LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

ADMINISTRATIVE RECORD

VOLUME 5 of 13

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Prepared for:

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Marshall, Texas 75671-1059

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1994

A. **Title:** Final Workplan - Phase II A-E Field Workplan For Remedial Investigation (RI)
Group(s): 1
Site(s): LHAAP-1 Inert Burning Ground
LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
LHAAP-27 South Test Area
LHAAP-54 Or LHAAP-XX Ground Signal Test Area
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Company: Sverdrup Environmental, Inc.
Author(s): Sverdrup Environmental, Inc.
Recipient: U.S. Corps Of Engineers, Tulsa District
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B. **Title:** Final Workplan - Phase II A-E Site Safety & Health Plan For The Remedial Investigation (RI)
Group(s): 1
Site(s): LHAAP-1 Inert Burning Ground
LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
LHAAP-27 South Test Area
LHAAP-54 or LHAAP-XX Ground Signal Test Area
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Company: Sverdrup Environmental, Inc.
Author(s): Sverdrup Environmental, Inc.
Recipient: U.S. Corps Of Engineers, Tulsa District
Date: August, 1994
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C. **Title:** Final Workplan - Phase II A-E Chemical Data Acquisition Plan For Remedial Investigation (RI)
Group(s): 1
Site(s): LHAAP-1 Inert Burning Grounds
LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
LHAAP-27 South Test Area
LHAAP-54 Or LHAAP - XX Ground Signal Test Area
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Company: Sverdrup Environmental, Inc.
Author(s): Sverdrup Environmental, Inc.
Recipient: Longhorn Army Ammunition Plant, Karnack, Texas
Date: August, 1994
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FINAL

A-E
FIELD WORK PLAN

for the

PHASE II
REMEDIAL INVESTIGATION
SITES 11, 1, XX, 27

at

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Submitted to:

U.S. ARMY CORPS OF ENGINEERS
Tulsa District

AUGUST 1994

Prepared by:

SVERDRUP ENVIRONMENTAL, INC.
ST. LOUIS, MISSOURI

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LIST OF ACRONYMS/ABBREVIATIONS

CDAP	Chemical Data Acquisition Plan
COE	U.S. Army Corps of Engineers
IDW	Investigation Derived Waste
INF	Intermediate-Range Nuclear Forces
LHAAP	Longhorn Army Ammunition Plant
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetetranitramine
RI/FS	Remedial Investigation/Feasibility Study
SvE	Sverdrup Environmental, Inc.
SWMU	Solid Waste Management Unit
TNT	Trinitrotoluene
USACE	U.S. Army Corps of Engineers
UXO	Unexploded Ordnance

1.0 INTRODUCTION

The purpose of this A-E Field Work Plan is to present the rationale and step-by-step plan of action for each field activity included in the Phase II Remedial Investigation (RI) for the Group No.1 sites at the Longhorn Army Ammunition Plant (LHAAP). This plan presents the number and qualifications of field crews, the type of equipment needed to complement the field crews, and a work schedule that coordinates and efficiently completes the RI tasks within the allotted 35 calendar days.

This A-E Field Work Plan has been written as a supplement to the LHAAP RI/FS Work Plan prepared by the U.S. Army Corps of Engineers (USACE) in June 1992 and the Field Work Plan Addendum prepared by Sverdrup Environmental, Inc. (SvE) in August 1994. As such, it does not repeat the rationale for determining the number and type of sampling locations. Please refer to those documents for this information.

2.0 SUMMARY OF WORK

This A-E Field Work Plan includes the Remedial Investigation of four (4) sites, listed as follows:

LHAAP Unit No. 11*:	Suspected TNT Burial Site at Avenues P and Q
LHAAP Unit No. 1:	Inert Burning Grounds
LHAAP Unit No. XX:	Ground Signal Test Area
LHAAP Unit No. 27:	South Test Area

An "*" denotes a SWMU listed in the RCRA Permit as requiring corrective action. The site locations within LHAAP are shown on Figure 2-1.

This section presents a brief description of the work to be performed at each LHAAP unit during the Phase 2 field investigation. A summary of the nature and extent of contamination and the field work to be performed at each site during the Phase II remedial investigation is presented in the Field Work Plan Addendum, Section 3 and 4 (Sverdrup, 1994).

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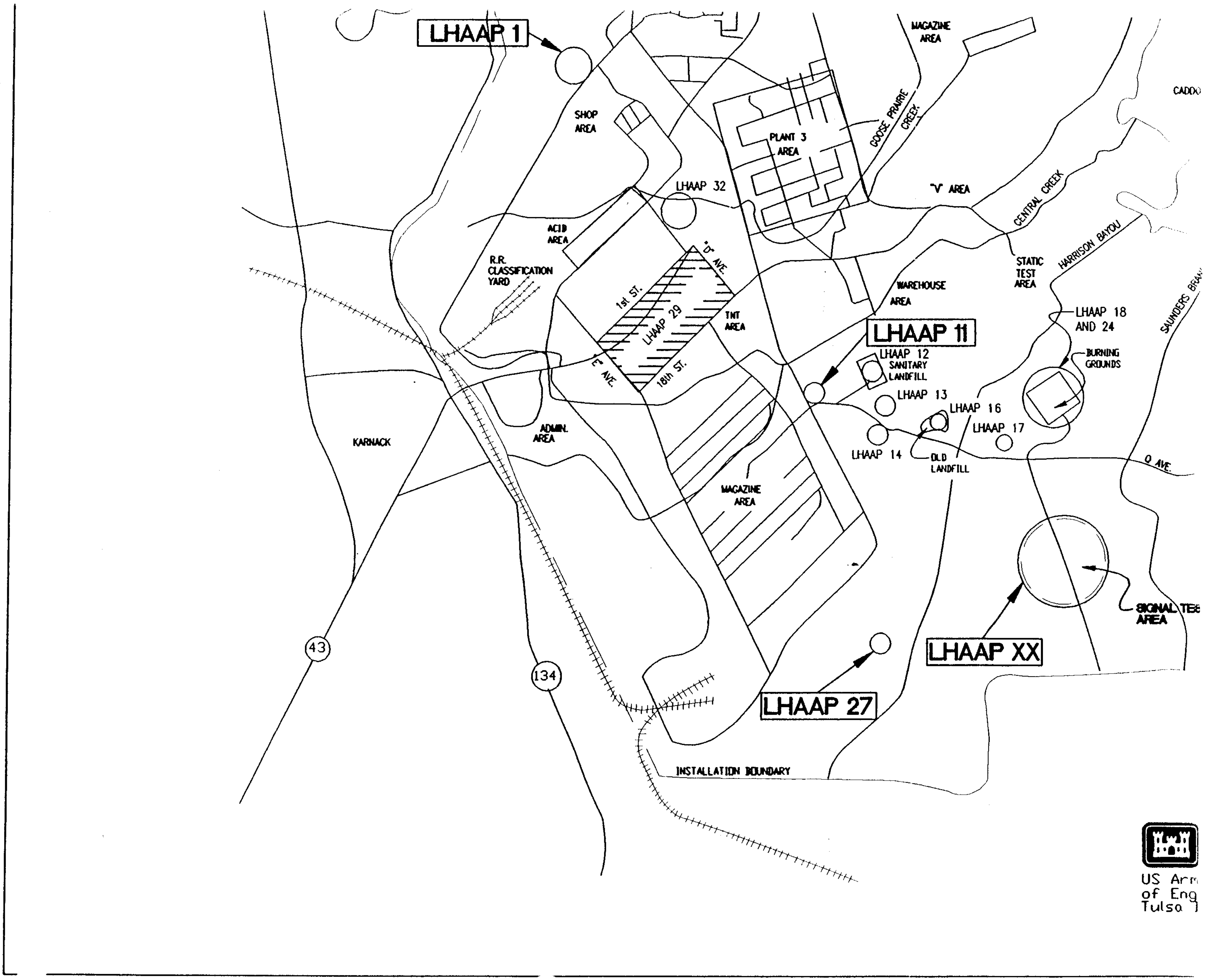

LHAAP 1
SHOP AREA
PLANT 3 AREA
GOOSE PRAIRIE CREEK
MAGAZINE AREA
CADDO
LHAAP 32
"V" AREA
CENTRAL CREEK
ACID AREA
R.R. CLASSIFICATION YARD
"D" AVE.
1st ST.
LHAAP 29
TNT AREA
18th ST.
"E" AVE.
STATIC TEST AREA
HARRISON BAYOU
WAREHOUSE AREA
LHAAP 11
LHAAP 12 SANITARY LANDFILL
LHAAP 13
LHAAP 16
LHAAP 17
LHAAP 14
OLD LANDFILL
LHAAP 18 AND 24
BURNING GROUNDS
Q AVE.
KARNACK
ADMIN. AREA
MAGAZINE AREA
43
134
LHAAP 27
LHAAP XX
INSTALLATION BOUNDARY
US Arm
of Eng
Tulsa

2.1 LHAAP 11: Suspected TNT Burial Site at Avenues P and Q

LHAAP 11 is an undocumented location where bulk TNT may have been buried in the 1940s. The Phase 2 field investigation is designed to further evaluate the potential for groundwater contamination with explosives compounds in the vicinity of boring 11-SB-04. The field work will involve the installation of three (3) monitoring wells. Soil and groundwater samples will be collected at each well using the procedures outlined in the A-E Chemical Data Acquisition Plan (CDAP, Sverdrup, 1994).

2.2 LHAAP 1: Inert Burning Grounds

LHAAP 1 was originally used during World War II for burning trash, ashes, scrap lumber, and waste from burned TNT. Bulk TNT may also have been burned at the site. During the 1950s other wastes including photoflash powder were burned, and intermittent, small-scale burning operations may have continued into the 1960s.

The Phase 2 field investigation is designed to further evaluate the potential for groundwater contamination with explosives compounds in the southern portion of the site. The field work will involve the installation of one (1) monitoring well, sampling of existing well 01MW04, and the collection of three (3) sediment and five (5) surface (0 to 0.5 ft) soil samples. The samples will be collected using the procedures outlined in the A-E CDAP.

2.3 LHAAP XX: Ground Signal Test Area

LHAAP XX is currently used for aerial and on-ground testing of various pyrotechnic, illuminant, and signal devices manufactured at LHAAP. From 1988 to 1992 the site was also used for the burn-out of rocket motors form the Pershing missiles destroyed in accordance with the INF Treaty. Over the past thirty years the site has been used for the testing and destruction of a variety of devices, including red phosphorous smoke wedges, infrared flares, illuminating mortar shells, and button bombs.

The Phase 2 field investigation is designed to further investigate the potential for soil and groundwater contamination with acetone and other volatile organic compounds in the vicinity of XX-SB-19. The field work involves a 6 to 26 point soil-gas survey within a 20-ft sampling grid. If no contamination is indicated, one 10-ft soil boring will be installed. If contamination is indicated for the soil boring or the soil-gas survey, one monitoring well will be installed at the location of greatest observed contamination. The samples will be collected using the procedures outlined in the A-E CDAP.

2.4 LHAAP 27: South Test Area

LHAAP 27 was used in the 1950s for testing photoflash bombs and demilitarizing signal devices and photoflash cartridges. The Phase 2 field investigation is designed to further investigate the potential for groundwater contamination with explosives compounds in the vicinity of boring 27-SB-33. The field investigation involves the installation of four (4) monitoring wells and the collection of three (3) surface (0 to 0.5-ft) soil samples. The samples will be collected using the procedures outlined in the CDAP.

3.0 FIELD WORK TEAMS

In order to complete the work within the allotted 35 calendar days, SvE will mobilize two 2-person teams to the site, one drilling inspection team and one sample coordination/management team. Subcontracted services will consist of one 2-person UXO (unexploded ordnance) team; one 2-person team for location surveying; one 3-person team (includes analytical chemist) for soil-gas surveying; and one 3-person team for soil borings, monitoring well installation and development, and equipment decontamination.

The drilling inspection team will consist of one geologist and one sampling technician who will also serve as the Site Safety Officer. The drilling inspection team will coordinate UXO and underground utilities clearance, inspect soil borings and collect soil samples, inspect monitoring well installation and development, and manage staging of investigation derived waste (IDW).

The sample coordination/management team will consist of one site manager and one sample coordinator. The sample coordinator will ensure sample quality and timely sample delivery to the analytical laboratories, and will conduct and coordinate sampling of sediment, surface soils, and monitoring wells. The site manager will manage the overall field effort and provide the single point of contact for COE and LHAAP personnel. The site manager will also supervise subcontractors for location surveying and soil-gas surveying, join with the sample coordinator to sample sediment, surface soils, and monitoring wells, and conduct slug permeability testing on the newly installed monitoring wells.

The UXO team will consist of one UXO Supervisor and one UXO Specialist, and will locate and clear access to new locations for soil borings, monitoring well installations, and sediment and surface soil sampling. UXB International, headquartered in Chantilly, Virginia, will provide UXO and surveying services under subcontract to SvE.

The drilling team will consist of an equipment operator and two laborers. One laborer will be dedicated to drilling and well installation, the other to equipment decontamination and well development. Alliance Environmental, Inc. of Houston, Texas, will provide drilling, well installation, and well development services under subcontract to SvE.

The soil-gas survey crew will consist of an equipment operator, a laborer and an analytical chemist. GEO Environmental, Inc. of St. Louis, Missouri will provide soil-gas surveying under subcontract to SvE.

4.0 FIELD EQUIPMENT

4.1 UXO Clearance

The UXO Team will provide geophysical, excavation and sampling equipment necessary to clear locations for the presence of ammunition, pyrotechnics, or explosive concentrations of TNT and RDX. The UXO Team will provide surveying services to locate sampling locations, and clear access to these locations, including the surface area of the 26-point soil gas survey grid at LHAAP XX. In addition to a surface magnetometer sweep, the team will conduct a hand auger boring at each new soil boring, soil gas survey boring, and monitoring well location. The hand auger boring will extend to a depth of five feet, with soil samples taken at 2.5 foot intervals and screened in the field for TNT/RDX. A new location is defined as being situated more than 50 ft horizontal distance from any previously cleared location.

Proposed geophysical equipment include White's Eagle II metal detectors, Forester Ferex ordnance locators, and Schonstedt Model GA-52B magnetometers. Excavation equipment includes stainless steel hand augers and shovels. Support equipment includes a four-wheel drive vehicle, radio communicators, and mobile phones.

4.2 Soil Boring and Well Installation

One drill rig will be mobilized to the site to perform the soil borings and install the monitoring wells. The rig will be mounted on a four- or six-wheel drive truck or an all-terrain-vehicle. The drilling subcontractor will provide an appropriate support vehicle for the drill, a steam cleaner, and materials and miscellaneous equipment storage trailer.

The drill will have a spindle horsepower of at least 80 horsepower, an automatic drill rod and casing holder device, and a main hoist rated at least 5000 lb. Hollow-stem augers with an inside diameter (I.D.) of 3.25 to 4.25 inches will be used to drill soil borings and sample using the 2.0-inch and 3.0-inch outside diameter (O.D.) split-barrel soil sampler. Hollow-stem augers with inside diameter of 6.25 to 8.25 inches will be used to drill and install nominal 4-inch diameter monitoring wells.

Sampling tools will include new, standard steel 2.0-inch and 3.0-inch split-barrel samplers.

4.3 Soil Gas Survey

The soil gas survey will be performed using a Geoprobe™ sampling system to hydraulically drive a sampling probe into the ground to a depth of approximately 5 ft. A 500 μl vapor sample is drawn to the surface, a personal sampling pump is attached to a glass sampling bulb, and a sample is collected. The samples are then analyzed in the field using a gas chromatograph with an electron capture detector (ECD). Samples will be analyzed for acetone.

4.4 Monitoring Well Development, Sampling, and Slug Testing

Well development will be performed by the drilling subcontractor under the direction of SvE's management crew. Well development will be performed using electric submersible pumps, hand pumps, and bailers without the use of drill rigs and other heavy equipment. Monitoring wells may be developed as soon as 48 hours after installation.

Purging and sampling of wells will be performed no sooner than 48 hours after development of each well. Purging will be performed with a nominal 3.5-inch diameter PVC bailer or decontaminated electric, submersible pump. Purging of all wells will continue until at least five casing volumes are removed and the field parameters of pH, temperature, and conductivity are stable. After purging is satisfactorily completed, the wells will be sampled with a stainless steel bailer.

Slug tests will be conducted on each well installed during this field investigation. These tests will be performed after development but prior to purging and sampling of each well. The slug tests require the use of a PVC slug (a PVC pipe filled with sand and sealed at the top and bottom), a transducer secured within the well, and a datalogger to monitor changes of the potentiometric surface.

4.5 Decontamination Facilities

A decontamination facility will be constructed to collect spent decontamination fluids and contain them in closed-top drums. The facility will be capable of supporting drill rigs and support vehicles, and will contain racks or sawhorses to suspend augers, drill rods, monitoring well casing and screen, samplers, pumps, bailers, hand augers, tools, etc.

The facility will be lined to collect spent fluids into a sump, the contents of which will be regularly pumped into closed-top drums staged nearby on pallets. The liner will be constructed of plastic sheeting with a cumulative thickness of at least 20 mils. The liner will be protected from damage by tires with plywood boards or other means. A perimeter berm will be constructed to contain and collect fluids to the sump.

4.6 Field Office

A field office trailer will be mobilized to the site, and will be located next to the existing COE field office. This location is in the central portion of LHAAP, and offers ready access to water, sewers, electricity, telephone, and garbage disposal. Portable toilets and telephone will be contracted by Sverdrup; LHAAP will provide all other utilities.

5.0 FIELD WORK SCHEDULE

Figure 5-1 presents the Phase II Remedial Investigation Field Work Schedule using a start date of August 16, 1994 (assumed date of work plan approval by the COE Contracting Officer). The schedule lists the RI field work in a logical order of completion of the required tasks. The schedule breaks the work into two tours: one to perform the soil gas survey, perform soil borings, and install and develop the monitoring wells; and the second to sample monitoring wells and conduct slug permeability testing. One day was allotted for rain delays, and a 14-day rest period is included between monitoring well development and sampling. The schedule completes the field work within the allotted 35 days.

Mobilization includes an orientation meeting between the site manager and LHAAP personnel, an initial site health and safety meeting with all Sverdrup and subcontractor field personnel, underground utilities clearance, and setup of the field office trailer.

The UXO team will first coordinate with the site manager and the surveyors to stake out and clear all sampling locations, and then proceed with hand auger borings of new boring locations.

UXO clearance activities, and soil borings and monitoring well installation work, will begin at LHAAP XX and LHAAP 27, in order to reduce any interruptions in the field work while deciding where to install the fourth, downgradient monitoring well at LHAAP 27, and the optional well at LHAAP XX. The work will then proceed to LHAAP 11, and finish at LHAAP 1.

Sediment and surface soil sampling will be conducted concurrently with soil borings and monitoring well installations. Monitoring well development will be performed as soon as possible after completion of well installation; however, a minimum rest period of 48 hours is required.

The drilling subcontractor will demobilize at the end of the first tour, along with Sverdrup's drilling inspection team. Driller demobilization will consist of removing the decontamination facility, labeling and staging of IDW at the LHAAP storage facility located in the Plant 3 area; and removal of all equipment and supplies. Each drum will be labeled as to material type (soil, water, PPE), source location (site name, boring/well number), and accumulation start date. IDW will be stored on pallets and covered with canvas tarps at LHAAP Unit 16. The IDW management plan, presented in the CDAP Addendum (Sverdrup, 1994), will be implemented.

The sample coordinator and site manager will return to LHAAP for the second tour of work, to conduct monitoring well sampling and slug permeability testing. The office trailer will be removed and all utilities and services disconnected at the end of this second tour.

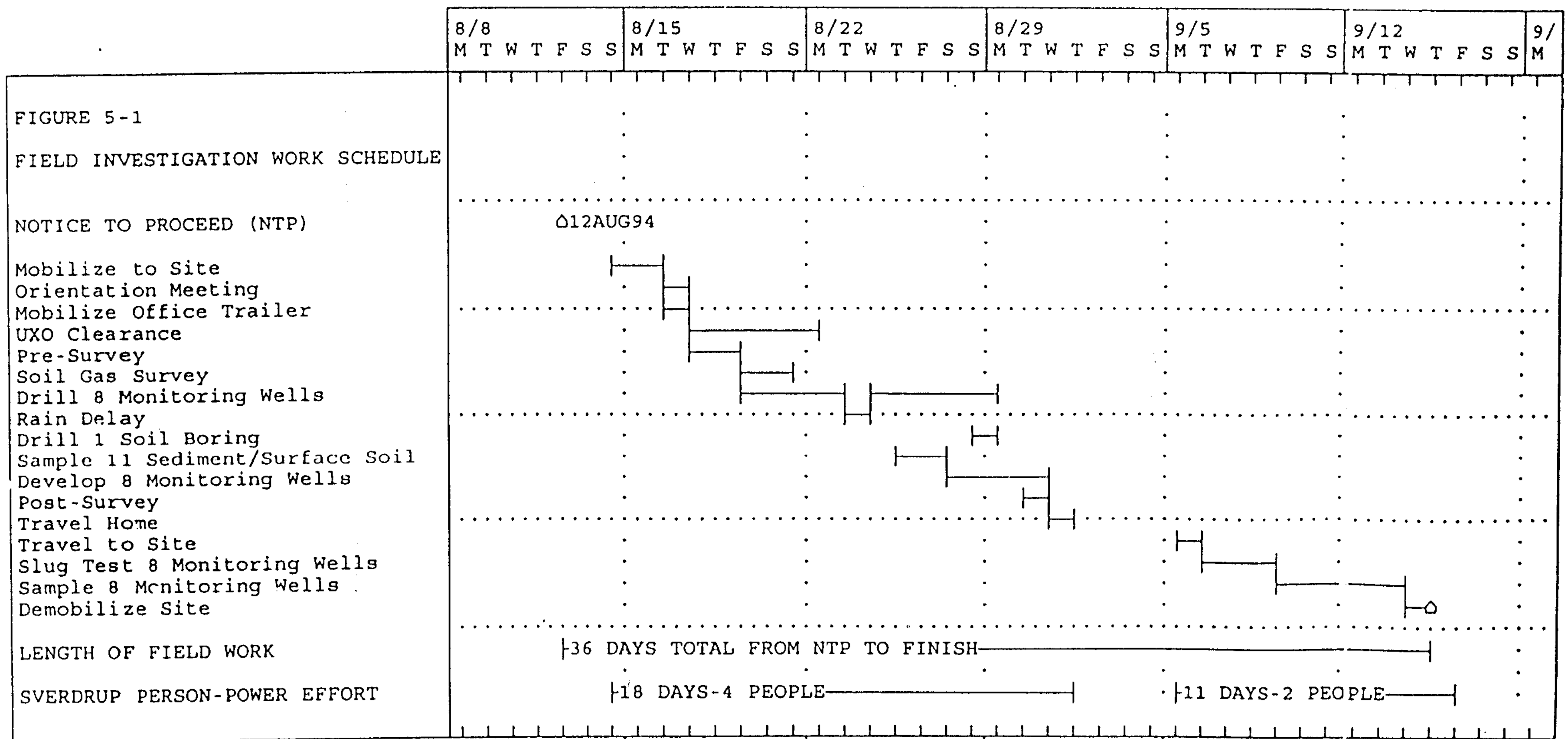
FIGURE 5-1
FIELD INVESTIGATION WORK SCHEDULE
8/8 M T W T F S S
8/15 M T W T F S S
8/22 M T W T F S S
8/29 M T W T F S S
9/5 M T W T F S S
9/12 M T W T F S S
9/ M
NOTICE TO PROCEED (NTP)
12AUG94
Mobilize to Site
Orientation Meeting
Mobilize Office Trailer
UXO Clearance
Pre-Survey
Soil Gas Survey
Drill 8 Monitoring Wells
Rain Delay
Drill 1 Soil Boring
Sample 11 Sediment/Surface Soil
Develop 8 Monitoring Wells
Post-Survey
Travel Home
Travel to Site
Slug Test 8 Monitoring Wells
Sample 8 Monitoring Wells
Demobilize Site
LENGTH OF FIELD WORK
36 DAYS TOTAL FROM NTP TO FINISH
SVERDRUP PERSON-POWER EFFORT
18 DAYS-4 PEOPLE
11 DAYS-2 PEOPLE

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FINAL

A-E
SITE SAFETY AND HEALTH PLAN

for the

PHASE II
REMEDIAL INVESTIGATION
SITES 11, 1, XX, 27

at

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Submitted to:

U.S. ARMY CORPS OF ENGINEERS
Tulsa District

AUGUST 1994

Prepared by:

SVERDRUP ENVIRONMENTAL, INC.
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1.0 INTRODUCTION

This A-E Site Safety and Health Plan (A-E SSHP) addresses Phase II Remedial Investigation field activities for the Group No. 1 sites at Longhorn Army Ammunition Plant, Karnack, Texas.

1.1 SCOPE AND APPLICABILITY

The purpose of this A-E SSHP is to identify, evaluate and control health and safety hazards, and provide for emergency response for hazardous waste operations at Longhorn Army Ammunition Plant Site during Phase II RI field activities. This plan applies to all Sverdrup employees and their subcontractors.

This health and safety plan covers the following site activities:

- Mobilization
- UXO Clearance
  - stake and clear new borings
  - escort for sediment sampling
- Sediment Sampling
  - stake and clear sampling locations
  - sample sediment

- Soil Borings
  drill and sample soil borings

- Monitoring Wells
  soil sampling
  install 4" monitoring wells
  complete surface casing/posts/pad

- Well Development
  bail or B-K hand pump
  stabilized pH, conductivity, temperature

- Groundwater Sampling
  purge and sample
  new wells

- Slug Tests
  datalogger/pressure transducer
  sand filled PVC slug
  decon and reuse
  rising head only

- Drum Staging
  stage in a central storage area within the present plant production area
  label, place on pallets, and log location in storage area

- Demobilization

All personnel on-site shall be informed of the site emergency response procedures and any potential fire, explosion, health, or safety hazards of the operation. This A-E SSHP summarizes those hazards and defines protective measures planned for the site.

This plan must be reviewed by all personnel prior to working at the site.

The A-E SSHP guidelines and requirements are based upon field activities during 1994 and are subject to revision upon subsequent discoveries regarding potential hazards at the site. All field work will be performed to comply with the Williams-Steiger Occupational Safety and Health Act parts 1910 and 1926.

1.2 VISITORS

All Sverdrup visitors entering the site will be required to read and verify compliance with the provisions of this A-E SSHP. Visitors will be expected to comply with relevant OSHA regulations and to provide their own protective equipment. Personal protective equipment, excluding respirators and foot protection, will be provided to government inspectors by Sverdrup.

In the event that a visitor does not adhere to the provisions of the A-E SSHP, he/she will be requested to leave the work area. All nonconformance incidents will be recorded in the site log.

1.3 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

1.3.1 Site Location and Description

Location: Longhorn Army Ammunition Plant (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 Highway 43 and 134 access the installation.

Boundary Features: Longhorn Army Ammunition Plant is bounded to the north and east by Caddo Lake, a large fresh water lake lying on the Texas-Louisiana state line. The eastern fence of the installation is 3-1/2 miles from the state border. The small incorporated city of Uncertain and the non-incorporated community of Karnack, Texas, are located immediately north and west of the installation boundary, respectively. The remaining surrounding area is sparsely populated and is known as the Pineywoods of east Texas.

Facility Background: Longhorn Army Ammunition Plant is a government-owned, contractor-operated (GOCO) industrial facility under the jurisdiction of the U.S. Army

Armament, Munitions, and Chemical Command (AMCCOM). Its primary mission is to load, assemble, and pack (LAP) pyrotechnic and illuminating/signal ammunition and solid propellant rocket motors. The Longhorn Division of Thiokol Corporation is the current operating contractor.

Longhorn Army Ammunition Plant was established in October 1942 with the primary mission of producing 2,4,6-trinitrotoluene (2,4,6-TNT) flake in the Plant 1 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 and the plant went on standby status until February 1952. From 1952 until 1956, Universal Match Corporation was the operating contractor, producing such pyrotechnic ammunition as photoflash bombs, simulators, hand signals, and tracers for 40mm cartridges. In November 1955, Thiokol Corporation began operation of the Plant 3 area rocket motor facility. Thiokol 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.

Current operations consist 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 as they apply to 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 (INF) Treaty in effect between the United States and the former U.S.S.R.

1.3.2 LHAAP Sites To Be Investigated

1.3.2.1 LHAAP 11 - Suspected TNT Burial Site at Avenues P and Q

Description: This site is an undocumented location where bulk TNT may have been buried in the 1940s. Previous investigations by Environmental Protection Systems, Inc. included shallow soil borings in which a trace of TNT and varying amounts of 1,3,5-trinitrobenzene (TNB), up to 117 ug/kg, were found.

Investigation Activities: RI activities at the suspected TNT burial site include the following:

- install three (3) monitoring wells and sample soil,
- sample groundwater from wells, and
- slug test wells.

CONTAMINANTS at LHAAP 11		
Soil (mg/kg)	**Sediment (mg/kg)**	**Groundwater (mg/l)**
Arsenic (0.3-5)	Arsenic (1.5-3.9)	1,3,5-TNB (0.62 ug/l)
Barium (19-167)	Barium (33.5-41.7)	Chloride (8.9-34.5)
Chromium (1.1-15.8)	Chromium (8.1-20.9)	Nitrate-Nitrite (0.02-1.23)
Mercury (0.01-0.02)	Mercury (0.02)	Sulfate (13-1400)
Nickel (1.4-10.8)	Nickel (2.7-3.1)	TOC (1.5-28)
Lead (1.6-22)	Lead (4-13)	TOX (5-87 ug/l)
Selenium (0.1-2.3)	Selenium (0.2-0.3)	
Chloride (18-44)	Chloride (44)	
Nitrate - Nitrite (0.35-2.64)	Sulfate (30)	
Sulfate (74-1200)		

1.3.2.2 LHAAP 1 - Inert Burning Grounds

Description: During World War II, this site was used for the disposal of industrial and solid wastes, including trash, ashes, scrap lumber, and waste from burned TNT. In the 1950s and 1960s, wastes disposed of reportedly included photoflash powder as well.

