females, probably because males do not shed residues by laying eggs (Meyers-Schone and Walton 1994, p. 113). This amount of residue sampling should provide the necessary backup for interpreting effects that are seen as well as providing a basic understanding of contamination levels while minimizing the cost of the study.

A permit to take blood samples from the threatened alligator snapper will be obtained from the State of Texas.

Processing. Turtles will be identified to species and sex. Carapace length will be measured, and each turtle will be weighed and marked by notching of a marginal scute with a triangular file. Marking is necessary to assure each turtle will be counted and blood sampled only once. After being bled, turtles will be released where they were caught.

Turtles will be sampled primarily by analysis of blood because it is non-lethal. Blood samples will be taken from the caudal vein of common and alligator snapping turtles and from leg veins and neck blood sinuses of sliders. Blood samples will be taken only from adult common snappers and sliders but from all alligator snappers regardless of age. Blood samples will not exceed 1% of the turtle's total weight. If analyses of first-year blood samples indicate high contaminant concentrations at a particular site(s), then 3 turtles (sliders or common snappers only) will be collected from that site(s) and fat samples analyzed for comparison with literature values. Eighteen sample analyses will be allotted for this aspect.

Female sliders will be considered adult if plastron length is at least 174 mm and males will be considered adult with plastrons of 90 mm or more (Webb 1961). Female common snappers will be considered adult with plastrons of 145 mm, males 149 mm (Christiansen and Burken 1979). Female alligator snappers will be adult with plastrons of 262 mm (carapace 330 mm), males 282 mm (carapace 370 mm) (Dobie 1971).

Blood volume requirements for analysis are 1 to 1.5 ml for metals, 1 to 1.5 ml for chlorinated hydrocarbons (includes PCBs), 5 to 7 drops for flow cytometry, and 2 ml for sex hormones. The portion of the blood sample to be analyzed for hormones will be centrifuged immediately after collection in heparinized vials and the serum saved for analysis. Samples will be stored at -40°C until analyzed.

Analyses for Genetic Damage and Hormone Levels. Analysis for estrogens and androgens will follow the procedures of L. J. Guillette and A. Crain (pers. comm.) of the University of Florida, Department of Zoology. Flow-cytometry procedures will follow Bickham et al. (1988).

Flow-cytometry measurements will be done under the direction of Dr. Bickham. Hormone measurements will be under the direction of Dr. Owens. These researchers have years of experience in these areas and both have extensive experience with turtles. Trapping of and blood sampling of turtles, and interpretation of metal and chlorinated hydrocarbon analytical data are areas in which Dr. Clark is experienced.

Contaminant Analyses. Analyses of samples for metals and chlorinated hydrocarbons will be performed by the GERG (Geochemical and

Environmental Research Group) of Texas A&M University with quality control and quality assurance by the Patuxent Analytical Control Facility of the National Biological Service, Laurel, Maryland.

Statistical Analyses. Standard analysis of variance procedures will be used to compare chemical analytical results, genetic damage index data, and hormone data among species and sites and between sexes.

Cooperation with Ongoing Faunal Survey. We intend to work with researchers from Stephen F. Austin State University. They may be able to provide assistance with trapping and processing of turtles and we can provide data concerning the turtle community for their survey.

Work Schedule. Fall and winter 1995-1996 will be used to assemble needed equipment and the collecting permit, visit Caddo Lake and locate trapping sites, and become familiar with the ongoing field work of cooperators. Turtles will be trapped at all four sites continuously for approximately 2 weeks in May or June 1996. If this is not sufficient time to achieve the required samples, additional sampling will be done in May or June 1997. Otherwise, trapping in spring of 1997 will be limited to obtaining turtles for fat samples for chemical analysis. If other sampling extends to the second year, some of the money for analyses will have to be shifted to that year.

PRODUCTS

The U.S. Army Corps of Engineers will obtain thorough and accurate information concerning the contaminant status of these receptors of concern. The U.S. Army, Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, and the Nature Conservancy will receive scientifically accurate information concerning the contaminant status of the wildlife of Caddo Lake. This information will be useful in the conservation and management of these native species. Results will be published in peer-reviewed journals as one or more scientific papers. Periodic progress reports will be submitted as requested.

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BUDGET

	FY 96	FY 97
Travel (PI) 3 trips to Caddo/year	150	150
Scientific meeting		1,500
Per diem (PI) 21 days/yr	1,617	1,617
Equipment		
Calipers (1 at 95 cm)	145	
(1 at 50 cm)	105	
Hoop Traps (3 ft diameter,		
2" mesh nylon)		
16 traps $43 each	688	
Scales (Pesola)		
3kg x 50g $45.75 (2)	92	
35kg x 1kg $58.50 (2)	117	
Triangular files (3)	30	
Blood sampling		
Syringes with needles (400)	103	
Centrifuge vials (300)	84	
Supercold freezer (3.1 cu.ft.)	3,457	
Sample analyses		
Blood		
Organics and metals		
65 at $584 each	37,960	
Flow-cytometry		
105 at $40 each	4,200	
Hormone analysis		
105 at $10 each	1,050	
Eggs		
Organics and metals		
5 at $584 each	2,920	
Fat		
Organics and metals		
6 turtles/3 sites		
or 18 samples		
at $584 each		10,512
Totals	$52,718	$13,779
Overall total	$66,497	
Overhead (19% NBS, 15% SSC)	$22,609	
Grand total	$89,106	