Investigation Activities: RI activities at the old landfill include the following:

- installation of one (1) monitoring well and sample soil,
- sample groundwater from newly installed and one existing (01AMW04) well,
- slug test well,
- sample three sediment locations, and
- sample five surface soil locations.

CONTAMINANTS at LHAAP 1		
Soil (mg/kg)	**Sediment (mg/kg)**	**Groundwater (mg/l)**
Toluene (6.7-8.9 ug/kg)	Phenanthrene (1060 ug/kg)	Barium (0.18-0.19)
Xylene (30.6 ug/kg)	Fluoranthene (1580 ug/kg)	Lead (0.01-0.011)
Phenanthrene (763 ug/kg)	Benzo(a)anthracene (420 ug/kg)	Chlorides (4.4-22.2)
Fluoranthene (1620ug/kg)	Benzo(b)fluoranthene (480 ug/kg)	Nitrate-Nitrite (0.05-0.36)
Benzo(a)anthracene (753 ug/kg)	Benzo(k)fluoranthene (390 ug/kg)	Sulfate (13-660)
Benzo(b)fluoranthene (887 ug/kg)	Benzo(a)pyrene (390 ug/kg)	TOC (1.2 -11)
Benzo(k)fluoranthene (762 ug/kg)	Pyrene (1130 ug/kg)	TOX (6-43 ug/l)
Benzo(a)pyrene (829 ug/kg)	Chrysene (550 ug/kg)	
Indeno (1,2,3-cd)pyrene (560 ug/kg)	Arsenic (1-2.8)	
Pyrene (1740 ug/kg)	Barium (13.4-55.7)	
Benzo(g,h)perylene (484 ug/kg)	Cadmium (1)	
Arsenic (0.2-6)	Chromium (4.4-14)	
Barium (17.3-98.7)	Mercury (0.01-0.04)	
Chromium (1.6-53.4)	Nickel (1.2-3.8)	
Mercury (0.02-0.15)	Lead (3.6-9)	
Nickel (1.5-44.4)	Antimony (1)	
Lead (2-75)	Selenium (0.1-0.3)	
Antimony (10.2)	Silver (1)	

CONTAMINANTS at LHAAP 1		
Soil (mg/kg)	**Sediment (mg/kg)**	**Groundwater (mg/l)**
Selenium (0.1-0.5)	Chlorides (31-1060)	
Chloride (44)	Nitrate-Nitrite (2.13-2.32)	
Nitrate-Nitrite (0.38-1.84)	Sulfate (30-60)	
Sulfate (130-750)		

1.3.2.3 LHAAP XX - Ground Signal Test Area

Description: From 1988 to 1992, this site was used for the burn-out of rocket motors from the Pershing missiles destroyed in accordance with the INF Treaty. Over the past thirty years the site has been used for the testing and destruction of a variety of devices, including red phosphorous smoke wedges, infrared flares, illuminating mortar shells, and button bombs. Rocket motor testing and burn-out has been conducted intermittently and has included rocket motors from Nike-Hercules and Sagent missiles in addition to Pershing missiles. LHAAP XX is currently used for aerial and on-ground testing of various pyrotechnic, illuminant, and signal devices manufactured at LHAAP.

Investigation Activities: RI activities at the ground signal test area include the following:

- sample soil from one (1) 10-foot soil boring,

- establish a six-point soil gas survey, and
- install one 20-foot monitoring well, sample soil and groundwater (optional).

CONTAMINANTS at LHAAP XX		
Soil (mg/kg)	**Sediment (mg/kg)**	**Groundwater (mg/l)**
Acetone (12.4-10,300 ug/kg)	Arsenic (1-3.5)	Barium (0.11-0.16)
Arsenic (1-6)	Barium (23-126)	Nickel (0.05-0.06)
Barium (20.2-100)	Chromium (3.5-9.8)	Lead (0.011-0.015)
Chromium (4.9-15.9)	Mercury (0.01-0.04)	Chlorides (1.8-873)
Mercury (0.03-0.07)	Nickel (2.6-14.7)	Nitrate-Nitrite (0.07-0.6)
Nickel (2.1-27.8)	Lead (4-9)	Sulfate (23-1240)
Lead (4-11)	Selenium (0.1-0.4)	TOC (1.1-43)
Selenium (0.1-1.2)	Chloride (44)	TOX (8-260 ug/l)
Thallium (0.2)	Sulfate (30-230)	
Chlorides (310)		
Nitrate-Nitrite (0.56-8.75)		
Sulfate (150-5700)		

1.3.2.4 LHAAP 27 - South Test Area

Description: LHAAP 27 was used in the 1950s for testing photoflash bombs and demilitarizing signal devices and photoflash cartridges. The site is located within the Harrison Bayou floodplain. It contains a large area of vegetation distress on the southern portion of the site, and hillocks with small craters on the western portion.

Investigation Activities: RI activities at the South Test Area include the following:

- install four (4) monitoring wells,
- sample groundwater from wells,
- slug test wells, and
- sample three surface soil locations.

CONTAMINANTS at LHAAP 27		
Soil (mg/kg)	**Sediment (mg/kg)**	**Groundwater (mg/l)**
Arsenic (0.4-2.3)	Arsenic (0.7-1.1)	Nitrobenzene (6.58 ug/l)
Barium (2.01-168)	Barium (39-254)	RDX (18.4 ug/l)
Chromium (1.6-22.2)	Chromium (1.9-5.2)	Barium (0.09-0.25)
Mercury (0.01-0.08)	Mercury (0.03)	Chlorides (4.4-6780)
Nickel (1.4-6.1)	Nickel (2.8-6)	Nitrate-Nitrite (0.01-3.31)
Lead (2-9)	Lead (4-9)	Sulfate (22 - 2080)
Selenium (0.1-0.3)	Selenium (0.2)	TOC (5.6-56)
Chlorides (44-1290)	Chlorides (44)	TOX (22-430 ug/l)
Nitrate-Nitrite (0.5-2.44)	Nitrate-Nitrite (2.17-2.36)	
Sulfate (30-6600)	Sulfate (30-50)	

2.0 HEALTH AND SAFETY ORGANIZATION

2.1 PROJECT ORGANIZATION

The project organizational structure and key project personnel are shown on Figure 2-1.

The Sverdrup personnel assigned specific health and safety responsibilities are identified below.

A. Altman, Project Executive Sverdrup Environmental, Inc.	Overall hazardous materials program responsibility.
D. Boll, Project Manager Sverdrup Environmental, Inc.	Responsible for environmental issues during sampling activities.
D. Schulz, Site Manager Sverdrup Environmental, Inc.	Responsible for all site coordination issues during site activities.
D. Maloney Site Safety Officer Sverdrup Environmental, Inc.	Implement the SSHP.
B. Knaus, CIH, CSP Health & Safety Manager Sverdrup Environmental, Inc.	Responsible for assembly of the health and safety plan.

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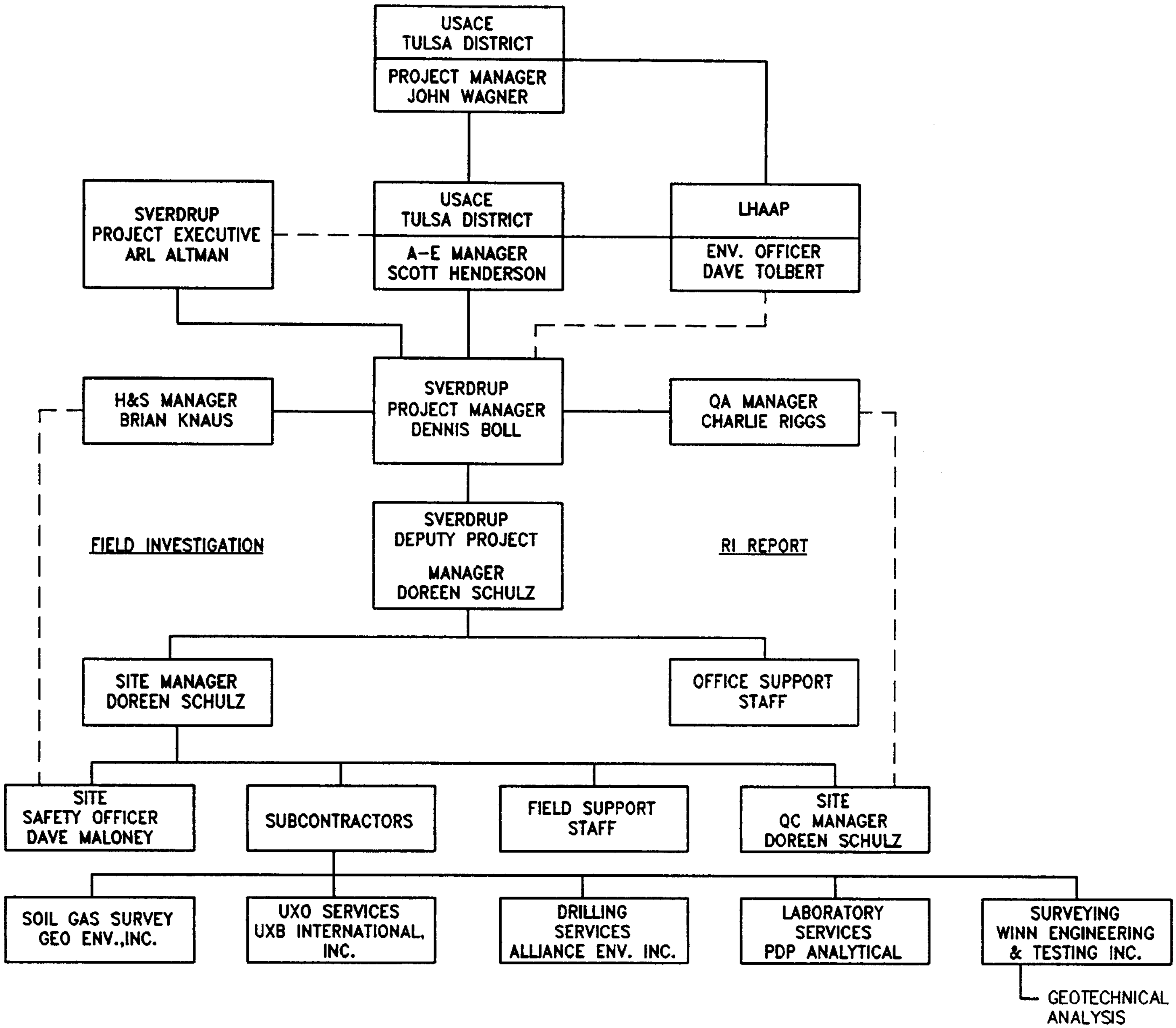

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
A-E SITE SAFETY & HEALTH PLAN

ORGANIZATION CHART

Sverdrup Environmental

FIGURE 2-1

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2.2 RESPONSIBILITY AND AUTHORITY OF KEY PERSONNEL

The responsibility and authority of key personnel relative to the implementation of this SSHP are described below.

2.2.1 Project Manager

- Verify that the project is performed in a manner consistent with the Sverdrup A-E SSHP.
- Verify compliance with the A-E SSHP by all site personnel.
- Coordinate with the Sverdrup Health and Safety Manager on health and safety matters.
- Temporarily suspend field activities if the health and safety of personnel are endangered, pending further consideration by the Sverdrup Health and Safety Manager.
- Report all infractions of the A-E SSHP to the Sverdrup Health and Safety Manager.

Dennis Boll will be the Project Manager. Doreen Schulz will be the Deputy Project Manager and RI Site Manager. In her absence, Dennis Boll will assume her health and safety responsibilities.

2.1.2 Site Safety Officer

A Sverdrup employee will serve as Site Safety Officer for the duration of the field activities. The Site Safety Officer has the following responsibilities:

- Direct health and safety activities on-site.
- Report safety-related incidents or accidents to the Project Manager and the Sverdrup Health and Safety Manager.
- Implement the A-E SSHP.
- Maintain health and safety equipment on-site, as specified in the A-E SSHP.
- Perform health and safety activities on-site, as specified in the A-E SSHP, and report results to the Project Manager and the Sverdrup Health and Safety Manager.
- Maintain documentation of health and safety measures taken at the site, including:
    - Communication of the A-E SSHP;

- Levels of protection and required upgrades;

- Environmental monitoring results; and

- Incident reporting.

- Upgrade or downgrade levels of protection in response to field conditions outlined in the A-E SSHP.

- Temporarily suspend field activities, if health and safety of personnel are endangered, pending further consideration by the Sverdrup Health and Safety Manager.

- Report all infractions of the A-E SSHP to the Sverdrup Health and Safety Manager.

- Perform and record instantaneous personal and area air monitoring to identify changes in each employee's task exposure.

Dave Maloney will serve as the Site Safety Officer.

2.1.3 Sverdrup Health and Safety Manager

- Develop the A-E SSHP for the project.

- Appoint or approve the Site Safety Officer for the project.
- Interface with the Site Safety Officer as may be required in matters of health and safety.
- Monitor compliance with the approved A-E SSHP.
- Assist the Project Manager in maintaining health and safety equipment for the project.
- Verify personnel working on the site have completed medical surveillance and health and safety training.
- Direct personnel to change work practices if they are deemed to be hazardous to health and safety of personnel.
- Remove personnel from the project if their action or condition endangers their health and safety or the health and safety of co-workers.
- Perform and record integrated personal air monitoring to characterize each employee's task exposure.

Brian Knaus is Sverdrup Environmental's Director for Health and Safety.

3.0 SAFETY AND HEALTH HAZARD ASSESSMENT

3.1 CHEMICAL HAZARDS

A hazard analysis has been prepared for the site contaminants. The hazard analysis utilizes exposure and toxicity information generated by the Occupational Safety and Health Administration, American Conference of Governmental Industrial Hygienists, the National Institute for Occupational Safety and Health, the National Toxicology Program, the International Agency for Research on Cancer and accepted industry data.

The Site Safety Officer, or Health and Safety Manager will perform instantaneous and integrated sampling to determine contaminant concentrations and document the concentration levels.

Antimony

Route of Entry: Inhalation, Skin or Eye Contact
Target Organs: Respiratory System, Central Nervous System, Skin, Eyes
Hazard: Toxic
PEL: 0.5 mg/m^3
IDLH: 80 mg/m^3

Antimony is a primary skin irritant. The dust and fumes are irritants to the eyes, nose, and throat and may be associated with gingivitis, anemia, and ulceration of the nasal septum and larynx. Antimony trioxide causes a form of dermatitis resulting in intense irritation of the nose, mouth, stomach, and intestines, vomiting, bloody stools, slow shallow respiration, pulmonary congestion, coma, and sometimes circulatory or respiratory failure. Chronic oral poisoning presents symptoms of dry throat, nausea, headache, sleeplessness, loss of appetite and dizziness. Liver and kidney degeneration are late manifestations.

Arsenic

Route of Entry:	Inhalation, Ingestion, Skin Absorption, Skin or Eye Contact
Target Organs:	Liver, Kidneys, Skin, Lungs, Lymphatic System
Hazard:	Toxic
PEL:	0.01 mg/m^3
IDLH:	100 mg/m^3

Trivalent arsenic compounds are corrosive to the skin, mucous membranes, eyes, nose and mouth. Wrists and genitalia are sites of dermatitis. Perforation of the nasal septum may occur. Arsenic may produce keratoses, and may cause cancer. Acute inhalation may cause cough, chest pain, dyspnea, headache, weakness.

Barium

Route of Entry:	Inhalation, Ingestion, Skin or Eye Contact
Target Organs:	Heart, Central Nervous System, Skin, Respiratory System, Eyes
Hazard:	Toxic
PEL:	0.5 mg/m^3
IDLH:	1,100 mg/m^3

Barium compounds may cause local irritation to the eyes, nose, throat and skin. When ingested, heart rate is slowed and may stop. Other effects include vascular constriction, bladder constriction and increased voluntary muscle tension. Inhalation of dust may produce baritosis, a benign pneumoconiosis.

Cadmium

Route of Entry: Inhalation, Ingestion
Target Organs: Respiratory System, Kidneys, Blood
Hazard: Toxic
PEL: 0.005 mg/m^3
IDLH: 50 mg/m^3

Cadmium is an irritant to the respiratory tract, and is retained in the kidneys and liver. Prolonged exposure can cause anosmia and a yellow stain on the necks of the teeth. Acute exposure may cause respiratory tract irritation. Chronic exposure may cause emphysema, kidney damage and anemia. Cadmium may cause cancer.

Chromium

Route of Entry: Inhalation, Ingestion
Target Organs: Respiratory System
Hazard: Toxic
PEL: 1.0 mg/m^3 (chromium metal)
IDLH: No evidence

Exposure can cause dermatitis to exposed skin and pulmonary sensitization. Acute exposure may cause coughing, headache, dyspnea, fever, weight loss. Chronic exposure may cause ulceration and perforation of the nasal septum, dermatitis, ulceration of the skin, cutaneous discoloration, and hepatic damage. Chromium can cause cancer.

Lead

Route of Entry:	Inhalation, Ingestion, Skin or Eye Contact
Target Organs:	Gastrointestinal Tract, Central Nervous System, Kidneys, Blood, Gingival Tissue
Hazard:	Toxic
PEL:	0.05 mg/m^3
IDLH:	700 mg/m^3

Inhalation or ingestion may cause headache, weakness, irritability, aching muscles, constipation, anorexia, abdominal pains, anemia, high blood pressure, fine tremors, and decreased hand grip. Exposure over an extended period causes wrist drop, convulsions, coma, kidney damage, infertility in both sexes, fetal damage and anemia.

Mercury

Route of Entry:	Inhalation, Skin Absorption
Target Organs:	Skin, Respiratory System, Central Nervous System, Kidneys, Eyes
Hazard:	Toxic
PEL:	0.05 mg/m^3
IDLH:	28 mg/m^3

Mercury is a primary irritant to the skin and nervous membrane and is a skin sensitizer. Acute exposure can produce intestinal pneumonitis and bronchitis. Prolonged exposure may produce weakness, loss of appetite, loss of weight, diarrhea, metallic taste in the mouth, black line on the gums, loss of memory, eyelid and finger tremors, and hallucinations. Chronic exposure produces irritability, muscular tremors, and gingivitis.

Nickel

Route of Entry:	Inhalation, Ingestion, Skin or Eye Contact
Target Organs:	Lungs, Paranasal Sinus, Central Nervous System
Hazard:	Toxic
PEL:	1 mg/m^3 (metal)
IDLH:	No evidence

Nickel is an irritant to the eyes and upper respiratory tract, can cause skin sensitization called Nickel Itch. Chronic exposure can cause injury to the heart muscle, brain, liver and kidneys. Nickel can cause cancer, targeting the lung and nasal passage.

Selenium

Route of Entry:	Inhalation, Ingestion, Skin Absorption, Skin or Eye Contact
Target Organs:	Upper Respiratory System, Eyes, Skin, Liver, Kidneys, Blood
Hazard:	Toxic
PEL:	0.2 mg/m^3
IDLH:	Not reported

Some selenium compounds (selenium dioxide and selenium oxychloride) can cause skin damage. They are strong irritants to the upper respiratory tract and eyes, may cause irritation of the mucous membrane of the stomach. Exposure may cause a pink discoloration of the eyelids and palpebral conjunctivitis. The first sign of selenium absorption is a garlic odor of the breath. Other systemic effects include pallor, lassitude, irritability, indigestion and giddiness.

Silver

Route of Entry: Inhalation, Ingestion, Skin or Eye Contact
Target Organs: Nasal Septum, Skin, Eyes
Hazard: Toxic
PEL: 0.01 mg/m^3
IDLH: No evidence

The local effect from metallic silver can cause skin discoloration. Silver nitrate dust and solutions are highly corrosive to the skin, eyes, and intestinal tract. All forms of silver are cumulative once they enter body tissue, and very little is excreted. The face, forehead, neck, hands and forearms develop a dark, slate-grey color, uniform in distribution and varying in depth depending on the degree of exposure. The dust may be deposited in the lungs and may be regarded as a form of pneumoconiosis, although it carries no hazard of fibrosis.

Thallium

Route of Entry:	Inhalation, Ingestion, Skin Absorption, Skin or Eye Contact
Target Organs:	Eyes, Central Nervous System, Lungs, Liver, Kidneys, Gastrointestinal Tract, Body Hair
Hazard:	Toxic
PEL:	0.01 mg/m^3
IDLH:	20 mg/m^3

Thallium salts are skin irritants and sensitizers. Thallium is extremely toxic and a cumulative poison. Systems include fatigue, limb pain, metallic taste in the mouth loss of hair, peripheral neuritis, proteinuria and joint pains. Neurological signs are present in severe poisonings. Long term exposure may produce optic atrophy, paraesthesia and changes in pupillary and superficial tendon reflexes. Upon ingestion, gastrointestinal symptoms include abdominal colic, loss of kidney function, peripheral neuritis, strabismus, disorientation, convulsions, joint pain, and alopecia develop rapidly (within 3 days). Death is due to damage to the central nervous system.

Acetone

Route of Entry:	Inhalation, Ingestion, Skin or Eye Contact
Target Organs:	Respiratory System, Skin
Hazard:	Flammable (Flash Point 1.4°F), Toxic
PEL:	770 ppm STEL: 1000 ppm
IDLH:	20,000 ppm

This solvent may produce a dry, scaly, and fissured dermatitis after repeated exposure. High vapor concentrations may irritate the eyes, nose and throat, may cause headache, nausea, dizziness, incoordination and unconsciousness.

Coal Tar Pitch Volatiles

Route of Entry:	Inhalation, Skin or Eye Contact
Target Organs:	Respiratory System, Bladder, Kidneys, Skin
Hazard:	Toxic
PEL:	0.2 mg/m^3
IDLH:	700 mg/m^3

The benzene soluble fraction of the coal tar pitch includes benzo(a)pyrene, phenanthrene, acridine, chrysene, anthracene, and pyrene. Exposure may produce skin, eye, and upper respiratory tract irritation. Photophobia may occur. Liver and kidney damage may result from overexposure. Chronic exposure may produce lung and skin cancer.

Nitrobenzene

Route of Entry:	Inhalation, Ingestion, Skin Absorption, Skin or Eye Contact
Target Organs:	Liver, Kidneys, Central Nervous System, Blood, Skin
Hazard:	Toxic
PEL:	1 ppm
IDLH:	200 ppm
IP:	9.92 eV

Nitrobenzene may cause irritation to the eyes and affects the central nervous system producing fatigue, headache, vertigo, vomiting, general weakness, depression, unconsciousness or coma. A powerful methemoglobin former, cyanosis appears when methemoglobin reaches 15%. Chronic exposure may lead to spleen and liver damage, jaundice, liver impairments, and hemolytic icterus. Alcohol ingestion may increase the toxic effects.

Toluene

Route of Entry:	Inhalation, Ingestion, Skin or Eye Contact	
Target Organs:	Central Nervous System, Liver, Kidneys, Skin	
Hazard:	Flammable (FP40°F), Toxic	
PEL:	100 ppm	STEL: 150 ppm
IDLH:	2,000 ppm	
IP:	8.82 eV	

This solvent may cause irritation to the eyes, respiratory tract, and skin. Repeated or prolonged contact with liquid may cause removal of the natural lipids from the skin, resulting in dry, fissured dermatitis. Liquid splashed in the eyes may cause irritation, and reversible damage. Acute exposure results in central nervous system depression, headache, dizziness, fatigue, muscular weakness, drowsiness, incoordination with staggering gait, and coma.

Xylene

Route of Entry:	Inhalation, Ingestion, Skin Absorption, Skin or Eye Contact
Target Organs:	Central Nervous System, Eyes, Gastrointestinal Tract, Blood, Liver, Kidneys, Skin
Hazard:	Flammable (FP 63-81°F), Toxic
PEL:	100 ppm STEL: 150 ppm
IDLH:	1000 ppm
IP:	8.44 - 8.56 eV

Xylene may cause irritation to the eyes, nose, and throat. Repeated or prolonged skin contact may cause drying and defatting of the skin which may lead to dermatitis. Ingestion may cause chemical pneumonitis, or hemorrhage. Repeated eye exposure may cause reversible eye damage. At high concentrations xylene may cause dizziness, staggering, drowsiness, unconsciousness, nausea, or abdominal pain.

RDX (cyclotrimethylenetetranitramine)

Route of Entry:	Inhalation, Ingestion
Target Organs:	Respiratory System
Hazard:	Explosive

RDX is a white crystalline powder and high explosive. When mixed with TNT, it is used as a bursting charge. Skin contact may cause irritation. Acute inhalation may cause epileptiform convulsions. The overexposure may produce dizziness, abdominal cramps, vomiting, bloody diarrhea, weakness, convulsions and collapse. Acute exposure may produce weakness, general depression, headache and mental impairment. RDX may explode when shocked, exposed to heat or flame, or by spontaneous chemical reaction.

1,3,5 Trinitrobenzene

Route of Entry:	Inhalation, Ingestion, Skin Absorption, Skin or Eye Contact
Target Organs:	Blood, Liver, Central Vascular System, Eyes, Central Nervous System
Hazard:	Toxic, Explosive
PEL:	None
IDLH:	No evidence

Severe explosion hazard when shocked or exposed to heat. TNB is a high explosive. When heated to decomposition, emits oxides of nitrogen.

Trinitrotoluene (TNT)

Route of Entry:	Inhalation, Ingestion, Skin Absorption, Skin or Eye Contact
Target Organs:	Blood, Liver, Central Vascular System, Eyes, Central Nervous System, Kidneys
Hazard:	Toxic, Explosive
PEL:	0.5 mg/m^3
IDLH:	No evidence

Exposure to TNT may cause irritation of the eyes, nose and throat with sneezing, cough and sore throat. It may cause dermatitis and may stain the skin, hair and nails a yellowish color. Fatalities have occurred from exposure to TNT from toxic hepatitis or aplastic anemia. TNT exposure may also cause methemoglobinemia with cyanosis, weakness, drowsiness, dyspnea and unconsciousness. Exposure may cause muscular pains, heart irregularities, renal irritation, cataracts, menstrual irregularities and peripheral neuritis.

3.2 PHYSICAL HAZARDS

The activities to be performed at the Longhorn Army Ammunition Plant Site involve field sampling which may include physical hazards such as cuts or punctures from sharp objects, falls from uneven terrain, steep grades or slippery surfaces, sprains and strains from lifting activities, noise and detonation of unexploded ordnance. Personnel should be aware that as the level of personal protective equipment increases, dexterity and visibility may be impacted and performing some tasks may be more difficult.

Rotary drilling rig and heavy equipment operation present inherent safety hazards. Employee experience in the use of such equipment and awareness to potential hazards will reduce risk. Equipment operation must be in accordance with guidelines set forth in applicable OSHA regulations and U.S. Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1.

3.2.1 Unexploded Ordnance

UXB International, Inc. is providing unexploded ordnance support during the installation of monitoring wells, soil borings and sampling at Longhorn Army Ammunition Plant. Their duties will include:

An unexploded ordnance (UXO) team will clear locations of all borings, monitoring well installations, 26-point soil-gas survey, and sediment and surface soil sampling locations prior to the start of work. The UXO team will consist of a UXO Supervisor and UXO Technician, both of which are graduates of the U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, Maryland. The Supervisor will have at least 10 years experience in active duty military EOD assignments; the Technician will have at least 4 years of such experience.

The UXO team will clear boring and monitoring well locations in advance of the drilling operations. The team will clear and mark corridors for safe equipment access (20 feet width) and operation (50 feet by 50 feet area). The team will conduct a hand auger boring at each new soil boring and monitoring well location. A new location is defined as being situated more than 50 ft horizontal distance from any previously cleared location. Soil samples will be collected at these new locations and analyzed, using field screening techniques, for TNT and RDX.

Locations where metallic objects or high concentrations of TNT/RDX are encountered will be offset 10 to 20 feet and clearance procedures repeated. Potential UXO locations will be noted to appropriate authorities at LHAAP; no attempts will be made to remove UXO. In general, boring and monitoring well locations will be cleared in advance of drilling operations. No escort will be provided during equipment access or drilling activities. The UXO team will escort the sediment sampling team, to clear access routes and sampling locations using the magnetometer.

3.2.2 Noise

Noise may be generated during site activities. Hearing protection, either ear muffs or ear plugs are mandatory in areas where the noise level equals or exceeds 90 dBA-TWA (Time Weighted Average).

3.2.3 Trenches and Excavations

When trenches or excavations are 4 feet deep or more, an adequate means of exit such as a ladder or steps shall be provided and located so as to require no more than 25 feet of lateral travel.

All trenches and excavations 5 feet or more deep shall be sloped, shored or shielded to eliminate cave-in. All trenches and excavation shall be covered or protected before the end of the work day. Unprotected excavations are not permitted.

3.2.4 Flammable Liquids and Gases

Gasoline and any other flammable liquid shall be stored in UL listed/FM approved properly labeled containers.

3.2.5 Heat and Cold Stress Monitoring

Introduction

Stress can contribute significantly to accidents or harm workers in other ways.

The term stress denotes the physical (gravity, mechanical force, heat, cold, pathogen, injury) and psychological (fear, anxiety, crises, joy) forces that are experienced by individuals.

The body's response to stress occurs in three stages:

- *Alarm Reaction* - in which the body recognizes the stressor and the pituitary-adreno-cortical system responds by increasing the heart rate and blood sugar level, decreasing digestive activity and dilating the pupils.
- *Adaptive State* - in which the body compensates for the stimulation and the stress symptoms disappear.
- *Exhaustion State* - in which the body can no longer adapt to stress and the individual may develop emotional disturbances, and cardiovascular and renal diseases.

The most common types of stress that affect field personnel are heat stress and cold stress. Heat and cold stress which may result from wearing personal protective equipment may be the most serious hazard to workers during site assessment and remediation activities.

3.2.5.1 Heat Stress

Heat stress can result when protective clothing decreases natural body ventilation, although it may occur at any time work is being performed at elevated temperatures.