PRINCIPAL INVESTIGATOR:

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DEPARTMENT OF THE ARMY
LONGHORN/LOUISIANA ARMY AMMUNITION PLANTS
MARSHALL, TEXAS 75671-1059

REPLY TO
ATTENTION OF

September 24, 1997

021051

SIOLH-CR

Ms. Diane Poteet
Superfund Investigation Section
Texas Natural Resource Conservation Commission
Post Office Box 13087
Austin, TX 78711-3087

SUBJECT: Concurrence with Proposed No Further Action on Sites 52 and 63, Group 5 Sites, Longhorn Army Ammunition Plant, Karnack, Texas

A site investigation activity for the Group 5 Sites (Sites 50, 52, 60, and 63) at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas, was conducted from October 9 to 18, 1995, November 29, 1995, and February 19 to 20, 1996.

At Site 50, Sump Water Storage Tank, sediment samples were found to contain two volatile organic compounds, cis-1,2-dichloroethene and trichloroethene. Surface soil samples were found to contain trichloroethene, and four semivolatile organic compounds, benzoic acid, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, and di-n-butylphthalate. Subsurface soil samples were found to contain five volatile organic compounds, 1,2,3-trichlorobenzene, cis-1,2-dichloroethene, n-butylbenzene, naphthalene, and trichloroethene, and four semivolatile organic compounds, benzoic acid, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, and di-n-butylphthalate.

At Site 60, Former Storage Buildings 411 and 714, surface soil samples were found to contain three pesticides, 4,4'-DDE, 4,4'-DDT, and dieldrin, and one herbicide, 2-(2,4,5-trichlorophenoxy)propionic acid (silvex). Subsurface soil samples from Site 60 were found to contain three pesticides, aldrin, dieldrin, and endosulfan sulfate.

At Site 52, Magazine Area Washout, surface soil samples were found to contain the volatile organic compound acetone. The presence of acetone in only one sample and at a concentration value of 15ug/kg is considered to be attributable to laboratory contamination. Subsurface soil samples were found to contain two volatile organic compounds, p-isopropyltoluene (16 ug/kg) and acetone, and two semivolatile organic compounds, bis(2-ethylhexyl)phthalate and butylbenzylphthalate. Again, the appearance of acetone in only one sample and at a concentration of 20 ug/kg, is considered to be attributable to laboratory contamination. The occurrence of p-isopropyltoluene in only one sample and at a concentration of 16 ug/kg led to the consideration that the detection was not representative of site conditions. The presence of bis(2-ethylhexyl)phthalate and butylbenzylphthalate, which are commonly used plasticizers that can be found in laboratory equipment, coupled with the ranges of concentrations detected, led to the conclusion that their presence was attributable to laboratory contamination.

At Site 63, Former Burial Pits, acetone was detected in one surface soil sample at 31 ug/kg, and subsequently determined to be considered laboratory contamination. Naphthalene was detected in one surface soil sample at a concentration of 6 ug/kg and subsequently determined to be considered non-representative of site conditions. Bis(2-ethylhexyl)phthalate was detected in nine of the 15 soils samples at concentrations ranging from 206-890 ug/kg. These values were subsequently determined to be considered laboratory contamination.

As a result of evaluating the Site Investigation, Longhorn moved Sites 50 and 60 from the Group 5 Sites into Group 4 Sites for further investigation (now scheduled for FY98). The investigation at Sites 52 and 63 leads to the conclusion that no discernible concentrations of chemical compounds reflecting a release into the environment is present at these two sites. Therefore, Longhorn Army Ammunition Plant respectfully requests the Texas Natural Resource Conservation Commission concur with the determination to conduct no further action at Sites 52 and 63.

Sincerely,

James McPherson

James McPherson
Commander's Representative

Enclosure

Concur: ______________________________
Texas Natural Resource Conservation
Comission

Date: ______________________________

Barry R. McBee, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
John M. Baker, *Commissioner*
Dan Pearson, *Executive Director*

021465

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

September 30, 1997

Mr. Myron O. Knudson, P.E., Director
Superfund Division
U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue
Dallas, TX 75202-2733

RE: Record of Decision for Areas Referred to as the Group 1 Sites
Within the Longhorn Army Ammunition Plant

Dear Mr. Knudson:

We have reviewed the proposed Record of Decision (ROD) for No Further Action at the Group 1 Sites within the Longhorn Army Ammunition Plant (LHAAP). We concur that the remedy described in the September 1997 ROD is the most appropriate for these sites.

Based on previous studies and surveys, no remedial action is warranted to protect human health and the environment at LHAAP Group 1 Sites. This decision complies with Federal and State applicable or relevant and appropriate requirements and is cost effective.

Sincerely,

Dan Pearson
Executive Director

DP/dp

P.O. Box 13087 • Austin, Texas 78711-3087 • 512/239-1000