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal. Because heat stress is one of the most common and potentially serious illnesses that is present at remediation sites, regular monitoring and other preventative measures are vital.

Site workers must learn to recognize and treat the various forms of heat stress. The best approach is preventative heat stress management. In general:

- *Have workers drink 16 ounces of water before beginning work*, such as in the morning or after lunch. Provide disposable, 4 ounce cups, and water that is maintained at 50-60°F. Urge workers to drink 1 - 2 of these cups of water every 20-minutes, for a total of 1 - 2 gallons per day. Provide a cool, preferably air conditioned area for rest breaks. Discourage the use of alcohol in non-working hours, and discourage the intake of coffee during working hours. Monitor for signs of heat stress.

- *Acclimate workers* to site work conditions by slowly increasing workloads, i.e., do not begin site work activities with extremely demanding activities.

- *Provide cooling devices* to aid natural body ventilation. These devices, however, add weight, and their use should be balanced against worker efficiency. An example of a cooling aid is long cotton underwear which acts as a wick to help absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing.

- *Install mobile showers* and/or hose-down facilities to reduce body temperature and cool protective clothing.

- In hot weather, *conduct field activities in the early morning or evening*.

- *Provide adequate shelter* to protect personnel against heat, as well as cold, rain, snow, etc., which can decrease physical efficiency and increase the probability of both heat and cold stress. If possible, set up the shelter in the shade.

- In hot weather, *rotate shifts of workers* wearing impervious clothing.

- *Good hygienic standards must be maintained* by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of heat regulating mechanisms of the body. The individual's temperature control system that causes sweating stops working correctly. Body temperature rises so high that brain damage and death will result if the person is not cooled quickly.

- *Symptoms:* Red, hot, dry skin, although the person may have been sweating earlier; nausea; dizziness; confusion; extremely high body temperature, rapid respiratory and pulse rate; unconsciousness or coma.
- *Treatment:* Cool the victim quickly. If the body temperature is not brought down fast, permanent brain damage or death will result. Soak the victim in cool but not cold water, sponge the body with cool water, or pour water on the body to reduce the temperature to a safe level (100.4°F). Observe the victim and obtain medical help. Do not give coffee, tea or alcoholic beverages.

Heat Exhaustion

Heat exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids from the body. This condition is much less dangerous than heat stroke, but it nonetheless must be treated.

- *Symptoms:* Pale, clammy, moist skin, profuse perspiration and extreme weakness. Body temperature is normal, pulse is weak and rapid, breathing is shallow. The person may have a headache, may vomit, and may be dizzy.
- *Treatment:* Remove the person to a cool, air conditioned place, loosen clothing, place in a head-low position, and provide bed rest. Consult a physician, especially in severe cases. The normal thirst mechanism is not sensitive enough to maintain body fluid replacement. Have the person drink 1 - 2 cups of water immediately, and every 20-minutes thereafter, until symptoms subside. Total water consumption should be about 1 to 2 gallons per day.

Heat Cramps

Heat cramps are caused by perspiration that is not balanced by adequate fluid intake. Heat cramps are often the first sign of a condition that can lead to heat stroke.

- *Symptoms:* Acute painful spasms of voluntary muscles; e.g., abdomen and extremities.

- *Treatment:* Remove the person to a cool area and loosen clothing. Have the person drink 1 to 2 cups of water immediately, and every 20-minutes thereafter, until symptoms subside. Total water consumption should be 1 to 2 gallons per day. Consult with a physician.

Heat Rash

Heat rash is caused by continuous exposure to heat and humidity and aggravated by chafing clothes. The condition decreases ability to tolerate heat.

- *Symptoms:* Mild red rash, especially in areas of the body in contact with protective equipment.

- *Treatment:* Decrease amount of time in protective equipment, and provide powder to help absorb moisture and decrease chafing.

Heat Stress Monitoring and Work Cycle Management

Acclimatized workers should work under conditions which do not elevate their deep body temperature above 38°C (100.4°F). Since deep body temperature measurement is not convenient, environmental temperature, work load and protective clothing parameters are used to evaluate heat stress.

The American Conference of Governmental Industrial Hygienists (ACGIH) suggest a guideline relating light, moderate and heavy work load activities with a work-rest regime. The permissible heat exposure values are given in degrees Centigrade Wet Bulb-Globe Temperature Index. This index relates natural wet bulb temperature, dry bulb temperature and globe thermometer readings.

The work load is categorized by ranking the work activities into three groups. Light work up to 200 Kcal/hr includes sitting or standing to control machines or performing light hand or arm work. Moderate work from 200 to 350 Kcal/hr includes walking with moderate lifting and pushing. Heavy work from 350 to 500 Kcal/hr includes pick and shovel work.

When work is self-paced, workers will spontaneously limit their hourly work load to 30-50% of their maximum physical performance capacity. This is accomplished by setting an appropriate work speed or by taking unscheduled breaks. The daily average metabolic rate under a self-paced condition seldom exceeds 330 Kcal/hr. Within an 8 hour work shift there may be periods where the hourly average metabolic rate will be higher.

The ACGIH permissible heat exposure values are valid for light summer clothing worn when working under hot environmental conditions. When clothing is heavier, or impedes sweat evaporation, or has higher insulation value, worker heat tolerance is reduced. For personal protective equipment usage, correct the Wet Bulb-Globe Temperature value by subtracting 5 to 10.

The Wet Bulb Globe Temperature Index (WBGT) is calculated by the equation (outdoors with solar load): $WBGT = 0.7NWB + 0.2GT + 0.1\ DB$ where NWB = Natural Wet Bulb Temperature, DB = Dry-Bulb Temperature, GT = Globe Temperature.

The following table is a guide for work-rest regimes for light, moderate and heavy work loads is recommended by the ACGIH.

	Work Load (°F-WBGT)		
Work-Rest Regimen	Light	Moderate	Heavy
Continuous Work	86	80	77
75% work - 25% rest, each hour	87	82	78
50% work - 50% rest, each hour	89	85	82
25% work - 75% rest, each hour	90	88	86

3.2.5.2 Cold Stress

Persons working outdoors in low temperatures, especially at or below freezing are subject to cold stress. Exposure to extreme cold for a short time causes severe injury to the surface of the body, or results in profound generalized cooling, causing death. Areas of the body which have high surface area-to-volume ratio such as fingers, toes, and ears are the most susceptible.

Protective clothing generally does not afford protection against cold stress. In many instances, it increases susceptibility.

Two factors influence the development of a cold injury: ambient temperature and wind velocity. Wind chill is used to describe the chilling effect of moving air in combination with low temperature.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is soaked with perspiration.

Frostbite

Local injury resulting from cold is included in the generic term frostbite. Frostbite of the extremities can be categorized into:

- *Frost nip or incipient frostbite* is characterized by sudden blanching or whitening of skin.
- *Superficial frostbite* is characterized by skin with a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- *Deep frostbite* is characterized by tissues that are cold, pale, and solid.

To administer first aid for frostbite: Take the victim indoors and rewarm the area quickly in water that is between 39°C and 41°C (102° - 105°F). Give a warm drink - NOT coffee, tea or alcohol. The victim must not smoke. Keep the frozen parts in warm water or covered with warm clothes for 30 minutes, even though the tissue will be very painful as it thaws. Then elevate the injured area and protect it from injury. Do not allow blisters to be broken. Use sterile, soft, dry material to cover the injured areas. Keep victim warm and get immediate medial care.

After thawing, the victim should try to move the injured areas a little, but no more than can be done alone, without help.

NOTE:

- Do not rub the frostbitten part (this may cause gangrene).
- Do not use ice, snow, gasoline or anything cold on the frostbitten area.
- Do not use heat lamps or hot water bottles to rewarm the part.
- Do not place the part near a hot heat source.

Hypothermia

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages:

- Shivering

- Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F
- Unconsciousness, glassy stare, slow pulse, and slow respiratory rate
- Freezing of the extremities
- Death

As a general rule field activities shall be curtailed if equivalent chill temperature (°F) is below zero (0°F) unless the activity is of an emergency nature.

WINDCHILL CHART

WIND SPEED (MPH)	LOCAL TEMPERATURE (°F)										
	32	23	14	5	-4	-13	-22	-31	-40	-49	-58
5	29	20	10	1	-9	-18	-28	-37	-47	-56	-65
10	18	7	-4	-15	-26	-37	-48	-59	-70	-81	-92
15	13	-1	-13	-25	-37	-49	-61	-73	-85	-97	-109
20	7	-5	-19	-32	-44	-57	-70	-83	-96	-109	-121
25	3	-10	-24	-37	-50	-64	-77	-90	-104	-117	-130
30	1	-13	-27	-41	-54	-68	-82	-97	-109	-123	-137
35	-1	-15	-29	-43	-57	-71	-85	-99	-113	-127	-142
40	-3	-17	-31	-45	-59	-74	-87	-102	-116	-131	-145
45	-3	-18	-32	-46	-61	-75	-89	-104	-118	-132	-147
50	-4	-18	-33	-47	-62	-76	-91	-105	-120	-134	-148
For Properly Clothed Persons	Little Danger		Considerable Danger				Very Great Danger				

DANGER FROM FREEZING OF EXPOSED FLESH

SOURCE: ACGIH, Threshold Limit Values for Chemical Substances in the Work Environment for 1984-85.

3.2.6 Lifting Techniques to Reduce Strain

Lifting objects can put great strain on the back. For example, lifting a 25-pound box from the floor requires 700 pounds of back muscle force. Since lifting objects during this field investigation is unavoidable, good lifting techniques must be used.

There are a number of factors which govern how much can be lifted safely. These factors include:

- weight of load
- size of load
- distance from load
- number of times lifted
- stability of load
- adequacy of grip
- nature of lift (floor to waist, waist to shoulder, shoulder to overhead)
- obstacles in path
- space constraints
- rest time between lifts
- distance to be moved

Rules for Lifting

1. Try out the load first. If it is too bulky or heavy, get help.
2. Keep the back straight and lift with the legs.
3. Lift slowly and carefully and do not jerk the load.
4. Keep the load as close to the body as possible.
5. Do not twist or turn the spine while lifting or carrying the load.
6. Remember that lowering the load can be more stressful than lifting it.

3.3 BIOLOGICAL HAZARDS

Biological hazards potentially present at the site include, but are not limited to, insects and poisonous snakes. Employee awareness to these hazards will reduce associated risk. Section 14 addresses recommended actions in the event of a snakebite.

3.4 AMBIENT AIR HAZARDS

Ambient air hazards are expected to be very minimal at this site due to the unconfined spaces to be sampled, the depth of containment of contamination, and minimal disturbance of contaminated material. No perimeter monitoring is needed because of these factors and because of the large size of the site. (Reference p.7.2 of LHAAP RI/FS Work Plan, Volume 3)

3.5 ACTIVITY HAZARD ANALYSIS

Activity

Soil Borings - using hollow stem augers, one soil boring will be drilled to a depth of ten feet. Soil will be sampled every five feet.

Hazard

- Chemical: See Section 1.3.2 for chemicals identified at the LHAAP area.

- Physical: Unexploded ordnance or potentially explosive materials may be present at the site.

  Drill rig has gears, belts and drives which may present nip points or point of operation physical hazards.

Drill rigs may contact underground utilities and above ground electrically energized power lines which may cause electrocution.

Noise exceeding 90dBA-TWA may be generated by the drill rigs during soil boring.

- Ergonomic: Back strains may occur while drillers and driller helpers manually lift augers and equipment.

Control

- Level D will be the basic level of protection. Air monitoring will be conducted to document that personal breathing zone concentrations are less than 25% of any applicable PEL-TWA.

- Hearing protection (muff or plug) will be worn in all areas where noise exceeds 90dBA-TWA.

- An ordnance locator and a magnetometer will be used to sweep the near surface. Intrusive work within the upper six feet of the subsurface will be monitored using a magnetometer and chemical screening for potentially explosive compounds.

- Point of operation guards or distance from nip points will be used to minimize contact with gears, belts and drives.

- Underground utilities will be located and marked prior to any drill rig activities. Drill rigs shall not be moved with mask vertical or outriggers extended. Adequate clearance shall be maintained between the drill rig and electrically energized power lines.

- Whenever practical, mechanical devices will be used to lift sampler and heavy equipment. Section 3.2.6 "lifting techniques to reduce strain" will be followed.

<u>Activity</u>

Monitoring Well Installation - Eight (8) four-inch diameter, stainless steel 316 monitoring wells will be installed.

Hazard

- Chemical: See Section 1.3.2 for chemicals identified at each LHAAP area.

- Physical: Unexploded ordnance or potentially explosive materials may be present at the site.

- Drill rigs may contact underground utilities and above ground electrically energized power lines which may cause electrocution.

- Noise exceeding 90dBA-TWA may be generated by the drill rig during monitoring well installation.

- Ergonomic: Back strains may occur while drillers and driller helpers manually lift pipe and equipment.

Control

- Level D will be the basic level of protection. Air monitoring will be conducted to document that personal breathing zone concentrations are less than 25% of any applicable PEL-TWA.

- Hearing protection (muff or plug) will be worn in all areas where noise exceeds 90dBA-TWA.

- An ordnance locator and a magnetometer will be used to sweep the near surface. Intrusive work within the upper six feet of the subsurface will be monitored using a magnetometer and chemical screening for potentially explosive compounds.

- Point of operation guards or distance from nip points will be used to minimize contact with gears, belts and drives. Underground utilities will be located and marked prior to any drilling activities. Drill rigs shall not be moved with mask vertical or outriggers extended. Adequate clearance shall be maintained between the drill rig and electrically energized power lines.

- Whenever practical, mechanical devices will be used to lift drill rig components and heavy equipment. Section 3.2.6 "lifting techniques to reduce strain" will be followed.

<u>Activity</u>

Groundwater Sampling - groundwater will be sampled at newly installed wells.

<u>Hazard</u>

- Chemical: See Section 1.3.2 for chemicals identified at each LHAAP area.

- Physical: Unexploded ordnance or potentially explosive materials may be present at the site.

<u>Control</u>

- Level D will be the basic level of protection. Air monitoring will be conducted to confirm that personal breathing zone concentrations are less than 25% of any applicable PEL-TWA.

- An ordnance locator and a magnetometer will be used to sweep the near surface prior to accessing heavy equipment to the site.

Activity

Sediment and Surface Soil Sampling - Sediment and surface soil samples will be collected using a hand driven sampler.

Hazard

- Chemical: See Section 1.3.2 for chemicals identified at each LHAAP area.
- Physical: Unexploded ordnance or potentially explosive materials may be present at the site. Wading into water may produce a slip/fall into the water. Hand-driven hammer assembly hazard due to potential of getting hands or fingers in the hammer slide path.

Control

- Level D will be the basic level of protection. Air monitoring will be conducted to document that breathing zone concentrations are less than 25% of any applicable PEL-TWA.

- An ordnance locator and a magnetometer will be used to sweep the near surface. Intrusive work within the upper six feet of the subsurface will be monitored using a magnetometer and chemical screening for potentially explosive compounds.

- Sampler will walk slowly through the water while collecting samples.

Activity

Drum Staging - 55 gallon metal drums will be used to store soil cuttings, drilling fluids, decontamination water, purge water and PPE.

Hazard

- Chemical: See Section 1.3.2 for chemicals identified at each LHAAP area.

- Physical: Contamination may accumulate on the exterior of the drums.

- Ergonomic: Drums and contents weigh in excess of 50 pounds. Manual lifting may produce back strains.

Control

- Level D will be the basic level of protection. Air monitoring will be conducted to document that breathing zone concentrations are less than 25% of any applicable PEL-TWA.

- When practical, mechanical devices will be used to lift and move drums. Lift trucks will be used to move drums. Five gallon buckets will be used to fill drums in the drum staging area. Section 3.2.6 "lifting techniques to reduce strains" will be followed.

- Drum exteriors will be wiped clean while in the appropriate level of PPE after the drum is full or after work in the area for which the drum was being used for is completed.

4.0 ACCIDENT PREVENTION

- The Site Safety Officer (SSO) has administrative responsibilities for effecting the site accident prevention plan.
- The Site Manager will coordinate daily with those performing assessment and remediation work.
- The Site Safety Officer will hold daily safety meetings. Section 5 gives details of safety meeting content.
- The Site Manager or SSO will put up traffic barriers at entrances to individual sites or portions of individual sites as appropriate to verify that no unauthorized personnel enter the site.
- Section 14 covers emergency response and contingency plans.
- The Site Manager or SSO will continually inspect the work areas for infractions of the SSHP.
- The SSO will investigate all accidents and complete an accident investigation report.

5.0 TRAINING

Consistent with OSHA's 29 CFR 1910 and 1926 regulations all site personnel will be trained in accordance with the federal and state regulations. At a minimum, all personnel will be trained to recognize the hazards on-site, the health and safety controls to minimize personnel exposure, the provisions of this SSHP, and the responsible personnel.

5.1 GENERAL

Prior to arrival on-site, Sverdrup Environmental, Inc. will be responsible for certifying that their employees meet the requirements of preassignment training.

The following individuals are identified as site supervisors:

Name	Title/Responsibility
D. Boll	Project Manager
D. Schulz	Deputy Project Manager/Site Manager
D. Maloney	Site Safety Officer

5.2 SITE SPECIFIC TRAINING

The following items will be discussed by the Site Safety Officer at the site pre-entry briefing(s). Daily health and safety meetings must be attended by all site personnel. Subjects discussed during the health and safety meetings must be documented in the site log book by Sverdrup Environmental, Inc. personnel.

Site Specific Training Meeting	Daily	Periodically	
X		X	Site Description, Section 1.3
X		X	Physical hazards, Section 3.2
X		X	Chemical hazards, Section 3.1
X		X	Medical surveillance requirements, Section 7.0
X		X	Symptoms of overexposure to hazards; Section 3.1
X		X	Site control, Section 10.0
X		X	Training requirements, Section 5.0
X		X	Engineering controls and work practices, Section 9.0
X		X	Heavy machinery
X		X	Backhoe

Site Specific Training Meeting	Daily	Periodically	
X		X	Overhead and underground utilities
X		X	Personnel protective equipment, Section 6.0
X		X	Respiratory protection
X		X	Air Monitoring, Section 8.0
X		X	Decontamination, Section 11 and 12.0
X		X	Emergency response plan, Sec. 14.0
X		X	Confined space entry procedure, Section 14.8
X		X	Spill Containment, Section 14.7

FORM 2

SAFETY MEETING RECORD FORM

Site name:____

Location:____

Meeting date:_______ Meeting time:__________________________

Meeting conducted by:_____________________________________

Topics Discussed

____
____
____
____

Accidents Reviewed

____
____
____
____

Suggestions/Comments Made

____
____
____

6.0 PERSONAL PROTECTIVE EQUIPMENT

This section describes the general requirements of the Levels of Protection (A-D), and the specific levels of protection required for the Longhorn Army Ammunition Plant.

6.1 PERSONAL PROTECTION LEVELS AND EQUIPMENT

Personnel must wear protective equipment when activities involve known or suspected atmospheric contamination, when hazardous vapor, gases, or particulates may be generated by site activities, or when direct skin contact with hazardous substances may occur. Full face-piece respirators protect lungs, gastrointestinal tract, and eyes against airborne contaminants. Chemical-resistant clothing protects the skin from contact with hazardous contaminants.

The specific levels of protection and necessary components for each have been divided into four categories according to the degrees of protection afforded:

Level A: Should be worn when the highest level of respiratory, skin, and eye protection is needed.

Level B: Should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection.

Level C: Should be worn when the criteria for using air-purifying respirators are met, and a lesser level of skin protection is needed.

Level D: Should be worn only as a work uniform and not in any area with respiratory or skin hazards. It provides minimal protection against chemical hazards.

Modifications of these levels are permitted, and routinely employed during site work activities to maximize efficiency. For example, Level C respiratory protection and Level D skin protection may be required for a given task. Likewise the type of chemical protective clothing will depend upon contaminants and degrees of contact.

The Level of Protection selected is based upon the following:

- Type and measured concentration of the chemical substance in the ambient atmosphere and its toxicity.
- Potential for exposure to substances in air, liquid splashes, or other direct contact with material due to work being done.
- Knowledge of chemicals on-site along with properties such as toxicity, route of exposure, and contaminant concentration.

Two levels of personal protection will be utilized during remedial investigation sampling activities. All on-site Sverdrup personnel will be required to comply with the personal protective levels of protection.

Level C: Full face or half face piece air purifying respirator

Type GMC-H respirator cartridges (or equivalent)

Disposable coverall

Disposable nitrile gloves or equivalent

Disposable latex inner gloves or equivalent

Chemically-resistant steel toe and shank boots

Disposable or reusable boot covers or equivalent

Hard hat

Eye protection in areas where airborne debris/dust exists

Level D: Disposable coverall

Disposable latex gloves or equivalent

Chemically-resistant steel toe and shank boots

Disposable or reusable boot covers or equivalent

Hard hat

Eye protection in areas where airborne debris/dust exists

6.2 SPECIFIC LEVELS OF PROTECTION PLANNED FOR SPECIFIC SITE ACTIVITIES

The personal protective equipment (PPE) decision logic for these remedial investigated sampling activities will include:

- Level D PPE for initial sampling activities at LHAAP No. 11, 1, XX, 27.
- During initial sampling activities at these sites, while in Level D PPE, monitor soil, groundwater and employee breathing zone using organic vapor analyzer/monitor and contaminant specific direct reading indicator tubes. When breathing zone concentrations are greater than 25% of the permissible exposure limits or any ceiling is exceeded, Level C PPE shall be donned.
- Keep the soil sampling area wet to minimize generating airborne particulates.

During the May 15 and 27, 1993 remedial investigation by Sverdrup Environmental, Inc., personal breathing zone concentrations were collected to characterize the sampling and drilling activity tasks. The data indicates the permissible exposure limit- time weighted averages were less than 1% of the PEL-TWA for aluminum, antimony, and zinc and less than the analytical detection limit for arsenic, cadmium, chromium, and lead.

Note: The explosives at this site can be detonated by flame, heat and shock. Avoid inhalation and skin contact with these explosives.

- Level C personal protective equipment will be worn:

During sampling, when the contaminant concentrations are greater than 25% of the Permissible Exposure Limit Time Weighted Average for any contaminant.

- Level D personal protection to be worn during all other site activities.

6.3 SUMMARY OF SITE ACTIVITY REQUIREMENTS

The following table summarizes the minimum levels of protection:

Activity	Level of Protection	Monitoring Equipment
Within exclusion zone during sampling	C	Foxboro Model 128 FID, HNu-PID or equivalent breathing zone concentrations equal to 5 ppm or higher, or Methylene Chloride direct reading indicator tubes indicate greater than 6 ppm (25% of NPRM*).

D	Foxboro Model 128, HNu or equivalent breathing zone concentrations less than 5 ppm and no carcinogens have been detected using direct reading indicator tubes.

*Notice of Proposed Rule Making

7.0 MEDICAL SURVEILLANCE PROGRAM

This medical surveillance program is designed to survey preemployment or baseline conditions prior to potential exposures and monitor physical conditions on a regular basis.

7.1 BASELINE OR PREASSIGNMENT MONITORING

Prior to being assigned to this site's sampling activities, each employee must receive a preassignment or baseline medical examination. The content of this examination has been reviewed by the Sverdrup Environmental, Inc. physician who is Board Certified in Occupational Medicine. The minimum medical monitoring requirements for work at the Longhorn Army Ammunition Plant Site is a follows:

- Complete medical and work history
- Physical examination
- Pulmonary function tests ($FEV_{1.0}$, FVC, and $FEV_{1.0}$ FVC ratio)
- Chest X-ray (as recommended by the physician)
- EKG
- Eye examination and visual acuity

- Audiometric Testing at 500, 1000, 2000, 3000, 4000, 6000 Hertz
- Urinalysis
- Blood chemistry, including hematology, serum analyses, and heavy metals toxicology and liver

The preassignment examination categorizes employees as fit-for-duty and able to wear respiratory protection.

7.2 PERIODIC MONITORING

In addition to a baseline examination for all employees involved in these sampling activities, a periodic annual examination shall be performed unless the advising physician believes a shorter interval is appropriate. The Sverdrup Environmental, Inc. medical consultant has prescribed an examination which fulfills OSHA 29 CFR 1910 and 1926 requirements.

The Site Manager/Site Safety Officer will verify all personnel working in potentially contaminated areas at the Longhorn Army Ammunition Plant Site are currently (within 12 months) participating in a medical surveillance program. This is done by obtaining a copy of the physician's written opinion form for the medical surveillance at the job site.

7.3 EXPOSURE/INJURY/MEDICAL SUPPORT

As a follow-up to an injury or possible exposure above established exposure limits, all employees are entitled to and encouraged to seek medical attention and medical testing. Depending upon the type of exposure, it is critical to perform follow-up testing within 24-48 hours. The Sverdrup Environmental, Inc. medical consultant will advise as to the type of test required to accurately monitor for exposure effects.

7.4 EXIT MEDICAL EXAMINATION

At termination of employment or at the physician's discretion each employee shall complete an exit medical surveillance examination. The content of the examination is to be determined by the employer's medical consultant. The minimum medical monitoring requirements for work at the Longhorn Army Ammunition Plant Site are found in Section 7.1.

8.0 FREQUENCY AND TYPES OF PERSONAL AIR MONITORING/ ENVIRONMENTAL SAMPLING

This section explains the general concepts of an air monitoring program and specifies the monitoring activities that will take place during sampling activities at the Longhorn Army Ammunition Plant Site.

8.1 ENVIRONMENTAL MONITORING

Sverdrup will perform instantaneous and integrated personal air monitoring at this site. SKC personal air samplers will be used to perform integrated monitoring during sampling activities. Sverdrup will evaluate this data to determine the effectiveness of engineering controls and the appropriate level of protection is being worn.

Foxboro Century Model 128 flame ionization detector, HNu organic vapor monitor, Sensidyne 100cc manual pump with direct reading indicator tubes or equivalent will be used to monitor total hydrocarbons during the site sampling. This instantaneous sampling will be performed in the employee breathing zone. Concentrations, instruments and calibration data will be maintained in the field log book.

Contaminant	Equipment	Sampling Strategy
organic vapor	Foxboro Model 128 PID or equivalent	instantaneous
organic vapor	Sensidyne 100cc pump with direct reading indicator tubes	instantaneous
metals	SKC personal air sampler with MCE filters	integrated
organic vapor	SKC personal air sampler with charcoal tubes	integrated
TNT	SKC personal air sampler with glass fiber filter	integrated

The Sverdrup Health and Safety Manager will perform personal, task-specific air monitoring during initial site mobilization. This integrated sampling strategy will characterize organic vapor and metals concentrations within the worker's breathing zone. The site and contaminant specific integrated air monitoring data will be maintained at the project site.

The Sverdrup Site Safety Officer will use instantaneous sampling instruments including direct reading indicator tubes, and flame ionization and photoionization organic vapor monitors to monitor each task. This instantaneous sampling strategy data will also be maintained at the project site.

The basis of this sampling strategy is to:

- characterize each task
- verify that the correct level of PPE has been chosen
- supplement the integrated monitoring data with daily instantaneous monitoring data

The sampling strategy report will include equipment used, contaminant concentration, calibration data and results. This data will be maintained at the project site and readily available for review.

9.0 STANDARD OPERATING SAFETY PROCEDURES, ENGINEERING CONTROLS AND WORK PRACTICES

Field work will be conducted only during daylight hours unless adequate lighting is provided. The buddy system will be observed at all times, where a minimum of two people work together within eye-sight or not greater than 100 ft of each other. Entry and exit into the exclusion zone, and contamination reduction zone will be permitted only through designated access points, except during an emergency or as authorized by the SSO. Personnel entering the exclusion zone must be wearing the required minimum protective clothing and they must exit these areas at the decontamination station.

No eating, drinking, smoking, or any other activity involving hand-to-mouth contact will be allowed by field personnel within exclusion zones or prior to completion of proper personnel decontamination sequence. Field personnel must thoroughly wash their hands and faces before eating.

Facial hair will not be allowed where the respirator seal contacts the face.

Contact lenses may not be worn during field work. Sverdrup personnel expected to use respirators should provide a pair of glasses that can be adapted to the respirator worn.

The appropriate mounting hardware will be provided. All other personnel should provide their own prescription glasses and should be prepared to also wear safety glasses, if necessary.

A waste storage area will be located at the site at which all personal protective equipment wastes generated will be stored pending their proper disposal.

Table 9-1 provides a checklist for PPE inspection.

Tables 9-2 and 9-3 provide standing orders for work zones.

TABLE 9-1
SAMPLE PPE INSPECTION CHECKLISTS

CLOTHING

Before use:

- Determine that clothing material is correct for the specified task at hand.
- Visually inspect for:
  - imperfect seams
  - non-uniform coatings
  - tears
  - malfunctioning closures
- Hold up to light and check for pinholes.
- Flex product:
  - observe for cracks
  - observe for other signs of deterioration
- If the product has been used previously, inspect inside and out for signs of chemical attack:
  - discoloration
  - swelling
  - stiffness

During the work task, periodically inspect for:

- Evidence of chemical attack such as discoloration, swelling, stiffening, and softening. Keep in mind, however, that chemical permeation can occur without any visible effects.
- Closure failure.
- Tears.
- Punctures.
- Seam Discontinuities.

GLOVES

Before use:

- Visually inspect for:
  - imperfect seams
  - tears, abrasions
  - non-uniform coating
  - pressurize glove with air, listen for pin-hole leaks.

TABLE 9-2
STANDING ORDERS FOR AN EXCLUSION ZONE

- No smoking, eating, or drinking in this zone.
- No horse play.
- No matches or lighters in this zone.
- Check-in upon entrance to this zone.
- Implement the communications system.
- Line of sight must be in position.
- Wear the appropriate level of protection as defined in the SSHP.

TABLE 9-3
STANDING ORDERS FOR CONTAMINATION REDUCTION ZONE

- No eating, smoking, or other tobacco products in this zone.
- No horse play.
- No matches or lighters in this zone.
- Wear the appropriate level of protection.
- Liquids may be consumed from squeeze bottles within this zone.

10.0 SITE CONTROL MEASURES

This section defines measures and procedures for maintaining site control. Site control is an essential component in the implementation of the site health and safety plan.

10.1 SITE MAP

Figure 10-1 provides a site vicinity map. Figure 10-2 provides a site map.

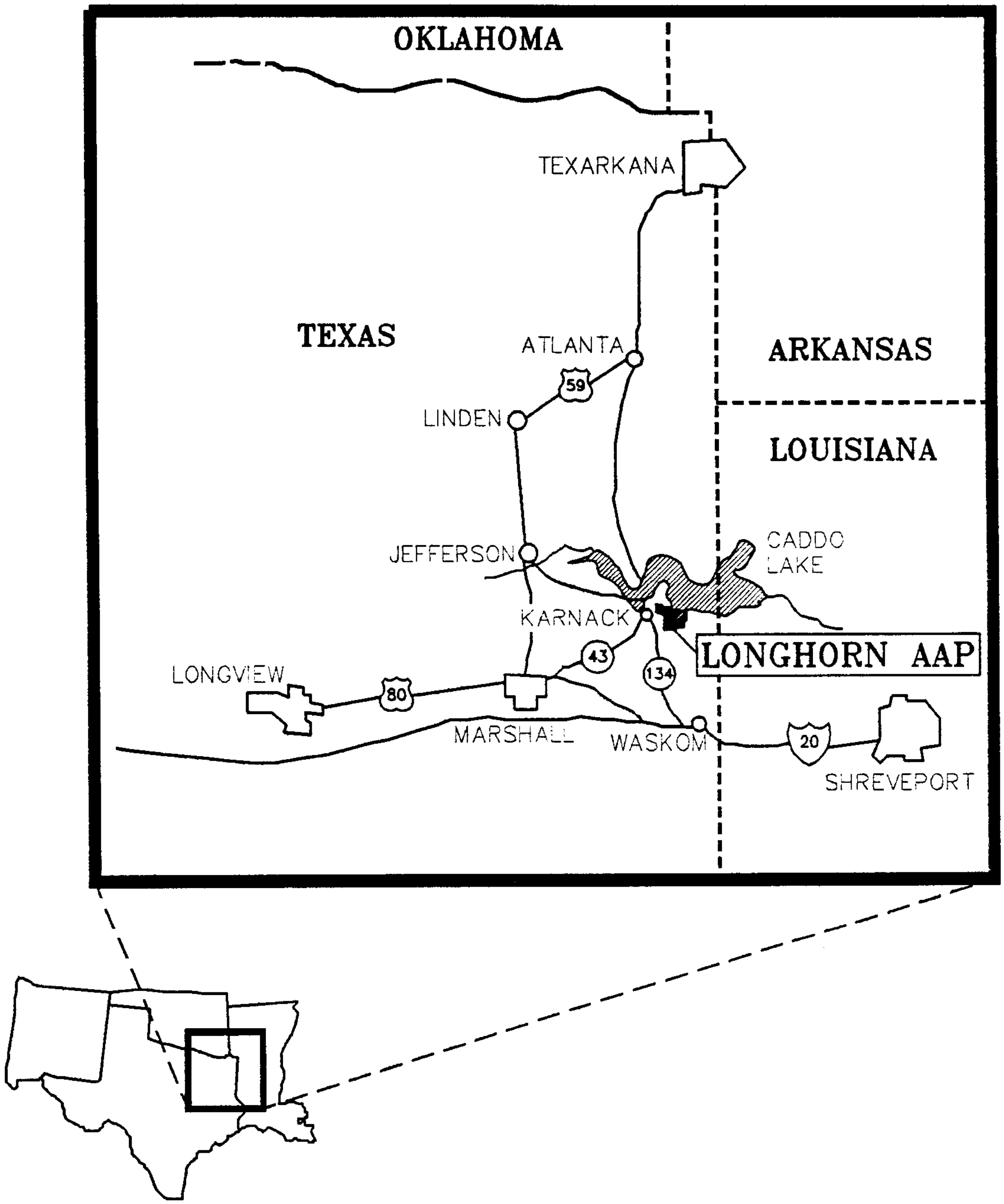
10.2 WORK ZONE DEFINITION

The three work zones established at this site are the Exclusion Zone, Contamination Reduction Zone, and Support Zone. Tape, cones or other warning barriers will be placed to identify the exclusion zones, contamination reduction zones and support zones.

Exclusion Zone: Active work areas where sampling or equipment decontamination are being performed. Level C or Level D personal protective equipment shall be used unless another level of PPE is appropriate. The Exclusion Zone will encompass all contaminated areas until the air monitoring and site sampling indicates no contamination or exposure exists. The exclusion zone shall be a 30-ft radius area around the drill rig, equipment decontamination facility, or work area.

Support Zone: Areas where site administrative activities are conducted. These areas are uncontaminated and where no exposure is anticipated. No PPE is required in this zone. The support zone is a staging area for equipment and personnel. It is within this zone that a log will be kept of all personnel entering and leaving the site. Access of personnel and equipment into the exclusion zone will be controlled through this zone.

Contamination Reduction Zone: The corridor between the Exclusion Zone and the Support Zone where personal decontamination will take place. Appropriate PPE will be donned in the Contamination Reduction Zone prior to entry into an Exclusion Zone. PPE that has been used in an Exclusion Zone will be removed in the Contamination Reduction Zone prior to entry to the Support zone.



CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
A-E SITE SAFETY & HEALTH PLAN

SITE VICINITY MAP

Sverdrup Environmental

FIGURE 10-1

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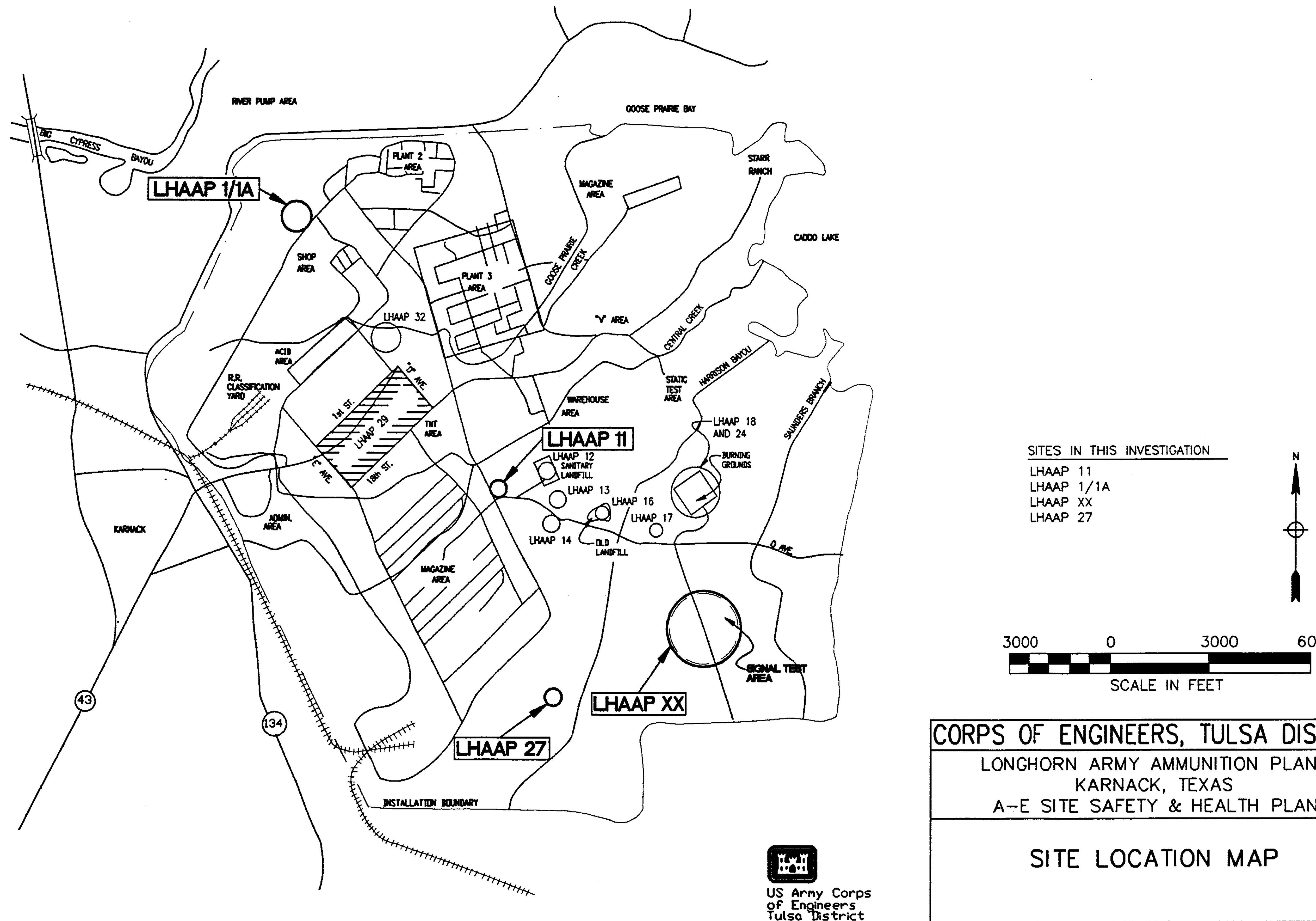


CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
A-E SITE SAFETY & HEALTH PLAN

SITE LOCATION MAP

Sverdrup Environmental

FIGURE 10-2

000086-3\CADD\LH3-01

10.3 SITE COMMUNICATIONS

Successful communications between field teams and contact with personnel in the support zone is essential. The following communications system will be available during activities at the Longhorn Army Ammunition Plant Site.

- The size and nature of the LHAAP will require radio and/or cellular telephone communications. The availability and suitability of various systems will be investigated locally.

- Hand Signals

Signal	Definition
Hands clutching throat	Out of air/can't breath
Hands on top of head	Need assistance
Thumbs up	OK/I'm alright/I understand
Thumbs down	No/negative
Arms waving upright	Send backup support
Grip partners wrist	Exit area immediately

10.4 SITE SECURITY

Entry and exit to and from the site will be limited to authorized personnel.

10.5 SITE ACCESS

Entry and exit to and from the site will be permitted only through designated access points, except during an emergency or as authorized by the SSO.

11.0 PERSONAL DECONTAMINATION FACILITIES AND PROCEDURES

11.1 PERSONAL HYGIENE

Sverdrup personnel must thoroughly wash their hands and faces before eating.

Facial hair will not be allowed where the respirator seal contacts the face.

11.2 PERSONAL DECONTAMINATION

Personnel and equipment decontamination is necessary when personnel or equipment enter and exit the exclusion zones and contamination reduction zones.

Personnel decontamination will be performed to minimize removing contamination from the site. Personnel decontamination will consist primarily of soap and water washings and water rinsing of reusable exterior protective gear to remove contaminants, followed by removal of the equipment. The extent of washing required, or modifications to the sequence, may be specified by the SSO. Coveralls should be removed by turning the clothing inside out.

General practices that will be observed while in contaminated areas will include:

- Do not walk through areas of obvious or known contamination.
- Do not handle or touch contaminated materials directly.
- Verify all PPE is free of cuts and tears prior to donning.
- Stay upwind from airborne contaminants.
- Limit the amount of contamination that contacts equipment.
- Keep excavated soils contained.

Steps in decontamination will include:

- Wash work gloves, boots, and outer protective coverall (if water resistant and reusable);
- Rinse work gloves, boots, and coveralls;
- Remove PVC or rubber boots;
- Remove tape at wrists, ankles;
- Remove outer suit (also gloves, hard hat, boot covers);
- Remove respirator;
- Wash and rinse respirator;
- Remove latex gloves or equivalent.

Non-reusable equipment will be collected in plastic trash bags. These materials will be disposed of as solid waste unless field evaluations indicate that the material should be containerized for disposal as a special waste or a hazardous material.

Respirators will be rinsed with potable water in the field after each use and will be cleaned at the end of each day using a soap and water wash followed by a potable water rinse. Respirators will be inspected daily for damage, missing parts, and proper function. A personnel decontamination station will be established at the main decontamination area.

12.0 EQUIPMENT DECONTAMINATION FACILITIES AND PROCEDURES

12.1 EQUIPMENT DECONTAMINATION

Decontamination of equipment will be performed to limit the migration of contaminants off-site and between work areas on the site. All equipment and other tools will be cleaned prior to site entry to remove grease, oil, encrusted dirt, or other materials. An inspection of the equipment will be made by the Site Manager/SSO prior to approving equipment for use on-site.

Decontamination of small reusable equipment will be performed at a designated location within the contamination reduction zone. Decontamination of equipment will consist of soap and water washing and water rinse. Details on equipment decontamination are contained in Section 4.8 of the CDAP Addendum.

Following decontamination, clean equipment will be stored on plastic sheeting if not immediately used. The Site Manager/Site Safety Officer will be responsible for inspecting all equipment leaving the site for adequacy of decontamination.

12.2 DISPOSITION OF DECONTAMINATION WASTES

Disposition of personal protective equipment will be collected in plastic trash bags and placed in 55-gallon drums for on-site storage.

Decontamination water will be collected and drummed. Sverdrup will take every precaution to prevent contaminated water from leaving the exclusion zone.

12.3 DOCUMENTATION

Implementation of the provisions of the SSHP will be completely documented. The Project Manager/Site Safety Officer will set up and maintain a separate file to receive health and safety related records and activity reports. This file should contain the following records:

- One copy of the SSHP
- One copy of the Sverdrup Health and Safety Manual
- Records of usage, calibration, and results of environmental monitoring equipment
- Sverdrup personnel injury/exposure incident reports, OSHA 200 forms, material safety data sheets

- Records of safety violations and remedial actions taken

A health and safety field logbook will be maintained on-site and will contain such information as: weather conditions, all personnel on-site, levels of protection worn, monitoring instrumentation readings (average, peak, and background), subjects discussed during daily site health and safety briefings, and safety violations.

13.0 EMERGENCY FIRST AID REQUIREMENTS AND EQUIPMENT

- American National Red Cross First Aid Handbook
- Compresses
- Gauze & gauze roller bandage
- Triangular bandages
- Eye dressing packet
- Portable eye wash unit
- Safety rope & harness
- Soap or waterless hand cleaner and towels
- Band aids
- Tape
- Scissors
- Tweezers
- Razors

14.0 STANDARD OPERATING PROCEDURES FOR EMERGENCY RESPONSE AND CONTINGENCY PLANS

This section describes contingencies and emergency planning procedures to be implemented at the Longhorn Army Ammunition Plant Site. This plan must be compatible with local, state and federal disaster and emergency management plans as appropriate.

14.1 PRE-EMERGENCY PLANNING

During the site briefings held periodically, all employees will be trained in and reminded of provisions of the emergency response plan, communication systems, and evacuation routes.

The plan will be reviewed and revised if necessary, on a regular basis by the Site Manager/Site Safety Officer. This will verify that the plan is adequate and consistent with prevailing site conditions.

14.2 PERSONNEL ROLES AND LINES OF AUTHORITY

The Site Manager has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measure to ensure the safety of site personnel and the public. Possible actions may involve evacuation of personnel from the site area. He is additionally responsible for verifying corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. The SSO/Site Manager will direct responses to any medical emergency.

All employees are responsible for assisting the Site Manager and SSO within the parameters of their scope of work.

14.3 EMERGENCY CONTACT/NOTIFICATION SYSTEM

The following list provides names and telephone numbers for emergency contact personnel. In the event of a medical emergency, personnel will take direction from the Site Manager and notify the appropriate emergency organization. In the event of a fire or spill, the Site Manager will notify the appropriate local, state, and federal agencies:

Organization	Contact	Telephone
Marshall Memorial Hospital (emergency # 903-935-8745)		903-935-9311
Ambulance Service 903-938-6711		911
Marshall Fire Department 903-938-6711		911
Marshall Police 903-935-7831		911
Texas Natural Resources Conservation Commission		903-595-5466
Longhorn AAP Fire Department (Thiokol)		903-679-2315
Longhorn AAP Ambulance (Thiokol)		903-679-2315
Longhorn AAP Security (Thiokol)		903-679-2710
LHAAP Environmental Coordinator Dave Tolbert		903-679-2613
RCRA/Superfund (M-F 8:30 am - 7:30 pm EST)		800-424-9346
Title III Community Right to Know (Answers questions about Regulatory issues)		800-535-0202
National Response Center		800-424-8801
Center for Disease Control (CDC) (Atlanta, Georgia)		404-639-3311
Poison Control Center		800-822-9761
CDC - Emergency Response (Chemical spills)		404-639-0615
National Institute for Occupational Safety and Health (NIOSH), Cincinnati, Ohio		800-356-4674
Chemtrec (24 hour emergency no.)		800-424-9300
Sverdrup Environmental Project Manager	Dennis Boll	314-770-4116

Following these emergency calls, the following personnel listed below shall be notified:

Tulsa District

Bob Vandegriff, Safety Office	(918) 669-7360
Greg Snider, Industrial Hygienist	(918) 669-7073
Scott Henderson, A-E Manager	(918) 669-7500

Huntsville District

David Douthat, Explosives MCX	(205) 955-5785 (Explosives incidents only)

14.4 EVACUATION ROUTES/PROCEDURES

Project Manager and Site Manager are to be contacted for all emergencies. Medical emergencies will be taken to:

Marshall Memorial Hospital

811 South Washington

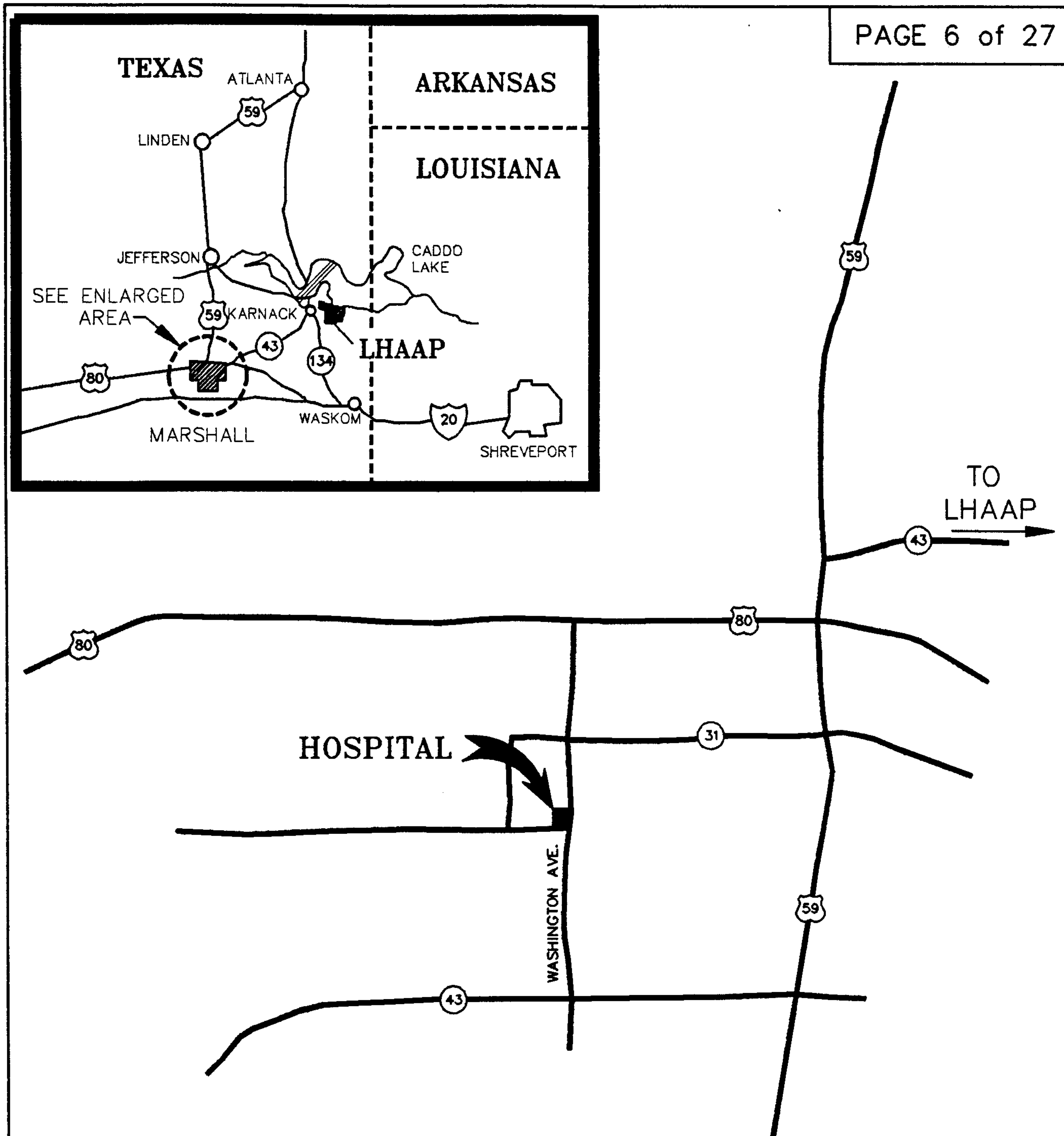
Marshall, Texas

903-935-9311 (Russ Collier - Director of Business Service)

From Longhorn, Hwy. 43 southwest to Hwy. 59, south on Hwy. 59 to Hwy. 80, west on Hwy. 80 to Grand, south on Grand 1 mile to Marshall Memorial Hospital. The hospital location is shown in Figure 14-1.

14.5 EMERGENCY MEDICAL TREATMENT PROCEDURES

Any person who becomes ill or injured in the exclusion zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must immediately be reported to the Project Manager and the Sverdrup Health and Safety Manager.



CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
A-E SITE SAFETY & HEALTH PLAN

HOSPITAL LOCATION MAP

Sverdrup Environmental

FIGURE 14-1

Any person being transported to a clinic or hospital for treatment should take with them information on the chemical(s) they have been exposed to at the site. This information is included in Section 3.0.

Any vehicle used to transport contaminated personnel will be treated and decontaminated as necessary.

14.6 FIRE OR EXPLOSION

In the event of a fire or explosion, the local fire department should be summoned immediately. Upon their arrival, the Site Manager or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials on-site.

If it is safe to do so, site personnel may:

- Use fire fighting equipment available on-site to control or extinguish the fire; and,
- Remove or isolate flammable or other hazardous materials which may contribute to the fire.

14.7 SPILL CONTAINMENT PROGRAM

The procedures defined in this section comprise the spill contaminant program in place for activities at the Longhorn Army Ammunition Plant Site.

- All drums and containers used during the clean-up shall meet the appropriate DOT, OSHA, and EPA regulations for the waste that they will contain.
- Drums and containers shall be inspected and their integrity verified prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions, shall be positioned in an accessible location and inspected prior to further handling.
- Operations on-site will be organized so as to minimize the amount of drum or container movement.
- Employees involved in the drum or container operations shall be trained concerning the hazards associated with the containers.
- Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (absorbent, etc.) will be stationed in the immediate area. The spill containment program must be sufficient to contain and isolate the entire volume of hazardous substances being transferred.

- Drums or containers that cannot be moved without failure, shall be emptied into a sound container.

- Fire extinguishing equipment meeting 29 CFR 1910 shall be on hand and ready for use to control incipient fires.

14.8 CONFINED SPACE ENTRY PROCEDURES

A confined space provides the potential for unusually high concentrations of contaminants, explosive atmospheres, limited visibility, and restricted movement. This section will establish requirements for safe entry into, continued work in, and safe exit from confined spaces. Additional information regarding confined space entry can be found in 29 CFR 1910, 1926, and NIOSH 87-113. The Sverdrup Director of Health and Safety will be notified before any confined space entry is attempted.

14.8.1 Definitions

Confined Space: A space or work area large enough and so configured that an employee can bodily enter and perform assigned work, has limited or restricted means for entry or exit (examples include tanks, vessels, silos, storage bins, hoppers, vaults, pits, and diked areas), is not designated for continuous employee occupancy and has one or more of the following characteristics:

- contains or has a known potential to contain a hazardous atmosphere,
- contains a material with the potential for engulfment of an entrance,
- has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls, or a floor which slopes downward and tapers to a smaller cross-section, or
- contains any other recognized serious safety and health hazard.

Confined Space Entry Permit (CSEP): A document to be initiated by the Project Manager, Site Manager or Site Safety Officer before enter into or work in a confined space. The Confined Space Entry Permit (CSEP) will be completed by the Site Manager/Site Safety Officer before personnel will be permitted to enter the confined space. The CSEP shall be valid only for the performance of the work identified and for the location and time specified. The beginning of a new shift with change of personnel will require the issuance of a new CSEP (CSEP Form follows).

SVERDRUP ENVIRONMENTAL, INC. CONFINED SPACE ENTRY PERMIT

DATE: ____________ TIME: ____________ EXPIRATION: ____________

LOCATION: ____________

DESCRIPTION OF CONFINED SPACE: ____________

____

PERSON IN CHARGE OF WORK: ____________

EMPLOYEES DOING WORK AND DUTIES: ____________

____

____

____

____

ITEM	YES/NO	COMMENT
Lockout completed		
Lines broken - capped or blanked		
Purged - flushed and vented		
Ventilation needed		
Area secured, posted		
Respiratory protection, type		
Head, eye, ear, skin, foot protection, type		
Escape harness, lifeline		
Tripod emergency escape unit		
Lighting		
Fire Extinguisher		
Welding/cutting permit issued		
Have all employees reviewed the Health and Safety Procedures		

Testing	PEL	Instrument/Calibration Date	Concentration
Percent Oxygen	19.5-23.5%		
Percent LEL	any over 10%		
Carbon monoxide	35 ppm		
Hydrogen sulfide	10 ppm		

EMERGENCY PHONE NUMBERS:

Fire Department: ____________ Police Department: ____________

Ambulance: ____________ Medical: ____________

Confined Space Observer: An individual assigned to monitor the activities of personnel working within a confined space. The confined space observer monitors and provides external assistance to those inside the confined space. The confined space observer summons rescue personnel in the event of emergency and assists the rescue team.

14.8.2 General Provisions

- When possible, confined spaces should be identified with a posted sign which reads: Caution - Confined Space.
- Only personnel trained and knowledgeable of the requirements of these Confined Space Entry Procedures will be authorized to enter a confined space or be a confined space observer.
- A Confined Space Entry Permit (CSEP) must be issued prior to the performance of any work within a confined space. The CSEP will become a part of the permanent and official record of the site.
- Natural ventilation shall be provided for the confined space prior to initial entry and for the duration of the CSEP. Positive forced mechanical ventilation may be required. However, care should be taken to not spread contamination outside of the enclosed area.

- If flammable liquids may be contained within the confined space, explosion proof equipment will be used. All equipment shall be positively grounded.

- The contents of any confined space shall, where necessary, be removed prior to entry. All sources of ignition must be removed prior to entry.

- Hand tools used in confined spaces shall be in good repair, explosion proof and spark proof, and selected according to intended use. Where possible, pneumatic power tools are to be used.

- Hand-held lights and other illumination utilized in confined spaces shall be equipped with guards to prevent contact with the bulb and must be explosion proof.

- Compressed gas cylinders, except cylinders used for self-contained breathing apparatus, shall not be taken into confined spaces. Gas hoses shall be removed from the space and the supply turned off at the cylinder valve when personnel exit from the confined space.

- For all confined space entries body harnesses and lifelines will be used. The outside observer shall be provided with the same equipment as those working within the confined space.

- An untested confined space or any confined space with conditions determined immediately dangerous to life and health (IDLH) shall not be entered.

- When air-moving equipment is used to provide ventilation, chemicals shall be removed from the vicinity to prevent introduction into the confined space.
- Vehicles shall not be left running near confined space work or near air-moving equipment being used for confined space ventilation.
- Smoking in confined spaces is prohibited at all times.
- Any deviation from these Confined Space Entry Procedures requires the prior review by the Sverdrup Health and Safety Manager.

14.8.3 Procedure for Confined Space Entry

The Project Manager/Site Safety Officer and Entry Team shall:

- Evaluate the job to be done and identify the potential hazards before a job in a confined space is scheduled.
- Verify that all process piping, mechanical and electrical equipment, etc. have been disconnected, purged, blanked-off or locked and tagged as necessary.
- If possible, verify removal of any standing fluids that may produce toxic or air displacing gases, vapors, or dust.
- Initiate a Confined Space Entry Permit (CSEP) in concurrence with the project manager or designated alternative.

- Verify that any hot work (welding, burning, open flames, or spark producing operations) that is to be performed in the confined space will be approved by the project manager or Site Manager/Site Safety Officer and is indicated on the CSEP.

- Verify that the space is ventilated before starting work in the confined space and for the duration of the time that the work is to be performed in the space.

- Verify that the personnel who enter the confined space and the confined space observer are familiar with the contents and requirements of this instruction.

- Verify atmospheric testing of the confined space prior to and continuously during employee entry and before validation/revalidation of a CSEP to verify the following:

  - Oxygen content between 19.5% - 23.5%.

  - Concentration of combustible gas in the space is less than 10% of the LEL. Sampling will be done throughout the confined space and specifically at the lowest point in the space.

  - The absence of other atmospheric contaminants, if the space has contained toxic, corrosive, or irritant material.

  - If remote testing is not possible, Level B PPE is required.

- Designate whether hot or cold work will be allowed. If all tests are satisfactory, complete the CSEP listing any safety precautions, protective equipment, or other requirements.

- Verify that a copy of the CSEP is posted at the work site, a copy is filed with the project supervisor, and a copy is furnished to the Project Manager.

The CSEP shall be considered void if significant changes within the confined space atmosphere or job scope occurs. Atmospheric testing will be continuous during a confined space entry.

The CSEP posted at the work site shall be removed at the completion of the job or the end of the shift, whichever is first.

14.8.4 Confined Space Observer

- While personnel are inside the confined space, a confined space observer will monitor the activities and provide external assistance to those in the space. The observer will have no other duties which may take his attention away from the work or require him to leave the vicinity of the confined space at any time while personnel are in the space.
- The confined space observer shall maintain at least voice contact with all personnel in the confined space. Visual contact is preferred, if possible.

- The observer shall be instructed by his supervisor in the method for contacting rescue personnel in the event of an emergency.

- If irregularities within the space are detected by the observer, personnel within the space will be ordered to exit.

- In the event of an emergency, the observer must NEVER enter the confined space prior to contacting and receiving assistance from a helper. Prior to this time, he should attempt to remove personnel with the lifeline and to perform all other rescue functions from outside the space.

- A helper shall be designated to provide assistance to the confined space observer in case the observer must enter the confined space to retrieve personnel.

14.9 STANDARD OPERATING PROCEDURES (SOP)

UXO SURVEYS

STEP DESCRIPTION	SPECIFIC INSTRUCTIONS
1. Daily Operations	a. All personnel report to the work site at time designated by the Senior UXO Supervisor.
	b. The Senior UXO Supervisor will give the daily safety briefing to all site workers and give specific instructions for the day's work.

c. The project command post (CP) will be designated and all personnel not directly involved in down-range operations will remain at the CP. Visitors requesting to observe down-range operations will be escorted by the Senior UXO Supervisor or his representative.

d. Communications with down-range personnel are mandatory. Radios, if required, will be tested prior to beginning UXO operations.

e. A minimum of two qualified UXO Technicians will be onsite during all UXO operations.

f. The Senior UXO Supervisor will maintain a log detailing all field operations in accordance with direction contained in the work plan.

2. Geophysical Survey Procedures

a. The UXO Supervisor will verify areas to be cleared of UXO with the Project Manager or Site Manager.

b. The UXB survey crew, consisting of a minimum of one UXO Supervisor and one UXO Technician, will conduct a visual inspection of the survey area to locate any obvious surface UXO hazards.

c. The survey area will be divided into six-foot-wide search lanes using wooden stakes and surveyor's line to clearly mark the lanes.

d. The geophysical instruments to be used to conduct the survey will be assembled and operationally checked in the CP area, by testing the instrument response to known objects buried at known depths, prior beginning the geophysical survey.

f. All subsurface metallic contracts will be marked with pin flags for later excavation and identification.

3. UXO Disposal

a. All confirmed UXO will be identified, recorded, and the responsible owner will be notified of their location, type, condition, and quantity for final disposition.

4. Post-Operation Procedures

a. The UXO Supervisor will ensure all equipment is properly stored and secured. Important: Loosen swivel screws on Foerster Ferex before folding probe.

b. The UXO Supervisor will conduct a daily debrief of the project and briefly outline the next day's objectives.

c. Prior to departing the work site the UXO Supervisor will ensure that the project area is clean and free of UXO and industrial hazards.

UXO SAFETY ESCORT

STEP DESCRIPTION	SPECIFIC INSTRUCTIONS
1. Daily Operations	a. All personnel report to the work site at time designated by the Senior UXO Supervisor.
	b. The Senior UXO Supervisor will give the daily safety briefing to all site workers and give specific instructions for the day's work.
	c. The project command post (CP) will be designated and all personnel not directly involved in down-range operations will remain at the CP.
	d. Communications with down-range personnel are mandatory. Radios, if required, will be tested prior to beginning UXO operations.
	e. A minimum of one qualified UXO Technician will be on site during all UXO operations.
	f. The Senior UXO Supervisor will maintain a log detailing all field operations in accordance with direction contained in the work plan.
2. Geophysical Survey Procedures	a. One UXO Technician will survey the area to be traversed ahead of the samplers and mark ordnance items (both surface and subsurface) with biodegradable spray paint or pin flags. These marked areas will be avoided during this and subsequent passage.
	b. Any UXO located is to be left in place and reported to the responsible unit for final disposition.

c. Areas such as demolition ranges, disposal burn sites, or landfills containing ordnance, will require a UXO Technician to accompany non-ordnance personnel during each excursion within the site boundaries.

d. Cleared areas will be re-inspected after excavation, heavy rains, or any other terrain-altering disturbances which may have uncovered ordnance.

e. Any area deemed to be too heavily contaminated with ordnance or explosive waste by the Senior UXO Supervisor to allow non-ordnance personnel to enter for sampling or other activities may require the activities to be performed by a UXO Technician under the instruction of the sampler.

UXO DOWN-HOLE MONITORING

STEP DESCRIPTION	SPECIFIC INSTRUCTIONS
1. Daily Operations	a. All personnel report to the work site at time designated by the Senior UXO Supervisor.
	b. The Senior UXO Supervisor will give the daily safety briefing to all site workers and give specific instruction for the day's work.
	c. The project command post (CP) will be designated and all personnel not involved in down-range operations will remain at the CP.
	d. Communications with down-range personnel are mandatory. Radios, if required, will be tested prior to beginning UXO operation.
	e. The Senior UXO Supervisor will maintain a log detailing all field operations in accordance with direction contained in the work plan.
2. Downhole Geophysics Procedures	a. Proposed soil boring monitoring well sites will be reviewed with prime contractor for position, physical obstacles, and access paths.
	b. Selected drilling sites will be marked with stakes and flagging tape to identify the cleared radius. Radii will be based on size of drill rig as follows: Minimum . . . . 15 feet 1 ton rig . . . . 30 feet 5 ton rig . . . . 45 feet 10 ton rig . . . . 60 feet
	c. The safety radii will be surveyed with the Foerster Ferex Ordnance Locator and the White's Eagle II detector to a depth of two feet. All metallic contacts

will be marked for avoidance or excavated and identified (contract specific).

d. A 15 foot wide access path from the nearest road to the well site will be marked with stakes and flagging and cleared in the same manner as the safety radius. The stakes will be of sufficient height to be visible to the drill rig driver as he maneuvers from the road to the drill site.

e. A UXO Technician will hand auger down two to three feet at the proposed well site. With the Foerster configured in the underwater mode, the probe will be lowered to the bottom of the hole and monitored for metallic contacts. The technician will then hand auger to a depth of five feet, and repeat monitoring with the Foerster. At this point, the well site will be cleared to a depth of seven feet.

f. Position the drill rig upwind of well site. To facilitate sampling in undisturbed soil, the drill rig auger can offset to within one foot of the hand-augered hole and still be assured of a UXO-free path.

14.10 SNAKE BITE

Normally, the noise created by a person approaching a snake habitat is sufficient to frighten the snake off. However, extreme caution is necessary when exploring areas where snakes might be found, such as behind rocks, under bushes, or in holes, crevices, and abandoned pipes.

The rules to follow if bitten by a snake are:

- **Do not** cut the bite area as it will exacerbate the effect of the venom.
- **Do not** apply suction to the wound as it is minimally effective in removing venom.
- **Do not** apply a tourniquet since venom is most dangerous when concentrated in a small area.
- **Do not** allow the victim to run for help as this will accelerate circulation.
- **Do** seek immediate medical attention.
- **Do** keep the victim calm and immobile.
- **Do** have the victim hold the affected extremity lower than the body while waiting for medical assistance.

14.11 THUNDERSTORMS AND TORNADOES

Meteorological conditions shall be closely watched, especially in the spring, when severe thunderstorms and tornadoes are most likely to occur. Thunderstorms and tornadoes often occur late in the afternoon on hot spring days, but can occur at any time of the day in any season of the year. Tornadoes are usually preceded by severe thunderstorms with frequent lightning, heavy rainfall, and strong winds.

A **severe thunderstorm watch** or a **tornado watch** announcement on radio or television indicates that a severe thunderstorm or tornado is possible. Work may continue at the work site during severe thunderstorm watches or tornado watches if conditions allow. A **severe thunderstorm warning** or a **tornado warning** signifies that a severe thunderstorm or a tornado has been sighted or detected by radar and may be approaching. All work on site shall cease during a thunderstorm, severe thunderstorm warning, or a tornado warning.

Personnel on site during a tornado shall take the following steps:

- Evacuate office trailers or vehicles.
- If outdoors, lie flat in a nearby ditch.
- Stay away from power poles, electrical appliances, and metal objects.
- Do not try to outrun a tornado.

14.12 ADVERSE WEATHER

In the event of adverse weather, the Site Safety and Health Officer will determine if work can continue without sacrificing the health and safety of site personnel. Some of the items to be considered prior to determining if work should continue are:

- Heavy rainfall
- Potential for heat stress
- Tornadoes
- Limited visibility
- Electrical storms
- Potential for accidents
- Malfunctioning of monitoring equipment

14.13 INCIDENTS

14.13.1 Investigation

Upon receiving a report of an incident on the site, the Site Safety and Health Officer will investigate the circumstances surrounding the incident. The COE Occupational Safety and Health Office may be requested to participate in the investigation of serious incidents.

14.13.2 Incident Reporting

All serious incidents resulting in a fatality, emergency response, lost work time, or medical treatment will be reported immediately by the appropriate Site Safety and Health

Officer. A written report will be forwarded to the COE Occupational Safety and Health Office, at the address listed below, within 48 hours of the incident. An incident follow-up report will be distributed within one week of the incident.

U.S. Army Corps of Engineers

Safety and Occupational Health Office

1645 S. 101 E. Ave

P.O. Box 61

Tulsa, Oklahoma 74121

15.0 RECORDKEEPING

Implementation of the provisions of this SSHP must be completely documented. The Site Manager/Site Safety Officer must set up a separate file to receive health and safety related records and activity reports. This file should contain the following records:

- One copy of the SSHP.
- A list of personnel engaged in each site activity and verification of the use of the specified protective and environmental monitoring equipment.
- Employee injury/exposure incident reports.
- Safety violation records and remedial actions taken.
- Other pertinent health and safety related observations.
- Air sampling pump calibration records, sampling data sheets, and chain-of-custody forms.

All field personnel must sign the Compliance Agreement, indicating that they have attended a briefing by the Site Manager/Site Safety Officer, understand, and agree to abide by the provisions of this SSHP prior to working at the Longhorn Army

Ammunition Plant Site. Personnel will be trained by the Site Manager/Site Safety Officer before entering the site.

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Ebasco, Draft RCRA Facility Investigation Site Safety and Health Plan, Eight Sites in RCRA Permit. 1990.

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Occupational Safety and Health Administration (OSHA), Construction Industry Standards, 29 CFR 1926, and general Industry Standards, 29 CFR 1910; especially 29 CFR 1910.120 - "Hazardous Waste Site Operations and Emergency Response," Federal Register, Vol. 54, No. 42, (6 March 1989).

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NIOSH/OSHA/USCG/EPA, "Occupational Safety and Health, Guidance Manual for Hazardous Waste Site Activities", October 1985.

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U.S. Army Corps of Engineers, Tulsa District Respiratory Protection Program.

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U.S. Dept of Labor, Occupational Safety and Health Administration, 29 CFR 1910, General Industry Standards.

U.S. Environmental Protection Agency, "Standard Operating Safety Guides," (July 1988).

17.0 APPROVALS

David Boll — 6-14-94

Sverdrup Project Manager — Date

Brian Kraus — 6-16-94

Sverdrup Health and Safety Manager — Date

18.0 COMPLIANCE AGREEMENT

I, ______________________, have read this Site Safety and Health Plan and hereby agree to abide by its provisions and to aid the Site Safety Officer in its implementation. I understand that it is in my best interest to see that site operations are conducted in the safest manner possible; therefore, I will be alert to site health and safety conditions at all times.

____
Signature

____
Date

008815

FINAL

A-E
CHEMICAL DATA ACQUISITION PLAN

for the

PHASE II
REMEDIAL INVESTIGATION
SITES 11, 1, XX, 27

at

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Submitted to:

U.S. ARMY CORPS OF ENGINEERS
Tulsa District

AUGUST 1994

Prepared by:

SVERDRUP ENVIRONMENTAL, INC.
ST. LOUIS, MISSOURI

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LIST OF ACRONYMS/ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ASTM	American Society for Testing and Materials
CDAP	Chemical Data Acquisition Plan
COC	Chain of Custody (form)
COE	U.S. Army Corps of Engineers
EPA	U.S. Environmental Protection Agency
GC/MS	Gas Chromatograph/Mass Spectrometer
GC/EC	Gas Chromatograph/Electron Capture
gpm	Gallons per minute
IDW	Investigation-Derived Waste
LHAAP	Longhorn Army Ammunition Plant
OEW	Ordnance and Explosive Waste
PID	Photoionization Detector
QA/QC	Quality Assurance/Quality Control
RI/FS	Remedial Investigation/Feasibility Study
SEC	Site Emergency Coordinator
SSHP	Site Safety and Health Plan
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

This A-E Chemical Data Acquisition Plan (A-E CDAP) for the Remedial Investigation at the Longhorn Army Ammunition Plant (LHAAP) in Karnack, Texas is intended to complete the CDAP Addendum which was written using the LHAAP RI/FS Work Plan prepared by the U.S. Army Corps of Engineers (USACE) in June, 1992. The A-E CDAP describes in detail the activities that will be used to carry out all steps of the information collection and development process for the Phase II remedial investigation of the Group No. 1 sites. The A-E CDAP supplements the RI/FS Work Plan and CDAP Addendum with minimal duplication of information. Each document is necessary to understand the background, purpose, methods and procedures of the planned field investigation.

The A-E CDAP presents the sections which contain additional information that is specific to Sverdrup Environmental, Inc. and the proposed plan of investigation. These sections are not intended to replace the corresponding section in the CDAP Addendum, only to expand on them. Those sections which are unchanged remain here with a reference to the CDAP Addendum.

2.0 PROJECT ORGANIZATION

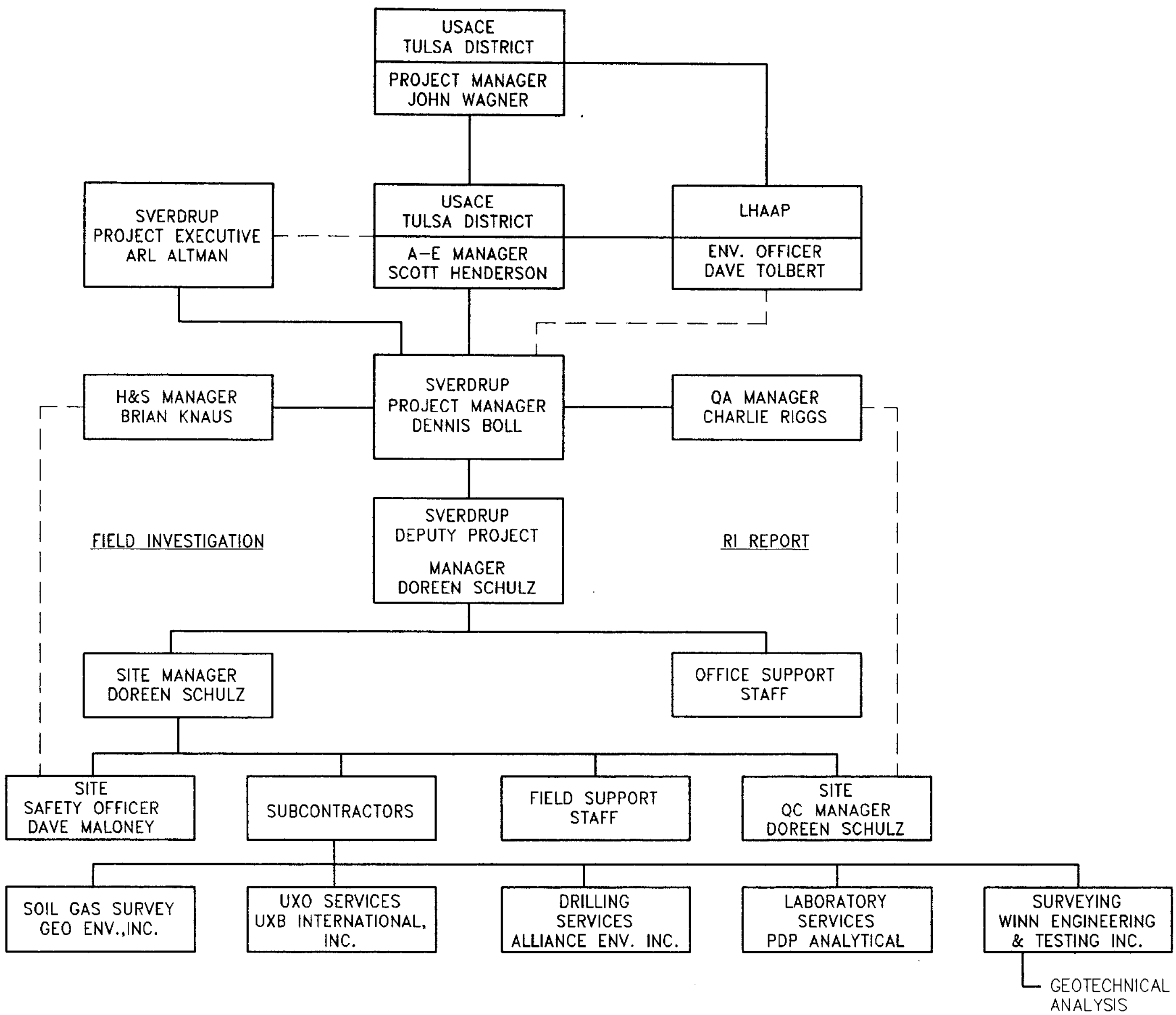
This section presents the responsibilities of the key Sverdrup project personnel and the subcontractors chosen to complete the field investigation. The management structure is illustrated in Figure 2-1. Resumes are presented in Appendix A. For information relating to the USACE project organization, please refer to the CDAP Addendum.

2.1 KEY SVERDRUP PROJECT PERSONNEL

2.1.1 Project Manager

Sverdrup's project manager will be responsible and accountable to USACE for overall project direction and performance, including:

- quality and timeliness of deliverables,
- application of resources,
- schedule and budget tracking, and revision, if necessary,
- progress reporting,
- work performed by subcontractors,
- problem resolution,
- keeping all parties appropriately informed,
- planning to avoid delays and



CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
A-E CDAP

ORGANIZATION CHART

Sverdrup Environmental

FIGURE 2-1

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- principal project contact and liaison with the USACE Project Manager and Contracting Officer.

Dennis Boll will serve as Sverdrup's project manager.

2.1.2 Project Executive

At Sverdrup, the project executive is the senior Sverdrup representative on a project, and is management's focal point for the client. The project executive's responsibilities include:

- negotiating and executing contracts and modifications,
- approving criteria and procedures manuals for the project,
- ensuring that Sverdrup's QA/QC program is applied,
- supporting the project manager in executing a successful project and
- maintaining contact with USACE throughout the work.

Arl Altman will serve as the project executive.

2.1.3 Site Coordinator

The site coordinator will be responsible for coordinating all site activities, including those of the on-site subcontractors, and all laboratory activities. The site coordinator will serve as site manager during the field investigation. Specific site manager duties include:

- providing overall direction and supervision of the drilling, excavation, well installation and related activities,
- seeing that appropriate field logs are maintained for project activities,
- providing overall supervision of the collection, handling and shipping of all samples and
- monitoring all drilling and sampling operations to ensure that all project site personnel adhere to the provisions of the CDAP, SSHP, and Field Work Plan.

Doreen Schulz will serve as the site coordinator.

2.1.4 QA Manager

The Sverdrup QA manager is responsible for assuring that Sverdrup's QA program is implemented in all project activities, including:

- QC protocols and procedures are followed,
- audits to see that all deliverables are properly reviewed and checked and

- documenting that all quality objectives have been met.

Charlie Riggs will serve as the project QA manager.

2.1.5 Site QC Manager

All project personnel must recognize that data quality begins with the individual tasks they perform. They must understand the quality requirements of the tasks, and bring to the attention of management conditions that adversely impact the quality of the data or other work product. The site QC Manager will be responsible for the proper execution of field QC procedures. On quality matters, the site QC Manager reports to the QA Manager and/or the Project Executive outside the normal project chain of command.

Doreen Schulz will serve as the Site QC Manager.

2.2 ANALYTICAL LABORATORY

PDP Analytical Services of Spring, Texas will serve as the analytical laboratory for the Phase 2 field investigation. PDP has been in operation for three years and is classified as a small, disadvantaged business. PDP has been utitlized in the past six months by USACE contractors associated with the Longhorn Army Ammunition Plant and is familiar with the analytical requirements of the investigation. A copy of PDP's Quality Assurance Plan is included as Appendix B.

2.3 HEALTH AND SAFETY MANAGEMENT

The field activities described in this A-E CDAP will be conducted in accordance with the requirements of the A-E Site Safety & Health Plan (A-E SSHP), submitted separately. Sverdrup staff assignments for management of health and safety compliance are detailed in the A-E SSHP.

2.4 SUBCONTRACTOR MANAGEMENT

The Subcontractor for drilling, monitoring well installation, geotechnical laboratory analysis and related services is Alliance Environmental, Inc., 117 Industry Road, Marietta, Ohio 45750-9355. Tel: (614) 373-2190; Fax: (614) 374-5908.

UXO site clearance services will be provided by UXB International, Inc., 14800 Conference Center Drive, Suite 100, Chantilly, VA 22021-3806. Tel: (703) 803-8904; Fax: (703) 803-9355.

Analytical laboratory services will be provided by PDP Analytical Services, 24900 Pitkin Drive, Suite 300, Spring, Texas 77386, Tel: (713) 363-2233; Fax: (713) 298-5784.

The soil-gas survey will be conducted by Geo Environmental Testing, 10770 Trenton, St. Louis, MO 63132. Tel: (314) 890-0038; Fax: (314) 890-0056.

Surveying services will be provided by Winn Engineering and Testing, Inc., 2702 Estes Parkway, P.O. Box 7236, Longview, TX 75607. Tel: (903) 758-1171; Fax: (903) 758-2701.

008830

3.0 DATA QUALITY OBJECTIVES

SvE offers no additions or modifications to this section, please refer to the CDAP Addendum for information on the Data Quality Objectives.

4.0 FIELD OPERATIONS

The principal operations of the field investigation will be soil sampling, installation of monitoring wells, groundwater sampling, sediment sampling, a soil-gas survey, management of investigation-derived wastes (IDW), and various field measurements. All intrusive activities will be preceded by UXO clearance and escort activities. The field investigation will be enveloped by the field QA/QC program in order to ensure that the data quality objectives are met. Surveying services to locate as-built sampling sites, monitoring wells, etc., and to establish ground surface and top of casing elevations, will be provided by a subcontractor.

This section presents detailed information on the activities required to complete the field investigation in accordance with the plan outlined in the Field Work Plan Addendum (Sverdrup, 1994) and the CDAP Addendum (Sverdrup, 1994).

The basis for selecting the general locations, types of samples to be collected and the analytical parameters at each of the four LHAAP areas are developed in the USACE RI/FS Work Plan, Volume 1 (USACE, 1992) and the Work Plan Addendum for Sites 11, 1, XX and 27 (Sverdrup, 1994). The field investigation plan developed to accomplish the objectives of the RI is presented in the CDAP Addendum (Sverdrup, 1994).

The procedures presented in Section 4.0 of the Addendum will be implemented by SvE during the field investigation. The following sections, which mirror those in the Addendum, present specific procedures SvE will follow during the field investigation. Sections not presented in the CDAP Addendum are added at the end of Section 4.0.

4.1 DRILLING

4.1.1 Soil Sampling Equipment

Soil sampling will be conducted in the manner outlined in Section 4.5. Soil samples collected during drilling will be obtained using a 3.0-inch O.D. standard steel split-barrels. This equipment will be used in the collection of both physical and chemical samples.

4.1.2 Protection of Lower Aquifers

Nominal 12-inch diameter steel casing will be installed at boring locations where perched water is encountered which may potentially contaminate deeper aquifers. In all cases, the surface casing will be seated within a sandy clay, silty clay, or clay stratum of relatively low hydraulic conductivity as compared with the aquifer materials.

Surface casings will be installed in the borings only after soil sampling has been conducted. The borehole diameter will be enlarged to a nominal 18-inch diameter using hollow stem augers or mud rotary drilling techniques. The surface casing will be seated in a stratum of relatively low hydraulic conductivity and grouted into place. Cement-bentonite grout will be pumped into the annulus between the casing and the borehole using a tremie pipe placed near the borehole bottom. The surface casing will be sand-blasted to remove any paint or other coating prior to installation. The grouted casing will be allowed to setup for at least 24 hours before proceeding to extend the borehole deeper.

Displaced waste drilling fluid and soil cuttings will be collected and contained in steel drums for later characterization and disposal by others.

4.1.3 Geological Logs

For each soil and sediment boring performed, a geological log will be completed using ENG Form 1836.

A geologist or geotechnical engineer will maintain the log for each boring. 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 strata changes
  - Presence and general orientation of 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, hammerweight, 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.

4.1.4 Borehole Abandonment

At completion of soil sampling, the soil boring will be completely grouted with cement/bentonite grout. The grout will be placed using a segmented PVC grout pipe lowered to the bottom of the borehole through the hollow stem augers. The grout will be pumped into the borehole until a return of grout is observed from the top of the auger casing. As the augers are withdrawn, grout will be added so that the grout level will not be allowed to fall below the bottom of the auger casing during casing withdrawal. Following removal of the last auger section, the remaining open annulus will be filled to the ground surface. Within 24 to 48 hours after grouting, any grout shrinkage will be topped-off to surface grade.

The grout mixture will consist of Portland cement, bentonite powder without additives, and tap water approved by the Contractor, in the proportions of 94 pounds (1 bag) Portland cement to 5 pounds of bentonite powder to 7 gallons of water. The grout will be prepared by first thoroughly mixing the bentonite and water, and then mixing in the Portland cement.

4.2 MONITORING WELLS

Table 4-1 lists eight (8) groundwater monitoring well installations and the estimated total depth of each well. The rationale for the selection of the locations for each well is presented in the Work Plan Addendum (Sverdrup, 1994). The estimated depths of individual well installations are based on anticipated soil conditions. Actual depths may vary depending on subsurface conditions encountered during the investigation.

The borings will be drilled using minimum 6.25-inch inside diameter (I.D.) hollow-stem augers to total depth. Soil samples for physical analyses will be obtained at minimum 5-ft depth intervals during drilling. Additional soil samples may be taken to better define stratigraphic conditions at individual boring locations. Soil samples for chemical analyses will be taken every 5-ft of unsaturated material. Each boring will be completed by installing a four-inch nominal diameter stainless steel 316 monitoring well with a 10-foot screened section.

TABLE 4-1

NEW MONITORING WELL INSTALLATIONS

Unit No.	Proposed Well No.	Estimated Total Well Depth (ft)
11	11-WW-01	20
	11-WW-02	20
	11-WW-03	20
1	01-WW-01	20
XX (optional)	XX-WW-01	30
27	27-WW-01	25
	27-WW-02	25
	27-WW-03	25
	27-WW-04	25

4.2.1 Soil Drilling and Well Installation

Typical soil drilling and well installation procedures will be as follows:

- Advance a nominal 6.25-inch I.D. hollow stem auger column to the required depth.
- Borings will be sampled on 5-ft intervals to total depth using a 3.0-inch O.D. split-barrel sampler.
- In the event that an obstacle is encountered in a boring, no attempt shall be made to drill through the obstacle. The boring will be abandoned and a second boring will be drilled approximately 10-ft horizontal distance from the original location.

- The depth of the completed borehole will be measured with a fiberglass tape having a stainless-steel weight on the end.
- Assemble the monitoring well screen, end plug, casing, and top cap. Casing and screen components will be handled by personnel wearing clean gloves. Personnel handling well casing will not touch the drill rig or other equipment except casing clamps, wrenches, and the hoisting plug , which will be used to suspend and place the well casing and screen inside the hollow stem augers.
- The auger casing will be slowly withdrawn one foot and the borehole depth remeasured. If the hole remains open, a six-inch thick layer of filter pack sand will be placed.
- The well assembly will then be lowered using the hoisting plug until it rests on the layer of filter sand.
- Filter sand will be placed in the well annulus with a slow continuous stream or by using a single hardware scoop. 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. As the sand level builds in small increments (1 to 2 inches) in the bottom of the annulus, the augers are withdrawn in equally small increments. The procedure of adding sand in small increments and withdrawing the augers in small increments shall be continued until the entire primary filter pack is installed.
- The primary filter pack sand will extend to approximately 3 feet above the top of the well screen.
- A 0.5-foot thick secondary filter pack will be installed above the primary filter pack prior to installation of the bentonite seal. The secondary filter will be installed in same manner as the primary filter.

- A 3-foot thick seal of 1/2-inch diameter bentonite chips will be installed above the lower secondary filter pack. The seal will be installed by slowly adding the chips to avoid bridging. The chips will be tamped with a stainless-steel weight suspended on a fiberglass measuring tape. The completed bentonite seal will be allowed to hydrate for approximately 45 minutes before proceeding with the installation, during which the annulus will be "sounded" to assure that the pellets or granules are not accumulating within the auger.
- A 0.5-foot thick secondary filter pack will be installed above the bentonite seal prior to installation of the annulus grout to assist in preventing infiltration of the grout into the bentonite seal.
- The remaining annulus will then be grouted from the top of the upper secondary filter pack to near the ground surface using a high solids pure bentonite grout containing no cement. The grout sets up with the consistency of a stiff clay and remains flexible when hydrated. The grout will be placed using a segmented PVC grout pipe lowered to the top of the secondary filter above the bentonite seal. Pumping will continue until a return of grout is observed from the top of the auger casing.
- The grout level within the auger column will be periodically topped-off as the augers are withdrawn. The grout level will not be allowed to fall below the bottom of the auger casing during casing withdrawal.
- Following removal of the last auger section, the top 3 feet of open annulus will be filled with a thick cement grout containing no bentonite.
- Before the cement grout sets, a protective steel cover will be centered on the well casing and inserted into the grouted annulus. The grout will be shaped to drain away from the riser casing.

Well casing will consist of flush-threaded, 4-inch nominal I.D., stainless steel 316 pipe. The casing will extend from the top of the well screen to an elevation above the potentiometric surface. Schedule 40 PVC casing will then be installed to approximately 24 to 36 inches above surface grade. Well casing will be provided with a vented PVC cap of similar size. No solvents, cements, or adhesive tapes may be used to join sections of pipe. PTFE tape may be used on threads to promote a tighter seal.

Well screen will consist of flush-threaded, 4-inch I.D., stainless steel 316 slot screen. Screen opening size will be 0.01 inches unless formation grain size indicates this is inappropriate. Screens will be a maximum of 10 feet in length. Installed screen lengths will vary, however, depending on the hydrogeologic conditions encountered at each borehole. No solvents, cements, or adhesive tape may be used to join sections of screen. PTFE tape may be used on treads to promote a tight seal.

The annular space between the well screen and the borehole wall will be backfilled with clean, washed, well graded, silica sand conforming to the requirements of ASTM C33. The filter pack shall be installed with a hardware scoop. The filter pack will extend from approximately six inches below the well screen to approximately three feet above the top of the screen. The filter material for the primary filter pack shall be clean silica sand with a 20-40 gradation.

Secondary filters, approximately 0.5 foot thick, will be installed between the primary filter pack and the bentonite seal, and between the bentonite seal and the annular grout. The secondary filter material shall be clean silica sand with 100 percent passing the No. 30 U.S. Standard sieve.

A bentonite seal will be installed above the filter pack and the lowermost secondary filter. The seal will consist of a tamped bentonite chip layer at least three feet thick.

The annular space between the well casing and the borehole wall will be grouted from the top of the uppermost secondary filter to the ground surface, using grout pumped through sectional, threaded, rigid, PVC grout pipe. The grout mixture will consist of high solids, pure bentonite without cement, in proportions of 50 pounds bentonite mix to 14 gallons of water. The grout will have a bentonite solids content of 30 percent by weight, and will have a density of 10.2 pounds per gallon.

The upper three feet of the borehole will be backfilled with pure cement grout in order to install a surface protective casing. The protective above-grade locking steel casing will be centered around the well and embedded into the cement before it has set-up. Dry granular bentonite will be placed in the annular space below the ground surface between the well and the protective casing. A 1/4-inch diameter drain hole will be drilled in the protective casing six inches above the ground surface. Pea gravel will be placed in the annular space between the well riser casing and the protective casing, to extend from the ground surface to six inches above the drain hole. The protective casing will be painted with conspicuous yellow, rust preventative paint. A notch will be placed on the top of the PVC well casing to serve as a measuring reference point for surveying and groundwater level measurements.

A four-foot-square concrete pad, minimum six inches thick, will be poured around the protective casing at the ground surface, and will be sloped to promote drainage away from the well. Steel posts, four to six inches in diameter and filled with concrete or gravel, will be placed in the corners of the concrete pad to protect each well.

4.2.2 Well Development

Monitoring wells will be developed to remove any drilling fluids or cuttings derived from the drilling process, and to remove fines from the filter pack and allow representative groundwater from the aquifer to enter the well screen. Each well will be developed by bailing or pumping until the discharge color, turbidity, temperature, pH and conductance have stabilized. Stability is defined as three consecutive sets of temperature and conductance values within 10 percent of each other, and pH within 0.1 units. The minimum volume of water removed between measurement sets is 5 gallons. The development process will be supervised and recorded in the field by a geologist or engineering technician.

Monitoring wells will be allowed to stand undisturbed for at least 48 hours prior to well development. In all cases, a minimum of five (5) well casing volumes will be removed. If water was added to the borehole during drilling or well installation, a minimum of three (3) volumes of water lost in the hole will be removed during development. Development water will be collected and containerized in accordance with Section 4.8 of this plan.

Each well will initially be developed using a decontaminated bailer or a PVC 1.7-inch outside diameter positive displacement hand pump, followed by an electric submersible pump. If the geologist or engineering technician so determines, the well will be surged and pumped repeatedly to facilitate flow of groundwater from the aquifer into the well screen, to be followed by bailing or pumping without surging to complete the development process.

The following data will be recorded by the geologist or engineering technician during well development:

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

4.2.3 Well Acceptance

Monitoring wells must be drilled and constructed to the criteria of Section 4.2.1. Each well is to be installed using the proper materials and methods, such that it yields representative samples of the water-bearing strata monitored by the well.

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 nominal 3-1/2-in. O.D. PVC pipe can be passed freely down the length of the well.
- Monitoring well filter packs and screened intervals will not be cemented.
- Monitoring well 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 Sverdrup.

If the above well acceptance criteria are not met for a particular well, the well will be abandoned following the procedures detailed in Section 4.2.5. A replacement well will then be drilled and installed offset from the abandoned well by at least 10 feet horizontal distance.

4.2.4 Well Schematics and Reports

A geologist or geotechnical engineer will be present during the drilling and installation of monitoring wells and will prepare a well schematic detailing their construction. Data recorded on each schematic will include the following:

- Project name/number
- Well 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 cement, bentonite powder, and water in grout mixture
- Nominal borehole diameter
- Riser pipe height

A Texas Well Driller's Report will also be prepared for each monitoring well.

4.2.5 Well Abandonment

No existing wells are scheduled to be abandoned during this phase of the field investigation. If problems are encountered during installation of the new monitoring wells, these wells will be abandoned according to Section 4.2.5 of the CDAP Addendum.

4.3 LOCATION SURVEYS

Surveying will be conducted in accordance with Section 4.3 of the CDAP Addendum.

4.4 WATER MEASUREMENTS

Field equipment for the RI will include meters to measure groundwater pH, temperature, and conductivity.

4.4.1 Groundwater

Groundwater pH, temperature, and conductivity will be measured using a YSI 3500 Water Quality Monitor or equivalent. All three parameters are simultaneously measured with this instrument. Water level indicators to be used are manufactured by the Slope Indicator Corporation and Keck. All indicators have tapes or cables marked in increments of 0.01 feet.

The only parameter that may be manually calibrated in the field on the YSI 3500 Water Quality Monitor is pH. The pH probe will be calibrated daily, and more often if necessary, using 4.00, 7.00 and 10.00 pH buffers. The two buffers expected to bracket the groundwater pH should be used (most commonly 4.00 and 7.00). The calibration for pH will be as follows:

- Rinse pH and temperature probes with distilled water and shake off excess water.
- Immerse temperature probe in pH 7.00 buffer. Observe temperature and check chart on buffer bottle to see what pH the buffer should be at this temperature. Set temperature knob on meter to correct value.
- Immerse pH probe in pH 7.00 buffer and allow reading to equilibrate.
- Turn knob labeled "CAL" until correct pH of 7.00 buffer is displayed.
- Rinse probes with distilled water, shake off excess, and calibrate with either 4.00 or 10.00 buffer depending on expected pH range of groundwater.
- Check temperature of second buffer and adjust temperature knob if needed. Determine pH of buffer at this temperature from chart on bottle.
- Immerse pH probe in buffer and allow reading to equilibrate.
- Adjust knob labeled "SLOPE" until display reads buffer pH value.

- Rinse probes off with distilled water and immerse in pH 7.00 buffer and check reading. Correct if necessary by adjusting the "CAL" knob. Recheck second buffer and change "SLOPE" adjustment if necessary.

Fresh buffer solution will be used daily for calibration. The calibration will be checked frequently during the day and adjusted if necessary. All pH meter calibrations and checks are recorded in the field logbook.

Conductivity on the YSI 3500 meter can not be adjusted in the field. However, the probe can be checked using standard solutions. At the start of field activities, the conductivity probe will be checked according to manufacturer's instructions using a 1000 microsiemen/cm standard solution. The reading obtained will be divided by the conductivity of the standard solution to obtain a correction factor for the probe. All readings should then be multiplied by this correction factor to obtain the correct reading. The meter will compensate for temperature and display the conductivity at 25°C which is known as "specific conductance." The programmed amount of compensation (1.8-1.9%/°C) is accurate unless the water has a high salinity.

Measurement of all three groundwater parameters will be accomplished by immersing all three probes in a clean polyethylene container containing at least 500 ml of water. Probes will be moved slightly to minimize effects of the container wall on probe performance and to keep the sample from stagnating during measurement. Probes should not be in contact with one another while readings are taken. Particular care will be exercised to ensure the conductivity probe is adequately submerged since it is sensitive to depth of submersion. Between readings, all three probes will be rinsed with distilled water and the excess shaken off before immersion in the sample.

To evaluate groundwater flow direction and aquifer characteristics, groundwater level measurements will be taken in all wells and boreholes and slug tests will be performed on monitoring wells.

4.4.1.1 Water Level Measurements

Prior to sampling monitoring wells, the water level will be measured to the nearest 0.01 foot with an electronic water level indicator. Measurements in monitoring wells will be measured at a mark or notch at the top of the PVC casing. The indicator probe will be decontaminated prior to and after use by rinsing with water meeting requirements of

ASTM Type II reagent water. If the well is heavily contaminated, additional cleaning of the probe will be performed as described in Section 4.8.

4.4.1.2 Slug Tests

Slug testing will be conducted on the eight monitoring wells installed as a part of this Remedial Investigation. Slug tests are performed to calculate the hydraulic conductivity of the water-bearing strata in which the well screen is placed. The method can consider the effects of discontinuities within the strata.

Slug tests will be conducted using the recovery test analytical method introduced by Bouwer and Rice (1976). The rising head method 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 by the sudden insertion of the slug into the water column within the well.

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 datalogger set to record data on a logarithmic sampling schedule. The transducer cable will be firmly attached to the top of the well casing using duct tape, such that it will be minimally disturbed during introduction and removal of the slug.

A slug will be constructed using a 5-ft 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 and thermoplastic glue. An eyebolt will be secured into the top cap, from which nylon rope can be attached. Four-inch nominal diameter wells will be tested using a slug constructed with three-inch nominal diameter pipe.

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 datalogger will be monitored until the potentiometric surface returns to equilibrium. The slug will then be removed from the water column while simultaneously starting to record potentiometric data with the datalogger. The datalogger will be monitored as the potentiometric elevation within the well increases and returns to equilibrium, at which time the test is complete.

The slug test data from each test will be downloaded from the datalogger to ASCII file and analyzed in the office using the Bouwer-Rice recovery time-lag test method. The data will be plotted and analyzed using AQTESOLV, developed by Geraghty and Miller.

4.4.2 Pondwater

No surface water samples are scheduled as part of this field investigation.

4.5 SAMPLING

4.5.1 Groundwater Sampling

Monitoring wells installed during Phase 2 of the RI will be sampled for the following groups of contaminants: volatile organics, semivolatile organics, high explosives, metals and anions.

Sampling Procedures

Purging and sampling of monitoring wells will proceed in a slightly different manner, depending on whether the well is an open or dedicated well. Open wells are those with no dedicated purging or sampling equipment. All wells installed during the Phase 2 field investigation will become open wells. All purging of 4 in. diameter open wells will be performed with a nominal 3.5-inch diameter PVC bailer or decontaminated electric, submersible pump. Purging of all wells will continue until at least five casing volumes are removed and the field parameters of pH, temperature, and conductivity are stable. These parameters will be considered stable when three consecutive readings have a temperature ± 0.5°C, pH is ± 0.1 units, and conductivity is ± 5 %. All purge water will be containerized at the well location. After purging is satisfactorily completed, the newly installed wells will be sampled as soon as possible with a stainless steel bailer. New nylon or polyester bailer cord will be used with the bailer at each well. If a well recharges slowly (1 to 2 hours), sampling will start as soon as sufficient recharge occurs to fill sampling containers. The bailer will be slowly lowered into the well to prevent excess agitation of the water that might result in the loss of volatile organics. Sample containers for each class of contaminants will be filled directly from the bailer in the following order:

Volatile organics

Semivolatile organics

High explosives

Metals (total metals only, no filtered samples)

Anions

Vials for the volatile organics sample will be carefully filled to avoid excess water agitation and in a manner that prevents air bubbles from forming in the vial after placement of the cap. The sample container size and type, number of containers, and method of preservation for each contaminant class are provided in the CDAP Addendum, Appendix B. All containers will be purchased precleaned according to EPA protocols. New, disposable gloves will be worn by sampling team members at each well.

Sampling Documentation

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

- date and time of collection
- sample location
- sample number

- water level and time of measurement
- total depth and diameter of well
- depth of water column and minimum purge volume
- HnU readings (if applicable)
- sample type (duplicate, split, field blank if applicable)
- purging and sampling method (bailer, hand pump, submersible electric pump, etc.)
- temperature, conductivity, and pH of well water during purging until stable readings are obtained.
- color or turbidity of sample (if applicable)
- volume purged prior to sampling
- sample preparation and preservation (filtering, HNO_3, etc.)
- instrument calibration check
- sampler's name and personnel present
- remarks on any special problems or observations

4.5.2 Surface Water and Sediment Sampling

Collection of sediment samples is required at two of the sites that are part of this field investigation. Procedures for the collection and documentation of the samples is given below. Collection of surface water samples is not scheduled during the Phase 2 field investigation.

Sediment Sampling Procedures

Sediment samples will be collected to help assess the amount of contamination spread by surface water flow through surface drainage features. Collection of sediment from the top 1 ft of depth is planned as this is the zone where the highest level of contamination is anticipated. After the sampler is withdrawn, only the top 5 inches of recovered material will be used for samples. Inclusion of deeper sediments in the sample may only serve to dilute contaminant levels. Sediment samples will be analyzed for the same parameters as the monitoring well, soil, and surface water samples.

Sediment samples will be collected using a decontaminated, hand-driven stainless-steel sampler. Before and during sampling, all decontaminated sampling equipment and bottles will be placed on clean plastic sheeting. The sampler will be driven 1 ft in depth if possible in order to recover at least 5 inches of material. The recovered material will be screened with a photoionization detector for the presence of volatile organics and examined for changes in color or the presence of layers. One or more cores will be obtained as necessary in order to have sufficient sample volume for all required tests. Bottles for volatile organics will be filled first using material from one sample core in order to minimize the loss of organics during additional core collection and compositing. Representative portions of the core will be removed with minimal disturbance to avoid organics loss. The volatiles sample bottles will be filled completely to minimize headspace. Care will also be taken to ensure the lip of the volatiles bottles are clean to ensure a good seal between the glass and Teflon cap.

After collection of the volatiles sample is complete, the remaining sample bottles will be filled in the following order: semivolatile organics, high explosives, metals, nitrates, chlorides, and sulfates. All cores obtained following collection of volatile organic samples will be composited in stainless-steel bowls prior to filling sample bottles. Compositing will consist of breaking sediment lumps apart and mixing together with stainless-steel spatulas, spoons or trowels.

When the filling of sample bottles is complete, excess sample will be containerized with other soil cuttings. New, disposable gloves will be worn at each sediment sampling location. Prior to leaving the sample location, a surveying stake with the location number written on it will be placed at the actual location if possible or directly across from the sample point on the bank or shore of the surface drainage feature.

Sediment Sampling Documentation

At a minimum, the following information will be recorded in a bound field logbook for each 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)
- HnU 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

4.5.3 Soil Sampling

Soil samples for chemical analysis will be collected using split-barrel samplers. All sampling and sample composite equipment will be decontaminated according to the procedures in Section 4.8 prior to use. Soil samples for physical testing will be collected at a minimum of one every five feet or every change in lithology, whichever occurs more frequently.

Standard-steel 3 inch O.D. split-barrels will be used inside hollow stem augers to collect the samples for both chemical and physical tests. The drilling contractor will be required to provide brand-new samplers at the start of the job. Standard-steel samplers will be used rather than stainless-steel, since stainless-steel is easily damaged in dense soil or soil with debris, gravel or cobbles. Split-barrel samplers will be driven with a falling hammer over a depth of 24 inches. This drive depth may be necessary to obtain enough sample to fill all containers with adequate material for analysis.

When the split-barrel is removed from the boring and opened, any material appearing to be slough will be removed. The soil will first be sampled for volatile organic compounds, taking care to minimize disturbance of the sample. Details on sample containers and preservation are presented in Appendix B, CDAP Addendum. New, disposable gloves will be worn by sampling team members for each sample collected.

Geotechnical Soil Sampling

Whenever possible, soil samples for geotechnical or physical tests will be collected from the same split-barrel as the chemical samples. If insufficient sample recovery occurs, samples for physical tests will be collected by driving an additional sample directly beneath the sample interval containing insufficient sample recovery.

Soil samples will be described in the field by a geologist or geological engineer and classified using the Unified Soil Classification System. Soil samples representative of the soil strata will be placed in sealed plastic bags for physical analyses. Samples will be tested in a geotechnical laboratory for the following:

- Moisture content (ASTM D2216-90)

- 3-pt. Atterberg limits (ASTM D4318-84, Procedure A or B)

- Grain size distribution (ASTM D422-63)

Based on the geologist's field description, the grain size distribution analysis will consist of either a combined washed sieve and hydrometer analysis, or a washed sieve analysis or hydrometer analysis alone. Also, Atterberg Limits will not be performed on soils described in the field as cohesionless. Samples will be taken and analyzed for these physical parameters at a maximum five-foot depth interval, or at every significant stratigraphic change, both in the unsaturated and saturated soil zones.

4.6 GEOPHYSICS

No geophysical testing is scheduled during the Phase 2 field investigation. If geophysical testing is requested, the tests will be performed as indicated in Section 4.6 of the CDAP Addendum.

4.7 FIELD SCREENING

Several instruments will be required in the field to monitor samples and the atmosphere during sampling for organic vapors. Reliable measurements are dependent on proper calibration and use. The types of equipment to be used and calibration and measurement procedures are described below.

4.7.1 Headspace Analysis

As sampling spoons are opened, the sampling technician will scan the length of the sample with the HNU. If contamination is indicated by the HNU or suspected from visual or olfactory observations, a headspace analysis may be performed.

A headspace analysis tests the air in a sampling jar for volatile organics. A sample will be placed in a glass jar, covered with foil, and warmed for one to two hours. At the end of the warming period, the vapor space in the jar will be tested with a photoionization detector.

4.7.2 Soil-Gas Surveys

A soil gas survey will be performed within a 20-ft sampling grid at LHAAP XX. By using the Geoprobe™ sampling system, a sampling probe will be hydraulically driven into the ground to a depth of approximately 5-ft. A 500 ul vapor sample is then drawn to the surface, a personal sampling pump is attached to a glass sampling bulb, and the sample is collected. Each sample collected will be analyzed in the field using a gas chromatograph with an electron capture detector (ECD). The samples will be analyzed for acetone.

4.7.3 Air Monitoring for Worker Protection

Air monitoring for worker protection will be conducted in accordance with the A-E Site Safety and Health Plan. Field equipment will include photoionization detectors and triple gas meters for gas and vapor monitoring.

Two brands of photoionization detectors (PID) may be used during the RI. The most commonly used PID will be the HnU Model PI-101 with a 10.2 eV lamp. An organic vapor monitor (OVM), a Thermo Environmental Instruments Model 580B, will also be available for use during the RI. As a backup, a Foxboro Model 128 flame ionization detector may be used at the site.

Industrial Scientific Model CMX271 triple gas meters will be used that simultaneously measure lower explosive limit, carbon monoxide, and percent oxygen.

All monitoring equipment will be properly calibrated and used according to manufacturer's instructions. Copies of the owner's 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. 100 ppm isobutylene will be used for calibration. Calibration of all photoionization detectors will be performed daily by attaching the calibration gas to the detector probe and adjusting the span setting 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 gas that display reading is referenced to, e.g. ppm as benzene, isobutylene, 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's 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 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.

4.8 DECONTAMINATION

In order to maintain sample integrity and minimize the spread of contamination between samples, personnel, and within and off the sites, the decontamination of all equipment and management of investigation derived wastes (IDW) will receive high priority. Equipment requiring decontamination will include drill rigs, soil augers, rods and split-barrel samplers, well casing material, groundwater purge pumps and bailers, soil and sediment samplers, and associated bowls and implements. IDW requiring management includes soil boring cuttings, excess sediment samples, well development and purge water, decontaminated water from cleaning of sampling equipment, and used personal protective equipment (PPE). The IDW Management Plan is included in the CDAP Addendum as Appendix C.

Prior to the collection of each sample, all sampling equipment that will come in physical contact with the matrix of interest will be thoroughly decontaminated. This will minimize potential cross-contamination of samples from different locations. Procedures for decontaminating the types of equipment and material anticipated to be used are described in the following sections.

A single, potable water source obtained from the Longhorn Army Ammunition facility will be used for decontamination and drilling activities, such as mixing drilling fluids and grout. Water obtained from the old firehouse near the Plant No. 3 area will be used. This water was sampled and used during the Phase 1 RI at the Group No.2 Sites. The analytical data indicated no notable contamination of this water source. During the first week of drilling activities, the water source will again be sampled and analyzed for the same analytical parameters scheduled for groundwater samples.

Solid wastes will be placed in DOT 17H, open-top 55-gallon drums. Liquid wastes will be placed in DOT 17H, closed-top 55-gallon drums. Each drum will be labeled on the exterior with a paint stick as to material type, source location, and accumulation start date. IDW will be stored on pallets in Building 54W in the Plant No. 3 Area, and the location of each drum will be recorded on a plan.

Sverdrup's current responsibility is to containerize and label all wastes generated during the RI activities. It is currently the responsibility of the Corps of Engineers to arrange for the testing and disposal IDW. Removal and disposal of IDW and associated drums will be the responsibility of USACE.

4.8.1 Drilling Equipment

Upon arriving at the site, all drill rigs will be inspected for leaks (e.g. hydraulic fluid, oil, gasoline, diesel fuel, etc.) that could contaminate the borings. All equipment must be free of leaks. If necessary, the drill rig will be pressure washed to remove contamination prior to use on site. No grease will be used on drill pipe joints or other downhole equipment; however, PTFE tape or PTFE paste may be substituted.

To accommodate the cleaning of the drill rig and downhole drilling equipment, a decontamination pad will be constructed to collect decontamination wastewater. The pad will be temporary and at a minimum be lined underneath with a minimum of three layers of 6-mil polyethylene sheeting. The edges will be folded upward to contain water and the bottom will be sloped toward a collection sump. Decontamination wastewater will be pumped from the sump into DOT 17E, closed-top 55-gallon drums for storage.

All hollow-stem augers, drill bits and rods, and tremie pipes will be decontaminated between borings at the decontamination pad. This equipment and the drill rig itself will be decontaminated using a high-pressure hot water washer as determined by the site geologist or geotechnical engineer, as well as upon entry and exit to the site.

Decontaminated equipment will be stored on plastic sheeting, sawhorses, or on decontaminated auger racks on the drill rig.

All split-barrel soil samplers will be decontaminated prior to collection of each sample using the following procedure:

- Clean any soil residue off by scraping or brushing
- Scrub in a Alconox detergent and potable water wash using a brush
- Rinse with potable water
- Rinse with distilled water
- Store split-barrel samplers in plastic or aluminum foil when not in use. Samplers may be placed on plastic sheeting or a clean rack prior to use.

The water rinses may be accomplished by either pouring water directly on the equipment or by dispensing the water through all-polyethylene garden sprayers. All wastewater from cleaning of equipment will be containerized in DOT 17E, closed-top 55-gallon drums.

As a further protection against sample cross-contamination, the soil samplers will ensure that their gloves are clean prior to handling each sample. If non-disposable type gloves are worn, they will be cleaned in a manner identical to the sampling equipment. If disposable gloves are worn, they shall be changed prior to handling each new sample.

4.8.2 Well Casing

In order to prevent aquifer contamination during well installation, all well casing and screen material will be decontaminated prior to installation. Only brand-new stainless steel 316 casings and screens will be installed. Prior to installation, all casing, screens and caps will be cleaned with a high-pressure hot water washer followed by a rinse with distilled water. Only Teflon tape will be allowed for use on the threaded joints. Items will be placed on clean plastic sheeting or racks during assembly and while awaiting installation.

4.8.3 Sampling Equipment

Besides split-barrel soil samplers, other sampling equipment requiring decontamination includes well development and purging pumps, sample bailers, stainless-steel bowls and hand tools, and other containers or tools used in collection of samples.

Equipment requiring decontamination for groundwater sampling will include groundwater level indicators, submersible electric pumps and bailers. Prior to sampling, the water level in each well will be measured using a water level indicator decontaminated by rinsing the probe with ASTM Type II, water and wiping the tape with a ASTM Type II water moistened paper towel as the probe is lowered in the well. As the probe and tape are removed, the tape will be wiped off once again and the probe rinsed off again.

Wells with no dedicated sampling equipment will first be purged using a submersible stainless-steel electric pump or PVC purging bailer. Prior to use, the pump or purging bailer will be cleaned using the following procedure:

- If a pump is used, flush interior of pump and hosing out by submerging pump in a container of potable water and running water through. Pump all remaining water out of hosing.
- Clean exterior of purging bailer, or pump motor assembly, hosing, and cable with Alconox detergent and potable water.
- Rinse interior and exterior surfaces of bailer or pump with potable water until all traces of detergent are gone.
- Rinse all washed surfaces with ASTM Type II reagent-water prior to use.
- Store decontaminated pump or purging bailer in a clean plastic bag between uses.

Once the wells are adequately purged, they will all be sampled using decontaminated Stainless steel bailers. If a well has a dedicated Stainless steel bailer, the bailer will be cleaned prior to use by rinsing with ASTM Type II water. If the dedicated bailer is not Stainless steel, the well will be sampled with a Stainless steel bailer decontaminated according to the procedures given below. All non-dedicated wells will be sampled with a common bailer(s). Disposable, pre-cleaned Stainless steel bailers may also be used for sampling. Prior to use, all non-dedicated, non-disposable bailers will be cleaned using the following procedure:

- Unscrew one end of bailer if possible and scrub interior and exterior with a bailer brush and Alconox detergent and potable water. If the bailer can not be disassembled, clean by placing detergent water inside and agitating water back and forth with hands placed over ends of bailer. Scrub exterior with a brush.

- Thoroughly rinse off traces of detergent with potable water.
- Rinse interior and exterior of bailer thoroughly with ASTM Type II reagent water.
- Rinse interior and exterior of bailer with ACS reagent grade isopropyl alcohol dispensed from a Teflon dispenser bottle.
- Allow isopropyl alcohol to completely evaporate before use.
- Place decontaminated bailer in a clean storage container or plastic bag during periods of nonuse. Bailer will not be allowed to come in contact with a contaminated surface prior to use.
- Rinse bailer with ASTM Type II water prior to use whether freshly cleaned or stored prior to use.

All other hand tools, bowls, containers etc. used during soil and sediment sampling will be decontaminated according to the following procedure after each use:

- Scrape or brush off all excess soil or contamination
- Scrub in a Alconox detergent and potable water wash using a brush
- Rinse thoroughly with potable water to remove detergent
- Rinse thoroughly with distilled water

- Place item on plastic sheeting until use or store in clean plastic bag.

4.9 FIELD QUALITY ASSURANCE (QA)/QUALITY CONTROL (QC) PROCEDURES

In order to ensure that sampling equipment is cleaned properly, that proper field sampling procedures are being implemented, and that laboratory performance is adequate to produce quality data, several forms of QA/QC samples will be collected and analyzed as part of the Phase 2 field investigation. QC samples are collected in the field and sent to the same laboratory as the rest of the field samples. QC samples include travel blanks, field blanks, and replicates. QA samples are replicates of field samples that are sent to the USACE - Southwestern Division analytical laboratory for analysis as a check on the performance of the contractor's laboratory.

4.9.1 Chemical Samples

Travel Blanks

Travel blanks are used to measure potential contamination of volatile organic samples during storage and shipment of samples. They consist of two 40-ml VOA vials filled in the field with organic free water meeting the requirements of ASTM Type II reagent water. The blanks are left sealed and sent along to the lab with other volatile organics samples. A travel blank will be prepared on a daily basis for each shipment of samples that contains volatile organic samples.

Equipment Blanks

Equipment blanks (also known as rinsates) are taken to evaluate the effectiveness of equipment decontamination procedures. They are produced by pouring organic free water meeting the requirements of ASTM Type II reagent water over the surfaces of sampling equipment that come in contact with samples. The water is collected into a sample bottle and preserved appropriately. Equipment blanks will be collected at a frequency of 1 per 20 samples collected and will be analyzed for the same parameters as the regular field samples. In addition to sampling equipment, equipment balnks will also be taken from hollow stem augers and stainless steel well casing and screen.

Replicate Samples

Replicate samples are extra samples collected at a location. In theory, they are identical to the field sample collected. Care is taken to ensure that all the samples collected from a specific location are as identical as possible. Replicate samples are used as duplicates of the field samples for QC purposes and as split samples for the Corps of Engineers QA laboratory. Replicate samples will be collected in triplicate at frequency of 1 per 10 samples. Two of the three samples will go to the Sverdrup's Subcontractor laboratory as a regular field sample and as a duplicate. The remaining sample will go to the QA laboratory. If insufficient sample volume exists to collect triplicates, duplicates will be collected at a frequency of 1 per 5 samples with the duplicate sample alternating as a QC and QA sample.

4.9.2 Samples for Physical Testing

No QA/QC will be required for physical testing.

4.10 UXO CLEARANCE

An unexploded ordnance (UXO) team will clear locations of all borings, monitoring well installations, the soil gas survey grid, and surface soil and sediment samples prior to the start of sampling work. The UXO team will consist of a UXO Supervisor and UXO Technician, both of which are graduates of the U.S. Naval Explosive Ordnance Disposal

(EOD) School, Indian Head, Maryland. The Supervisor will have at least 10 years experience in active duty military EOD assignments; the Technician will have at least 4 years of such experience.

The UXO team will clear boring and monitoring well locations in advance of the drilling operations. The team will clear and mark corridors for safe equipment access (20 feet width) and operation (50 feet by 50 feet area). At each boring location, the team will drill a hand auger boring to five feet in depth, scanning the borehole with a magnetometer at 2.5-ft depth intervals.

In addition to a magnetometer sweep, the team will clear borings for high concentrations of TNT and RDX. At each boring location, the team will drill a hand auger boring to five feet in depth, sampling the soil at 2.5-foot depth intervals and analyzing the sampled soils in the field for reactivity.

Locations where metallic objects or high concentrations of TNT/RDX are encountered will be offset 10 to 20 feet and clearance procedures repeated. Potential UXO locations will be noted to appropriate authorities at LHAAP; no attempts will be made to remove UXO.

In general, boring and monitoring well locations will be cleared in advance of drilling operations. An escort will not necessarily be provided during actual equipment access or drilling activities.

A UXO Technician will escort the sediment and surface soil sampling team, to clear access routes and sampling locations using the magnetometer.

5.0 SAMPLE HANDLING AND TESTING

In order to preserve the quality and integrity of samples from time of collection until time of analysis, sample preparation, preservation, storage and shipment procedures need to be established. Also, to keep track of the numerous samples collected at each unit location and of each sample matrix, a logical sample numbering system is required. Procedures and methods for accomplishing these tasks are described in the CDAP Addendum with the additions described below.

5.1 SAMPLE NUMBERING SYSTEM

The sample numbering system outlined in the CDAP Addendum will be followed without modification.

5.2 SAMPLE CONTAINERS AND PRESERVATION

The appropriate type and number of sample containers and method of preservation will be used for each class of contaminants. These requirements are summarized in the

CDAP Addendum, Appendix B. The requirements were adapted from Appendix E of ER 1110-1-263 and SW-846. All containers will have Teflon-lined caps or septa. All sample containers will be purchased as new containers cleaned according to standard EPA cleaning protocols and packaged in custody-sealed boxes.

5.3 SAMPLE PREPARATION AND SHIPMENT

Sample bottles will be prepared and packaged for shipment to minimize bottle breakage and ensure proper sample temperature. Samples will be sent to all laboratories by overnight courier in large, metal or rigid plastic ice chests or coolers. Arrangements will be made with each laboratory, including the COE QA lab, prior to sample shipment to ensure that a person is available to receive and handle the samples so that sample temperatures and holding times are not exceeded. Prior to shipment, the bottles and coolers will be prepared and packed according to the following procedure:

- Place vermiculite, foam or other inert packing material on the floor of the cooler
- Wrap bottles in bubble wrap or place in plastic sleeves to prevent direct bottle-to-bottle or bottle-to-cooler contact. No packing materials containing adhesives will be used on VOA vials to prevent potential contamination.
- Place each bottle or group of bottles in clear Ziploc plastic bags and seal. Place bottles in cooler in an upright position and place packing material so that bottles will not touch during shipment.
- Place ice in Ziploc bags and place around and among the sample bottles.

- Place adequate packing material in empty spaces to prevent potential movement of bottles during shipment.
- Place completed chain-of-custody in a Ziploc bag, seal and tape to inside cover of cooler.
- Tape drain cover shut.
- Secure cooler lid by wrapping cooler in two locations with strapping tape.
- Complete shipping label and attach to top of cooler so that it is unobscured.
- Place "Fragile" labels on at least two sides and "This Side Up" labels on at least four sides of the cooler.
- Affix signed custody seal forms on the front right and back left of each cooler and cover with clear packing tape.

5.3.1 Packaging and Transport of Potentially Explosive Materials

Sediment and soil samples with the potential for explosives contamination, as indicated by sampling location or visual observance, will be screened by a UXO team using a field analytical method. The field method provides data for explosive concentrations of greater than nine percent (9%).

Samples with an explosive concentration of nine percent or less will be considered non-explosive. Such samples will be classified as a non-flammable material, and labeled and shipped via air cargo as typical environmental samples.

Samples with an explosives concentration of greater than nine percent will be wetted with ASTM Type II reagent water to a minimum of thirty percent (30%) by weight. The sample containers will be placed in paint cans, and labeled and shipped via air cargo as a flammable solid.

5.4 LABORATORY RECEIVING

Upon receipt of the sample coolers at the appropriate laboratory, the laboratory will check the following items:

- Check cooler for damage or leakage and ensure that chain-of-custody seals have not been broken.
- Compare contents of cooler with the chain-of-custody to verify that all sample numbers and requested analyses match and check that no samples are missing.
- Inspect bottles for breakage or leakage. Notify field personnel immediately if this occurs so that another sample may be collected.
- Measure temperature of the bath ice to verify that the contents of cooler were kept below 4°C. Record temperature on chain-of-custody.
- Check pH of liquid samples for metals to verify pH is less than 2. Record pH on chain-of-custody.
- Record any discrepancies between cooler contents and chain-of-custody or comments about damaged samples or problems in the "Remarks" section of the chain-of-custody.
- Record date, time and sign chain-of-custody acknowledging the condition and receipt of samples.

Once the laboratory has signed the chain-of-custody, it has assumed responsibility for the proper storage, analysis and disposal of the samples.

5.5 LABORATORY TEST METHODS AND QUANTITATION LIMITS

Laboratory test methods and quantitation limits are presented in the CDAP Addendum, Appendix B.

6.0 SAMPLE INTEGRITY AND DOCUMENTATION

Because analytical results are suspect if the integrity of samples is compromised, measures will be taken to ensure that the integrity is preserved from the time of collection till analysis is complete. Integrity largely involves the security of the sample so that it is known that samples have not had an opportunity to be altered or compromised. A large part of ensuring that all samples can be identified and information about their collection is known is the proper documentation of the sample collection and labeling of containers. Procedures for ensuring the integrity of collected samples and properly documenting their collection are presented in the CDAP Addendum, Section 6.0, with the additions described below.

6.1 SECURITY

Security will entail procedures for protecting monitoring wells from potential tampering and protecting collected samples from tampering by unauthorized personnel from the time of collection till analysis is completed.

6.1.1 Monitoring Well Security

To prevent unauthorized access to monitoring wells, No. 1 or No. 3 Master locks, or equivalent, will be placed on all well caps. Only authorized personnel will possess keys. As part of well sampling procedures, any signs of tampering or damage to wells will be noted in the field book.

6.1.2 Sample Security In the Field

All samples collected will remain in the possession of the sampling crew until shipment. Samples will be promptly placed in coolers. Locked vehicles or trailers will be used for interim storage as necessary. If coolers must be left unattended for extended periods of time, signed custody seals will be placed on the coolers.

6.1.3 Sample Security In the Lab

Once the sample coolers arrive at the lab intact with unbroken custody seals, sample security and integrity will be the laboratory's responsibility. Upon arrival, the laboratory will check the temperature of the cooler contents, verify pH of water samples for metals, check cooler contents versus chain-of-custody, inspect contents for damaged or leaking containers and verify the accuracy of paperwork.

It will be the responsibility of the laboratory to store the samples in a secure area which is accessible only to authorized personnel.

6.2 CUSTODY

Sample custody consists of the forms and labels that document that the samples have been released and received by the proper individuals and that shipping containers have not been opened prior to receipt by the laboratory. Chain-of-custody forms and custody seals are commonly used to accomplish this.

6.2.1 Chain-of-Custody Forms

The chain-of-custody (COC) is used to record the sample number, number of containers, date and time of collection, requested analyses and any remarks for each sample collected. It is also used to record the signatures of persons releasing and receiving the samples. Normally, the COC is filled out and signed by the sampler and is signed again by the receiving individual at the laboratory. Both the sampler and the laboratory will retain a copy of the COC. COC forms are customarily provided by the laboratory.

6.2.2 Custody Seals

To ensure that sample coolers have not been opened by unauthorized personnel during shipment, signed custody seals will be placed on at least two locations. The individual preparing the samples will sign and date the custody seals and place one on the front right and one on the back left side of the cooler. The seals will be covered with clear packing tape. The laboratory will note upon receipt whether or not the seals were intact. Instances of broken seals will be noted on the COC.

6.2.3 Bill of Lading

The shippers bill of lading can also serve as documentation of sample integrity. It documents the transfer of the samples from the sampler to the shipper since the shipper is not able to sign the COC form. The sampler will retain a copy of the shippers bill.

6.3 SAMPLE LABELING AND DOCUMENTATION

In order to identify all sample containers and record adequate information about the sample, labeling and field documentation are of great importance. Samples with no labels or with conflicting information often must be discarded since their source is unknown or the integrity is compromised. Improper documentation of sample collection may result in data being generated that is useless because the location, depth of collection, or other vital information was not recorded. Procedures for minimization of these problems are given below.

6.3.1 Sample Labeling

All sample containers will be labeled with water-resistant adhesive labels. Black permanent ink felt-tipped markers will be used to complete labels. At a minimum, the following information will be recorded:

- Date and time of collection
- Sampler's name
- Unique sample number
- Method of preservation (if applicable)
- Requested analysis

6.3.2 Sample Documentation

All pertinent information about each sample will be recorded in a bound field logbook using permanent ink pens. Any procedures performed and problems encountered are documented in the logbook. Each sampling crew will have a logbook. Corrections to items placed in the logbooks will be made by a single line through the information with the corrector's initials by the line. The minimum information to be recorded for each type of sample is listed in Section 4.0. In the case of soil borings and well installations, much of the information will be recorded on a well boring log and well installation diagram.

7.0 DATA REDUCTION, VALIDATION, AND REPORTING

Responsibilities for properly managing analytical chemical laboratory data and technical data are presented in the CDAP Addendum, Section 7.0, with the additions described below. Details about procedures and criteria are provided in USACE and USEPA documents referenced in Section 10.

7.1 ANALYTICAL DATA

7.1.1 Field Data

Field data collection and reduction operations require complete understanding and use of Standard Operating Procedures by those performing the operations. Instruments must be properly calibrated as specified by the manufacturer and used as directed by the manufacturer. Duplicate (QC) measurements of data obtained from field instruments will be collected at a rate of 1 in 10 measurements. The Site QC Manager is responsible for oversight of the field data collection, reduction, and validation steps and record keeping.

7.1.2 Chemical Laboratory Data

Laboratory data are reduced at the laboratory, which generates a report containing the analytical data and the lab QC results. If needed, calibration and internal standards information, raw data, and all instrumentation graphs and traces will be provided by the laboratory. Sverdrup will prepare a data validation report. The process will include the following:

- 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 determine if sampling protocols were appropriate
- review to compare the data against the field and trip blanks to detect contamination from sampling
- review to compare field sampling replicates
- review of laboratory QC including laboratory blanks, spike recovery, and duplicates
- review of Chain of Custody forms; sample receipt data, damaged sample containers, etc.

- delete unusable data and attach appropriate qualifiers to usable data

- review sampling design for dealing with media variability

For each group of analyses, Sverdrup will discuss the data quality objectives as delineated in Section 3.0 of the CDAP Addendum.

7.1.3 Physical (Geotechnical) Laboratory Data

Sample analysis and data reduction of the physical (geotechnical) results from the laboratory or field testing will be the responsibility of the laboratory and the field engineer, respectively. The testing laboratory will be required to submit for review by the field engineer and the Site QC Manager a quality assurance summary report of its sample analysis and validation program.

7.2 TECHNICAL DATA

Technical data refers to data of several types, such as slug test analyses, 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 according to Sverdrup's QA/QC program for developing and reporting environmental data.

8.0 AUDITS

This section remains unchanged, please refer to the CDAP Addendum for information pertaining to system and performance audits.

9.0 CORRECTIVE ACTION

Corrective actions that will be taken in response to nonconformances with established quality control procedures are described in U.S. EPA's "A Compendium of Superfund Field Operations Methods". Corrective actions relating to field activities, field data, the analytical laboratory, and implementing and reporting will follow the procedures presented in the CDAP Addendum. SvE will incorporate the following steps when implementing a corrective action.

Following problem identification, the responsible individual, as assigned by the Project Manager or Site Coordinator, will identify the root cause(s) of the problem and develop a corrective action. As appropriate, a corrective action report will be prepared. The report will describe the problem, potential ramifications, the corrective action, implementation, results of implementation, and effectiveness of the correction action.

Corrective action reporting will be the responsibility of the Project Manager. The Site QC Manager will also report corrective actions to Sverdrup's QA Manager. A variety of mechanisms are available for reporting to the USACE Project Manager, depending upon the nature and potential significance of the correction action.

10.0 REFERENCES

1. Bouwer, H. and R.C. Rice. 1976. A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. Water Resources Research, v. 12, no. 3.

2. Sverdrup Corporation, "Quality Control Manual", 1992.

3. Sverdrup Corporation, Longhorn Army Ammunition Plant, CDAP Addendum, June 1994.

4. Sverdrup Corporation, Longhorn Army Ammunition Plant, A-E Site Safety and Health Plan, June 1994.

5. U.S. Army Corps of Engineers, Longhorn Army Ammunition Plant, RI/FS Work Plan, Vol. 1 - General, June 1992.

6. U.S. Army Corps of Engineers, Longhorn Army Ammunition Plant, RI/FS Work Plan, Vol. 2 - Chemical Data Acquisition Plan, June 1992.

7. U.S. Army Corps of Engineers, Longhorn Army Ammunition Plant, RI/FS Work Plan, Vol. 3 - Site Safety and Health Plan, June 1992.

8. U.S. Environmental Protection Agency, "A Compendium of Superfund Field Operations Methods", OSWER Directive 9355.0-14 (December 1987) EPA/540/P-87/001.

As noted in Section 1.0, this CDAP supplements the Longhorn AAP RI/FS Work Plan referred to above. Each of the three volumes include a list of references. Copies of the References for Volumes 1 and 2 follow. Some of the listed references were used in the preparation of this CDAP.

APPENDIX A

Resumes - Key Project Personnel

ARL A. ALTMAN, PE
Vice President

SPECIALIZED EXPERTISE
Program and project management
Design and construction management of environmental facilities

EDUCATION
BS in Chemical Engineering, Purdue University, 1970
Credits towards MBA, Illinois Institute of Technology, 1975-77

REGISTRATION
Registered Professional Engineer in Wisconsin and Oregon

CERTIFICATION
OSHA Hazardous Waste Health and Safety Course (29 CFR 1910.120)
OSHA 8-Hour Annual Updates
Value Engineering

RELATED EXPERIENCE
Mr. Altman specializes in the program management of hazardous waste projects. He is thoroughly familiar with Federal Agency indefinite delivery contracts, FARs and DFARS. He has negotiated contracts involving government audits from DCAS, DCAA, and the EPA. Representative experience includes:

PROGRAM MANAGEMENT/HAZARDOUS WASTE EXPERIENCE

- ***U.S. EPA ARCS Program — Regions VI, VII and VIII***

Program Manager responsible for the first five years of the $65 million program from BAFO negotiations through the successful initiation of 25 work assignments. The value of these work assignments range from $20,000 to $1.8 million. The actual costs for these projects are approximately 10% lower than the original estimates due to Sverdrup's project management performance, proven control systems, and integration with the EPA's ARCS PM system.

In particular, his management skills resulted in significant cost savings for two work assignments in Louisiana which were in close proximity. Program Management costs were minimized through integrated project teams and sharing of resources. Mr. Altman's technical, management and financial skills resulted in the projects being completed under budget and within schedule.

Sverdrup's performance has been recognized by the EPA's award process in Program Management and technical areas. This level of performance has continued through present work assignments as evidenced by the consistently lowest program management (0.2%) versus total contract outlay ratios of Region VII ARCS contractors. Mr. Altman's leadership has also resulted in achieving a 50% small and small disadvantaged business participation versus a goal of 30% for the program.

ARL A. ALTMAN, PE
(Continued)

RELATED EXPERIENCE (Continued)

- ***Tulsa District USACE, HTRW Program***

Program Manager for the USACE HTRW Program for a $15 million hazardous waste task order contract similar in scope and complexity to RACs. Mr. Altman was responsible for planning and executing two major delivery orders totaling nearly $5 million. The $2.5 million White Sands project required a Phase II RCRA Facility Investigation of 46 solid waste management units (SWMUs). Mr. Altman had responsibility for coordination of a nine-person field team, eight subcontractors, and SBE/SDBE participation of 50%. He also negotiated the contract and managed the $2.4 million project and the 13-member field team for the RI/FS at the Longhorn AAP. The field work included seven sites and coordination of a 13-member field team. The project is completing within budget and schedule despite scope changes and delays in work plans.

- ***Wastewater Treatment Program — Jefferson Parish, LA***

Program Manager for a $380 million sewerage and wastewater treatment capital improvement program. Mr. Altman was responsible for the startup of a new management office, coordination of more than 100 separate design contracts by 11 consultants, and the completion of 150 separate wastewater projects. Under Mr. Altman's direction, Sverdrup maintained a change order record of negative 0.1 percent and reduced construction costs by over $20 million through value engineering and management control.

During the initial phase, the Parish was preparing to sell bonds, but the cash flow had not been determined. Mr. Altman led a team to target an overall budget, schedule, and cash flow. The initial budget proved to be within 0.1 percent of the final budget. The cash flow proved accurate and allowed investments which were close to arbitrage.

- ***Wastewater Treatment Program — Eugene/Springfield, OR***

Program Manager responsible for day-to-day management and operation of 30-person staff and $105 million wastewater expansion program. Program involved management of seven design contracts, 30 construction contracts, 40 pre-purchased equipment and material packages. Elements managed included design, biddability/constructibility reviews, value engineering, construction, and start-up.

- ***Wastewater Treatment Program — Eugene/Springfield, OR***

Technical Quality and Construction Manager of a $105-million wastewater expansion program. Program involved management of seven design contracts, 30 construction contracts, 40 pre-purchased equipment and material packages. Elements managed included design, biddability/constructibility reviews, value engineering, construction, and start-up.

- ***Department of Energy — Weldon Spring, MO***

QA/QC and Technical Oversight Manager responsible for the review of health physics and risk assessment program.

- ***Confidential Client***

Technical Quality and Construction Manager for engineering services during upgrade and expansion of 3.0-mgd advanced wastewater treatment plants. Managed preparation of quality programs, master schedule, biddability/constructibility reviews, and construction.

ARL A. ALTMAN, PE
(Continued)

RELATED EXPERIENCE (Continued)

▸ ***Bissell Point Secondary Wastewater Treatment Plant Expansion — St. Louis, MO***
QA/QC Manager responsible for QA/QC and construction operating procedures for control systems, including a computerized document control filing system and an overall program schedule and computerized reporting system for the $280 million wastewater treatment plant.

▸ ***Confidential Client***
QA/QC and Construction Manager and Office Engineer for a 16-mgd wastewater plant.

▸ ***Indianapolis, IN***
Value engineering team member for two 150-mgd wastewater treatment plants.

▸ ***Confidential Client — Grand Rapids, MI***
Value engineering team member on a 950-mgd pump station and storm water retention basin.

PROFESSIONAL BACKGROUND

Entered the profession in 1970; joined Sverdrup in 1984

Member - American Institute of Chemical Engineers
- Missouri Water Pollution Control Association
- Hazardous Materials Control Research Institute

DENNIS F. BOLL, PE
Project Manager

SPECIALIZED EXPERTISE
Hazardous waste project management
RCRA landfills and caps
Groundwater recovery and treatment systems
Hazardous waste and geotechnical investigations
Computer modeling of groundwater flow, contaminant transport, dewatering systems

EDUCATION
MS in Geological Engineering, University of Missouri, Rolla, 1982
BS in Geological Engineering, University of Missouri, Rolla, 1981
Short courses in Hazardous Materials Handling, 3-Dimensional Groundwater Modeling and Contaminant Transport in Fractured and Porous Media

REGISTRATION
Professional Engineer in Missouri, Iowa and Texas
Groundwater Professional in Iowa

CERTIFICATION
OSHA Hazardous Waste Health and Safety Course (29 CFR 1910.120)
OSHA 8-Hour Annual Updates
Red Cross First Aid Certified/CPR Certified

RELATED EXPERIENCE
Mr. Boll specializes in managing remedial design and remedial action projects for hazardous waste sites. He has design and construction management experience in field investigations, geotechnical engineering and hydrogeology. Representative experience includes:

HAZARDOUS WASTE

- ***Confidential Client — Colorado***

Project Manager for remedial design and construction of a soil cover barrier over metals-contaminated soils and a perimeter groundwater monitoring system for a Superfund Site. Performed remedial design field investigations, developed design drawings and analyses, and prepared construction specifications and bid packages for drilling, surveying and earthwork services. Engineering design and construction management services for the project are estimated at $500,000. Implemented a site characterization to define the source(s), extent and concentrations within a contaminant plume of heavy metals in groundwater. Characterization involved groundwater sampling using the Hydropunch system, and real-time field analysis using colorimetric methods, correlated with analytical laboratory data.

- ***Tulsa District USACE, Longhorn Army Ammunition Plant — Karnack, TX***

Project Manager for remedial investigations at seven sites at the active U.S. Army facility. Project includes developing work plans, site health and safety plans, field sampling plans, analytical data validation, and preparing a site characterization report. Special considerations include clearing for unexploded ordnance, and sampling of TNT/RDX wastes. Subcontracted field work totaling $1,260,000 completed within a challenging 75-day schedule from notice-to-proceed and under budget. Project is on schedule for completion of Remedial Investigation Report in July 1994.

DENNIS F. BOLL, PE
(Continued)

RELATED EXPERIENCE (Continued)

- ***U.S. EPA ARCS Program — Regions VI, VII, and VIII***

Midwest Manufacturing Superfund Site, Kellogg, IA — Project Manager for remedial design involving soil and groundwater contamination with heavy metals and volatile organics. Conducted a 72-hour pumping test to evaluate the radius of influence of the pumping well and recharge from the neighboring river. Designed an 8-well groundwater recovery system using low-flow pneumatic pumps with discharge filtration and aeration to meet safe drinking water requirements for discharge to a river. Designed a geosynthetic cover and drainage system to meet RCRA standards for capping an abandoned metals sludge disposal trench.

- ***Omaha District USACE, United Scrap Lead/Troy and Arcanum Superfund Site — Troy, OH***

Site Manager for a remedial design investigation at the abandoned facility. Subcontracted field work totaled $150,000 and was completed in two months. Managed preparation and implementation of investigation work plans, contract specifications, and a preliminary design report and analyses.

- ***U.S. Post Office Terminal Annex — Seattle, WA***

Group Leader and Site Manager for free product recovery and contamination assessment from leaking underground fuel tanks. Completed a hydrogeological characterization involving monitoring well installation, development and sampling. Contaminated soil was removed, and a 30-inch diameter recovery well was installed within a 30-ft long gravel infiltration gallery to recover floating free product and contaminated groundwater. A skimmer pump was placed in the well to collect floating free product, and contaminated groundwater was pumped and treated through an oil-water separator, a pre-filter and two carbon adsorption units before discharging to the Seattle Metro Sewer System under a special discharge authorization. Groundwater pumping rates varied from 10 to 30 gpm during the six-month remediation period. A total of 122 gallons of free product was recovered, and groundwater contamination was lowered below regulatory limits.

- ***City of Columbus — Nebraska***

Hydrogeologist for an RI/FS investigation of a 145-ft alluvial aquifer contaminated with TCE and PCE that provides the water supply. Field work included installation of more than 30 monitoring wells, soil and groundwater sampling, and two aquifer pumping tests. Engineering analysis included geologic profiles, 3-dimensional groundwater modeling using MODFLOW of the city well field involving 12 deep wells screened in three distinct aquifers, and contaminant transport modeling in the uppermost aquifer using SOLUTE.

GEOTECHNICAL ENGINEERING

- *Vandenberg Air Force Base — California*

Group Leader for field investigations, design and construction of test facilities, railroads and roads, and embankments in an area of active sand dunes and wetlands.

- *Disposal Facility — Illinois*

Group Leader for field investigations, embankment design and seepage analyses, and construction specifications for a 600-acre mine tailings impoundment.

DENNIS F. BOLL, PE
(Continued)

RELATED EXPERIENCE (Continued)

GROUNDWATER MODELING

- ***Confidential Client — Albers, IL***

Managed hydrogeological investigation and analysis for a 100-acre coal refuse disposal facility. Analyzed impoundment seepage to evaluate the potential impact of disposal operations on the underlying aquifer using SOLUTE. Designed a well field to capture predicted high TDS groundwater and prevent off-site migration.

- ***Confidential Client***

Performed groundwater modeling for contaminants escaping barrier containment at a major NPL site in U.S. EPA Region VIII. Analyzed groundwater flow patterns and DNAPL contaminant transport in a complicated groundwater flow regime controlled by buried bedrock valleys.

- ***Lock and Dam No. 4 — Red River in LA***

Design, computer modeling and construction specifications for an excavation dewatering system. System required dewatering and control of uplift pressures within more than 100 ft of saturated soils. Flow models included analytical equations, electric-analog, and MOC and MODFLOW digital flow models.

PROFESSIONAL BACKGROUND

Entered the profession in 1983; joined Sverdrup in 1984
Member - National Water Well Association - Association of Groundwater Scientists and Engineers
- Association of Engineering Geologists

Sverdrup Master Builder Award, 1993, Riverport Levee, Maryland Heights, Missouri

BRIAN W. KNAUS, CIH, CSP

Director, Health and Safety

SPECIALIZED EXPERTISE

Health and safety
Industrial hygiene

EDUCATION

MS in Industrial Hygiene, Central Missouri State University, 1982
BS in Chemistry and Biology (Minor), St. Louis University, 1968

CERTIFICATION

Certified Industrial Hygienist
Certified Safety Professional
Certificate, Program in General Insurance, Insurance Institute of America
Certificate, Blasting and Explosives Safety, DuPont
Certificate, Industrial Hygiene Engineering (551) NIOSH
Certificate, Sampling and Evaluating Airborne Asbestos (582) NIOSH
Certificate, Hazardous Waste Operations and Emergency Response
Certificate, Manager/Supervisor Hazardous Waste Operations and Emergency Response
Certificate, Asbestos Abatement Contractor/Supervisor, Inspector, Management Planner, Designer
Certificate, OSHA Competent Person
Red Cross First Aid Certified/CPR Certified
Licensed, Certified Asbestos Consultant, California
Licensed, Asbestos Consultant, Florida
Licensed, Certified Industrial Hygienist, Illinois

RELATED EXPERIENCE

With over 20 years of experience, Mr. Knaus, as Health and Safety Manager for Sverdrup Environmental, assesses site operations, conducts in-plant and environmental surveys, collects air and bulk samples for characterization of physical and chemical hazards, evaluates physical, chemical, and material handling procedures, and recommends corrective actions. He is knowledgeable concerning TSCA, RCRA, and OSHA regulations. He enforces Sverdrup's Health and Safety Program, which he developed, and performs safety and industrial hygiene services.

Mr. Knaus' unique background combines occupational health and safety with construction safety. Representative experience includes:

- ***U.S. EPA ARCS Program - Regions VI, VII, and VIII***

Mr. Knaus developed the overall health and safety plan for the ARCS Program and then developed the site-specific hazardous waste health and safety plan for a Superfund Site RI/FS study at PAB Oil and Chemical Service, Inc. and Gulf Coast Vacuum Services, Inc. in Abbeville, Louisiana. He also performed personnel air monitoring at Gulf Coast Vacuum, in conjunction with the site safety officer. He conducted site health and safety meetings at all sites and developed a decontamination plan for employees and equipment.

BRIAN W. KNAUS, CIH, CSP
(Continued)

RELATED EXPERIENCE (Continued)

Midvale Slag Superfund Site, Midvale, UT — Health and Safety Manager responsible for the assembly of the site-specific hazardous waste health and safety plan. To effectively control costs, the project's health and safety monitoring was performed by a trained site safety officer. This cost control mechanism helped the project remain under budget.

Denver Radium Superfund Site, Denver, CO — Health and Safety Manager responsible for the assembly of the site-specific hazardous waste health and safety plan. Training programs allowed the site manager to conduct air monitoring and site auditing, bringing the project under budget.

Cleburn Street Well Superfund Site, Grand Island, NE — Health and Safety Manager performing on-site air monitoring and auditing. The project consisted of RI/FS and installation of groundwater monitoring wells and investigation of an aquifer contaminated with dense chlorinated solvents that originated from a dry cleaning operation.

- ***Confidential Food Processing Client - Jersey City, NJ***

Manager of Health and Safety providing medical surveillance, personal air monitoring and a site specific health, safety and emergency response plan to identify and control workplace hazards.

- ***Times Beach Superfund Site, I-44 Corridor Remediation and Site Demolition — Times Beach, MO***

Health and Safety Manager for dioxin-contaminated site. Asbestos-containing materials work included an identification survey, abatement specification preparation, environmental air monitoring, abatement contractor prequalification, and documentation package assembly. Because Sverdrup provided design/build services on this project, Mr. Knaus worked closely with construction personnel to verify their safety and understanding of the site conditions. He monitored subcontractors' compliance with Sverdrup's health and safety plan by making a number of periodic site audits/visits. He applied our experience on other projects to develop a confined space entry plan for use on this project, which addressed oxygen deficiency, combustibility, and toxicity concerns.

- ***Stamina Mills Superfund Site Remediation — North Smithfield, RI***

Health and Safety Manager responsible for monitoring site demolition and remediation activities. Assembled the health and safety plans, and performed personal air monitoring and health and safety job-site audits during remediation and demolition. Also was responsible for development of a plan for decontamination of employees and equipment.

- ***Bee Cee Manufacturing NPL Site — Malden, MO***

Health and Safety Manager responsible for the assembly of the site-specific hazardous waste health and safety plan for remedial investigation. Performed personal air monitoring to characterize contaminant concentrations.

- ***Tulsa District USACE, Longhorn Army Ammunition Plant***

Health and Safety Manager responsible for developing safety and health work plans. Mr. Knaus trained the site manager and site safety officer to perform air monitoring and site auditing to effectively control costs on the project.

BRIAN W. KNAUS, CIH, CSP
(Continued)

RELATED EXPERIENCE (Continued)

- ***Confidential Aerospace Manufacturer — California***

Health and Safety Manager responsible for the site health and safety for the demolition and restoration of 76-acre site for a former aerospace manufacturing facility. The project is on a fast-track schedule including demolishing existing buildings, and removing soils contaminated with metals and solvents.

- ***Motorola, Inc. — Phoenix, AZ***

Health and Safety Manager responsible for developing the site specific health, safety and emergency response plan and performed personal air monitoring to characterize employee exposure to site contaminants and verify the correct level of protection is worn. Assembled the hazardous waste health and safety plan for a groundwater treatment plant and assembled a design to store flammable and toxic chemical stock and chemical waste products.

- ***Omaha District USACE, United Scrap Lead Superfund Site — Troy, OH***

Health and Safety Manager responsible for developing site specific health, safety and emergency response plan and performed personal air monitoring to characterize employee exposure to site contaminants and verify the correct level of protection is worn.

- ***Opus Dei — New York, NY***

Health and Safety Manager responsible for developing site specific health, safety and emergency response plan, developed and performed personal air monitoring to characterize employee exposure to site contaminants and verify the correct level of protection is worn.

- ***World Color Press, Spartan Printing Division — Sparta, IL***

Health and Safety Manager responsible for developing site specific health, safety and emergency response plan and performed personal air monitoring to characterize employee exposure to site contaminants and verify the correct level of protection is worn.

- ***General Services Administration — Chicago, IL***

Asbestos Project Manager responsible for identifying asbestos-containing building materials, assembling an asbestos abatement specification, performing environmental air monitoring and managing asbestos abatement for 19 months during asbestos abatement in a ten-story occupied office building.

- ***General Services Administration — Kansas City, MO***

Asbestos Project Manager performed asbestos surveys to identify asbestos-containing materials and prepared asbestos abatement specifications.

- ***Washington National Records Center — Suitland, MD***

Asbestos Project Manager performed asbestos surveys to identify asbestos-containing materials and prepared asbestos abatement specifications.

- ***McMillon Reservoir, CEASA Building — Washington, DC***

Asbestos Project Manager performed an asbestos survey to identify asbestos-containing materials and prepared an asbestos abatement specification.

BRIAN W. KNAUS, CIH, CSP
(Continued)

RELATED EXPERIENCE (Continued)

- ***Kraft General Foods, Inc. — Springfield, MO***

Asbestos Project Manager responsible for performing asbestos surveys, preparing asbestos abatement specifications, performing environmental air monitoring and managing asbestos abatement.

- ***Maxwell House Coffee Company — Jacksonville, FL***

Asbestos Project Manager responsible for preparation of an asbestos abatement specification and environmental air monitoring for a roof demolition.

- ***Rockwell International — Palmdale, CA***

Asbestos Project Manager prepared an asbestos abatement specification and performed as the environmental air monitor.

- ***U.S. Navy — Bremerton, WA***

Asbestos Project Manager responsible for assembly of an asbestos abatement specification to remove 1,200 feet of asbestos containing building materials from a pier.

- ***Federal Aviation Administration — Nationwide***

Asbestos Project Manager responsible for performing asbestos surveys and assembling asbestos abatement specifications. Performing as the asbestos project manager and environmental air monitor during a control wing renovation at the Minneapolis ARTCC.

- ***NASA Goddard Space Flight Center — Greenbelt, MD***

Asbestos Project Manager performing asbestos-containing building material surveys in six occupied buildings.

- ***Pentagon Navy Annex — Arlington, VA***

Asbestos Project Manager performing asbestos-containing building material surveys in an occupied office building.

- ***McDonnell Douglas Corporation — St. Louis, MO***

Industrial Hygiene Specialist responsible for the identification, evaluation and control of physical chemical, and ergonomic stresses, revising the Outside Contractor Asbestos Exposure Control Program and monitoring all contractors performing asbestos containing materials abatement activities. Responsible for a series of environmental impact projects to reduce the volume of hazardous waste generated from aircraft production and to comply with the Clean Air Act. These projects included identifying and facilitating the elimination of lead paints used in aircraft production. As a member of a team, reviewed substitutes for 1,1,1 trichloroethane and freon as aircraft degreasing processes. A related objective was to identify a degreaser that could be regenerated or reused with minimal reprocessing. Worked as part of a team to collect, segregate and recycle aluminum and titanium metals from production processes. As a member of the F15 program and the F15 research and testing laboratories, reviewed material safety data for existing aircraft corrosion coatings, performed personal air monitoring to characterize tasks exposure to corrosion coatings during mixing and application onto aircraft and implemented engineering and personal protective equipment controls to minimize employee exposures to the coatings.

CHARLES O. RIGGS, PHD, PE
Vice President and Director of Hazardous Waste Engineering

SPECIALIZED EXPERTISE
Hazardous waste management
Geotechnical engineering and exploration
Hydrogeology

EDUCATION
PhD in Civil Engineering (Geotechnical), University of Missouri, Rolla, 1978
MS in Engineering Management, University of Missouri, Rolla, 1968
BS in Civil Engineering, University of Missouri, Rolla, 1964

REGISTRATION
Professional Engineer in Missouri, 1968

CERTIFICATION
OSHA Hazardous Waste Health and Safety Course (29 CFR 1910.120)
OSHA 8-Hour Annual Updates
Red Cross First Aid Certified/CPR Certified

RELATED EXPERIENCE
Dr. Riggs has served as a project manager or project principal for numerous remediation projects confronting such contaminants as chlorinated solvents, PCBs, PAHs (both waste oil and wood preservatives), dioxin, explosives, and heavy metals. His management and technical experience in the areas of geotechnical and geohydrological exploration, hydrogeology, groundwater remediation and groundwater analysis and development includes:

- ***Nashville District USACE***

Program Manager for multiple hazardous waste projects within the Ohio River Division at the direction of Nashville Districts. Projects include RIs, RFIs, closure studies, lead abatement studies, remedial action plans, and asbestos remediation oversite.

- ***Times Beach Superfund Site, I-44 Corridor Remediation and Site Demolition — Times Beach, MO***

Project Engineer and Quality Control Manager responsible for the I-44 Corridor landfill design, all geotechnical analysis, design of a clay liner and cap, and the leachate collection systems at the site.

- ***U.S. EPA ARCS Program — Regions VI, VII, and VIII***

Engineering Program and Quality Control Manager responsible for the management of 50 people for Sverdrup's team. Responsibilities included total engineering planning and quality oversight for remedial investigations, feasibility studies, remedial design, and remedial construction management at 20 hazardous waste sites.

Weldon Spring Superfund Site, Weldon Spring, MO — Project Manager for the oversight of the 17,000-acre site. Contamination included low-level radioactive and explosive waste. His responsibilities included oversight of surface soil and groundwater contamination and transport studies and remediation studies, and he directed library research on treatment of explosive wastes.

CHARLES RIGGS, PHD, PE
(Continued)

RELATED EXPERIENCE (Continued)

- ***Confidential Aerospace Manufacturer — California***

Engineering and Quality Control Manager overseeing a multidiscipline team ranging from 10 to 30 people during assessment, design and remediation planning activities for the demolition and remediation of a 76-acre aircraft manufacturing facility located within an NPL site.

- ***Stamina Mills Superfund Site — North Smithfield, RI***

Project Principal with final responsibility for initial site assessment, contract negotiations, required site exploration, development of demolition work plans, RA plans and specifications. Sverdrup provided construction management for multiple elements of site remediation and restoration.

- ***Confidential Food Processor — California***

Project Manager for site exploration and remediation of a confidential food processor's facility. Responsibilities included approval of work plans, installation of groundwater monitoring wells, and soil and groundwater sampling and analysis.

- ***Omaha District USACE United Scrap Lead/Arcanum Iron and Metal Superfund Site — Troy and Arcanum, OH***

Manager of the environmental design investigation effort, which included extensive drilling, sampling, and groundwater monitoring for the Site. He participated in public meetings and was involved with U.S. EPA Region V and the state environmental agency. Responsibilities included contract negotiations with the Omaha District and negotiations and management of project subcontractors which included a WBE drilling subcontractor and MBE exploration subcontractor.

- ***Motorola, Inc., Integrated Groundwater Treatment Facility — Phoenix, AZ***

Program Principal responsible for reviewing construction plans with regard to worker safety during construction for suspected areas of remaining contamination and previous hazardous waste remediation on site. He participated in biddability/constructability reviews and was responsible for overall quality oversight.

- ***U.S. EPA Superfund Site, Groundwater Modeling Project, Region VII — Colorado***

Project Manager for modeling groundwater seepage at a major slurry wall-hydrodynamic containment seepage barrier in the Rocky Mountains. This work was performed under subcontract to a Region VII EPA contractor and involved research of USGS and EPA records of geology, well logs, soil sampling and permeability analyses, and groundwater quality analyses to construct a physical geologic model and perform contamiant transport modeling.

- ***Rio Nuevo Landfill — Tucson, AZ***

Project Manager responsible for overall management of the design of a groundwater monitoring system at a 60-year-old landfill that was being compacted for construction of a highway across the landfill. Aerial infrared thermography was used to locate suspected buried drums in the landfill. Monitoring wells and subsurface instrumentation were installed to evaluate the behavior of the landfill during dynamic compaction. His responsibilities also included management of Sverdrup site managers and exploration subcontractors.

CHARLES RIGGS, PHD, PE
(Continued)

RELATED EXPERIENCE (Continued)
Representative projects for others

- Previous research and development activities include applications research in geotechnical and hazardous waste drilling and sampling tools, including the CME Automatic Penetration Test Hammer and the CME Continuous Sampler; direct involvement with standards writing agencies, particularly developing nine exploration standards for ASTM and the U.S. EPA, development and presentation of numerous short courses and seminars on geotechnical, geoenvironmental and geohydrological exploration, analysis, and safety; participation in other professional education programs including U.S. EPA regional groundwater monitoring seminars, technical liaison with professional societies, and extensive consultations with individuals and organizations involved in geotechnical and geoenvironmental exploration including groundwater monitoring.

- Previous experience includes eleven years of geotechnical and environmental remediation engineering practice with principal responsibilities in management of field projects and geotechnical and geoenvironmental engineering report preparation, six years of teaching geotechnical engineering and engineering mechanics, and two years of field engineering with a large groundwater development company.

PROFESSIONAL BACKGROUND

Dr. Riggs has worked in geotechnical and geohydrological engineering for 26 years, beginning with the State of California Department of Water Resource in 1964. Before joining Sverdrup in 1987 he worked as a groundwater development contractor in Eastern Missouri and Southern Illinois, with a geotechnical firm in Memphis, Tennessee and taught geotechnics at the University of Missouri-Rolla, South Dakota Tech and Tufts University. He designed and has taught University of Missouri-Rolla groundwater short course since 1970, organized the first ASTM Symposium on groundwater transport, and has been instrumental in the development of several ASTM groundwater monitoring draft standards. In addition, he spent two years on a U.S. EPA groundwater monitoring seminar team that taught basic monitoring technology to the EPA Regions and subscribing agencies.

Entered the profession in 1960; joined Sverdrup in 1985

PUBLICATIONS

"North American Geotechnical Exploration Practice", Proceedings, International Conference on Deep Foundations, Vol. II, Beijing, China, September, 1986

"North American Standard Penetration Test Practice: An Essay," Proceedings, Insitu 86, ASCE, Blacksburg, Virginia, June, 1986

"Groundwater Monitoring Field Practice -- An Overview," (with A. W. Hatheway) presented at Cocoa Beach, Florida, ASTM February, 1986

"Methods for Achieving and Measuring Soil Compaction," Concrete Construction, Vol. 30, No. 8, 1985 (with N. O. Schmidt) (Republished in Building Standards, Vol. 55, No. 2, March-April, 1986)

CHARLES RIGGS, PHD, PE
(Continued)

PUBLICATIONS (Continued)
"Soil Sampling for the Ground Water Monitoring Professional: Some Practical Guidelines", Workshop on Drilling Monitoring Wells, National Water Well Convention and Exposition, 1985, Baltimore, Maryland

"A Field Study of an Automatic SPT Hammer System," Geotechnical Testing Journal, ASTM, GTJODJ, Vol. 6, No. 3, 1983 (with N. O. Schmidt and C. L. Rassieur)

"The Standard Penetration Test," XIII Ohio River Valley Soils, Seminar, Recent Advances in Geotechnical Engineering Practice, Proceedings, Lexington, Kentucky, 1982

"A Proposed Standard Test Method for a Free Fall Penetration Test," Geotechnical Testing Journal, ASTM, GTJODJ, Vol. 5, No. 3/4, 1982

"Permeability and Groundwater Transport", Standard Technical Publication 746, ASTM, Philadelphia, 1981 (Chairmen of Symposium and Editor with T. F. Zimmie)

"Utilization of Field Borehole Data for Pile Design and Installation," Geopile Conference, Proceedings, Atlanta, Georgia, 1981

"Installation of High Reinforced Diaphragm Walls in Venezuela, " XI Ohio River Valley Soils Seminar, Earth Pressures and Retaining Structures, Proceedings, Louisville, Kentucky, 1980

"Foundation on Loess," PhD Thesis, University of Missouri-Rolla, College of Engineering, 1978

PRESENTATIONS (Partial List)
"Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells," Seminar developed for USEPA and presented to six USEPA Regions in 1991-1992

"Installing Monitoring Wells with Hollow-Stem Augers" Three-day outdoor seminar developed and presented for the NGWA (formerly NWWA) at Las Vegas, NV, 1988-1991

"RCRA Ground-Water Monitoring Enforcement: Use of the TEGD and COG," a workshop presented to all USEPA Regions: RCRA Enforcement Division, Office of Waste Programs Enforcement in 1985, 1986

Seminar on "Geotechnical and Geoenvironmental Exploration" at Arlington, Virginia and San Jose, California: In association with the Old Dominion University, Norfolk, Virginia and the University of Pacific, Stockton, California respectively

Seminar on "Drilling and Geotechnical Exploration" at Sacramento, California and Boise, Idaho: In association with Humboldt State University, Arcata, California and Idaho State University, Pocatelle, Idaho respectively

Seminar for Exploration Managers and Drillers: University of Missouri-Rolla

Short Course on "Fundamentals of Shallow Foundation Design:" University of Missouri-Rolla

CHARLES RIGGS, PHD, PE
(Continued)

PRESENTATIONS (Continued)
Short Course on "Groundwater Analysis and Design of Dewatering Systems:" University of Missouri-Rolla

Short Course on "Fundamentals of Grouting:" University of Missouri-Rolla

Short Course on "Quality Geotechnical Lab Testing:" University of Missouri-Rolla

Short Course on "Embankment Dams:" University of Missouri-Rolla

Short Course on "Geotechnical Field Technology and Inspection:" University of Missouri-Rolla

Short Course on "Fundamentals of Deep Foundation Design:" University of Missouri-Rolla

DOREEN M. SCHULZ

Scientist/Geologist

SPECIALIZED EXPERTISE

Geochemical testing
Hazardous waste management

EDUCATION

BS in Geology, University of Missouri, Rolla, 1991

CERTIFICATION

OSHA Hazardous Waste Health and Safety Course (29 CFR 1910.120)
OSHA Hazardous Materials Manager and Supervisor Training (29 CFR 1910.120)
OSHA 8-Hour Annual Updates
AHERA Certified Asbestos Training for Building Inspectors

RELATED EXPERIENCE

- ***Times Beach Superfund Site, I-44 Corridor Remediation and Site Demolition — Times Beach, MO***

Field Inspector responsible for evaluating and sampling asbestos containing materials and supervision of asbestos abatement crew. Field Inspector involved in inventory, identification, and collection of household hazardous materials contained in on-site structures.

- ***U.S. EPA ARCS Program, Regions VI, VII, and VIII***

Gulf Coast Vacuum Services, Inc. Superfund Site — Abbeville, LA - Project Geologist responsible for hazardous sludge sampling and compiling data for RI/FS report.

- ***Tulsa District USACE Longhorn Army Ammunition Plant — Karnack, TX***

Project Geologist/Site Safety Officer responsible for installation of monitoring wells, boring log compilation, and collection of water and soil samples for chemical analyses.

- ***South Central Bell, Environmental Assessment — Tennessee***

Project Geologist responsible for assessing USTs and ASTs to analyze future compliance for regulatory requirements.

- ***General Services Administration — Chicago, IL***

Project Geologist responsible for evaluating and sampling 10-story building for asbestos containing materials.

Representative Projects for Others

- Laboratory Assistant for University of Missouri-Rolla. Experience included soil testing for lead

PROFESSIONAL BACKGROUND

Entered the profession in 1991; joined Sverdrup in 1991

APPENDIX B

Analytical Laboratory QC Program

008918

QUALITY ASSURANCE PLAN

FOR

ENVIRONMENTAL CHEMICAL ANALYSES

RCS NUMBER: PDP-QAP-0394

REVISION 0

Approval:	**Date:**
Dee Davis	3/1/94
Dee Davis **Quality Assurance/Quality Control Officer**	
Reddy Pakanati	3/2/94
Reddy Pakanati **Vice President, Laboratory Operations**	

PDP ANALYTICAL SERVICES
24900 PITKIN DRIVE, SUITE 300
SPRING, TEXAS 77386

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1.0 INTRODUCTION

1.1 Purpose and Scope of Document

The PDP Analytical Services (PDP) Quality Assurance Plan presents an overview of the essential elements of PDP's Quality Assurance (QA) program. PDP has modeled this plan along EPA guidelines as outlined in the individual methodologies employed and QAMS-005/80*, and by Good Laboratory Practices. The Plan also incorporates the elements outlined in the U.S. EPA Contract Laboratory Program's Statement of Work (6/93).

PDP's QA program is designed to monitor and control the quality of data generated in its laboratory. This QA program plan describes the procedures that are implemented to achieve the following:

- maintaining data integrity, validity, and useability;
- ensuring that analytical measurement systems are maintained in an acceptable state of stability and reproducibility;
- detecting problems through data assessment and establishing corrective action procedures which keep the analytical process reliable; and,
- documenting all aspects of the measurement process to provide data which are technically sound and legally defensible.

An overview of the components of the QA Plan is presented in Table 1-1.

The QA/QC policies and procedures described herein are designed to eliminate systematic errors and minimize the occurrence of other errors. However, no QA program, regardless of how elaborate, can eliminate all errors which may occur during an analysis. The QA program forms the framework for minimizing errors and identifying and correcting those errors which do occasionally occur. These QA/QC policies and procedures must be coupled with the professional judgement of the technical staff in interpreting the event surrounding the generation of the final result to ensure that quality data is consistently produced.

It is the responsibility of each employee at PDP to read, understand, and follow the provisions outlined in this document. The QAP is meant to be a training tool and source of information. It is the responsibility of each employee to report changes in procedure, as a result of policy or due to newly promulgated regulations, to the Quality Assurance/Quality Control (QA/QC) Officer to initiate the updating process. The QA/QC Officer must also be informed of any errors or omissions that are found.

Note: QAMS-005/80, Interim Guidelines and Specifications For Preparing Quality Assurance Project Plans, USEPA, 12/29/80.

Table 1-1

COMPONENTS OF PDP'S QUALITY ASSURANCE PLAN

Components				Section of QA Plan
A.	Organization and Personnel			
	1.	QA Policy and Objectives		1
	2.	QA Management		2
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		b.	Assignment of Responsibilities	
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C.	Document Control			13
	1.	Laboratory Notebook Policy		
	2.	Samples Tracking/Custody Procedures		
D.	Analytical Methodology			5, 6, 12
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	3.	Standards Preparation Procedures		
E.	Data Generation			7
	1.	Data Collection Procedures		
	2.	Data Reduction Procedures		
	3.	Data Validation Procedures		
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	2.	Internal Quality Control Checks		
	3.	Responsibility Designation		
G.	Quality Assurance			2, 8, 10, 12
	1.	Data Quality Assurance		
	2.	Systems/Internal Audits		
	3.	Performance/External Audits		
	4.	Corrective Action Procedures		
	5.	Quality Assurance Reporting Procedures		
	6.	Responsibility Designation		

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1.2 Quality Assurance Policy

PDP is committed to providing quality environmental analytical services to both public and private sectors. To ensure the production of scientifically sound and legally defensible data of known and documentable quality, an extensive QA program has been adopted to be strictly followed by PDP personnel at all levels. This program relies on well defined objectives, well-documented procedures, an extensive audit system, and management support for its effectiveness. PDP is committed to the philosophy that optimum quality can be better achieved through proactive and preventive rather than reactive and curative measures. In order to effectively monitor the QA program, a QA/QC Officer is dedicated to execute the policies of PDP. The QA/QC Officer is independent of the operational staff and reports directly to the President of PDP.

1.3 Governing Documents

Complete documentation of PDP's QA Program requires different types of operational and QA documents. Those completed on a daily or repetitive basis are presented in the applicable sections of this document or in Section 15.0, Laboratory Documentation. However, there are other governing documents used at PDP, presented below in an authority hierarchy.

1.3.1 Level I: Safety Policies

The protection of PDP employees from exposure to potentially hazardous substances and/or injurious events takes precedence over all other company policies. Employee activities, at the request of Laboratory Management and/or clientele, shall in no way challenge or conflict the provisions set forth in the following safety documents:

- Chemical Hygiene Plan
- Emergency Action Plan
- Chemical Spill Policy
- Regulations, set forth by OSHA through the Hazard Communication Standard and Laboratory Standard

1.3.2 Level II: Client Contracts

Subject only to the provisions of PDP's Safety Policies, the contact has the highest authority of control.

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1.3.3 Level III: Quality Assurance Project Plans (QAPPs)

A QAPP is a written document, which presents the policies, organization, objectives, functional activities, and specific QA and quality control (QC) activities for project management, field, and laboratory operations designed to achieve the project data quality goals. It is important that the Laboratory QAP is consistent with the project QAP and that any discrepancies be discussed and approved before analytical activity commences. This authority is subject only to the provisions of PDP's Safety Policies and the Contract.

1.3.4 Level IV: PDP's Quality Assurance Plan

The QAP, in conjunction with laboratory standard operating procedures, is the final level of authority subject only to the provisions of all documents presented in Levels I through III.

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2.0 RESPONSIBILITIES AND AUTHORITIES

PDP Analytical Services is organized along clear lines of authority to provide clients with service that is efficient and reliable (See Figure 2-1). It is important that employees understand the operational structure as outlined through technical divisions and accented by quality assurance. Each employee should also understand that even though quality assurance operates independently from operations, quality assurance must be integrated into all aspects of operations. PDP is organized into the following functional groups:

- Login
- Organic Extractions
- Metals Preparations
- GC Analysis
- GC/MS Analysis
- Metals Analysis
- Wet Chemistry
- Data Management
- Project Management
- Quality Assurance/Quality Control
- Health and Safety

The head of each department has full management control over their staff allowing for an organized chain of authority. Support staff include a systems analyst and receptionist/secretary.

Key personnel meet weekly, or more frequently as needed, to discuss the activities in the laboratory. These key individuals include, but are not limited to, the section supervisors and the following:

S.R. Pinnapureddy	–	President, Administration and Marketing
Reddy Pakanati	–	Vice President, Operations Technical Director
Dee Davis	–	Quality Assurance/Quality Control Officer Chemical Hygiene Officer
Bruce Howbert	–	Project Manager

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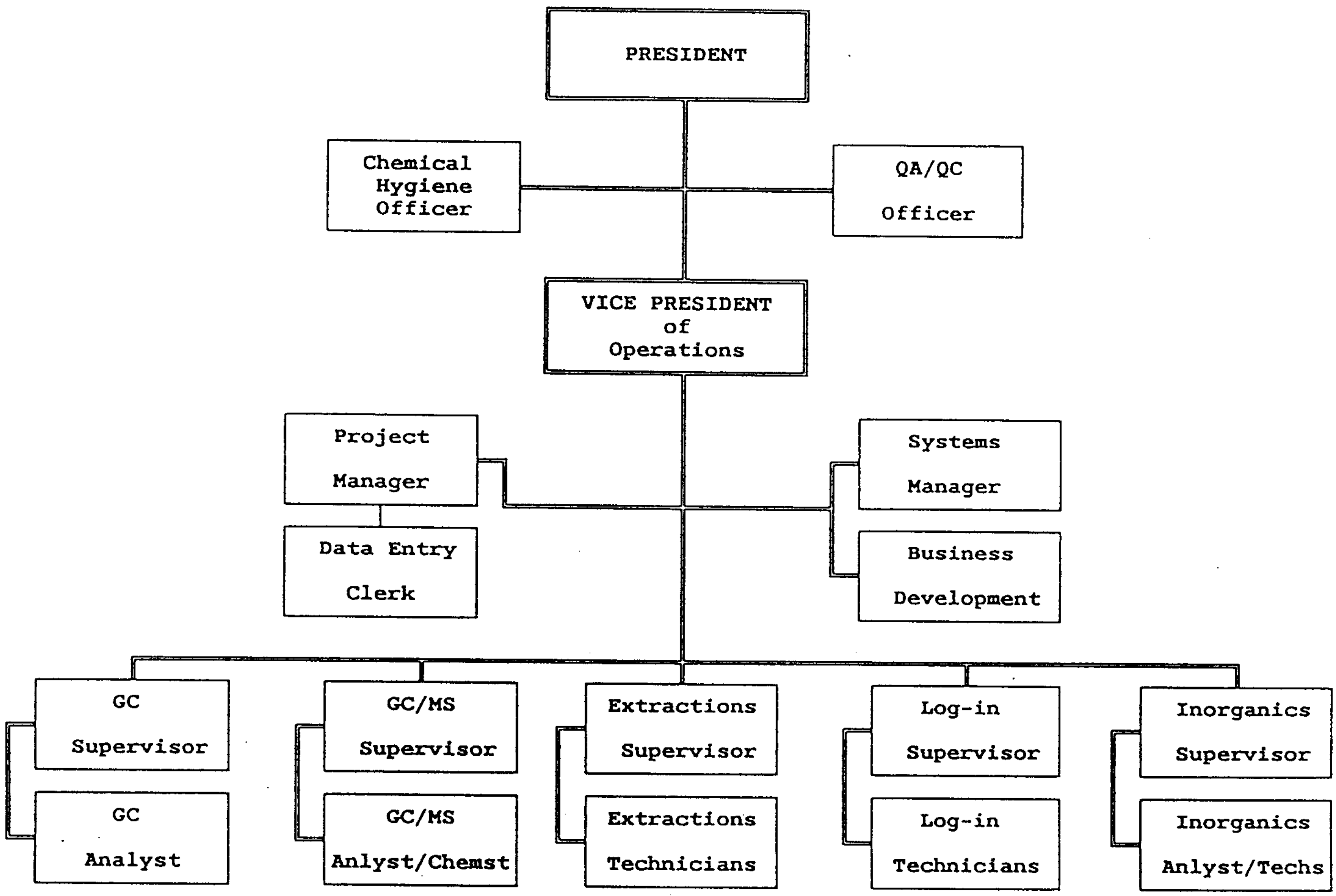

Figure 2-1
Organizational Chart

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2.1 Position Descriptions

2.1.1 Technical Director

The Vice President of Laboratory Operations serves as the Technical Director at PDP and is responsible for the training and supervision of all activities involved in generating analytical data. The oversight of operations includes working closely with section leaders, providing necessary technical support to all members of the PDP organization including, but not limited to GC/MS and GC analysts and extraction technicians. The Technical Director participates in all meetings and discussions pertaining to all technical matters. The Technical Director makes necessary recommendations for any variations to the EPA Methods to achieve the detection limits.

2.1.2 Vice President of Operations

The Vice President of Laboratory Operations is responsible for management of all activities involved in generating analytical data. Management of laboratory operations includes supervising section leaders, providing technical support to the members of the laboratory, and managing special projects, including CLP. The authority of the VP of Laboratory Operations comes from the President of PDP.

All laboratory personnel involved in the generation and reporting of data have a responsibility to understand and follow the PDP QA Plan. Laboratory personnel have the authority to accept or reject data based on compliance with well-defined QC criteria. The acceptance or rejection of data that fall outside of established QC guidelines must be approved by laboratory management and the QA/QC Officer. The authority of the laboratory personnel comes from the VP of Laboratory Operations.

The Vice President of Laboratory Operations and all laboratory personnel are responsible for:

- Having a thorough knowledge of this QA document and all SOPs specific to the analysis. A copy of the SOP should be available in the general area of performance of the analysis;

- Ensuring that all instrument tuning and calibration required is followed prior to conducting any analysis;

- Ensuring that all QC criteria is met and documentation related to performance of analysis and reporting is complete and accurate; and,

- Immediately reporting to the VP of Laboratory Operations, if any problem arises during analysis including but not limited to instrument calibration, tuning, QC criteria, analysis, and delays.

2.1.2 Quality Assurance/Quality Control Officer

Executing an effective QA program demands the commitment and attention of both management and staff. The QA/QC Officer is responsible for all the QA efforts at PDP. The QA/QC Officer reports directly to the President and has the responsibility for overseeing and regulating all laboratory functions. The QA/QC Officer operates independently of all areas generating analytical data to ensure complete objectivity in the evaluation of laboratory operations.

All personnel within the organization play a vital role in assuring the quality of their work. PDP believes that the success of the organization is dependent upon the continued commitment of all within the organization to a strong and viable QA Program.

The QA/QC Officer is the final authority on all issues dealing with data quality and has the authority to require that procedures be amended or discontinued, or analyses suspended or repeated. Also, the QA/QC Officer has the authority to suspend or terminate employees on the grounds of dishonesty, incompetence, or repeated non-compliance with QA procedures. The authority of the QA/QC Officer comes from the President of PDP.

The QA/QC Officer is responsible for:

- Implementing QA policies;
- Monitoring the implementation of the QA Plan within the laboratory to ensure complete compliance with QA objectives;
- Conducting in-house audits to identify potential problems and ensure compliance with written SOPs;
- Reviewing all final reports before submission to the Project Manager and the client;
- Performing statistical analyses of QC data and establishing databases that accurately reflect the performance of the laboratory;
- Prescribing and monitoring corrective actions;
- Serving as the in-house client representative on all project inquiries involving data quality issues;
- Assisting chemists in the writing of SOPs;
- Reporting the status of the laboratory QA program to the President and Vice President of PDP with formal and informal communications;

- Assuring that the laboratory staff has access to current SOPs; and,

- Monitoring laboratory performance in the areas of holding times, turn-around times, and meeting contractual obligations.

2.1.3 Project Manager

The Project Manager is responsible for the timely delivery of a complete and accurate report to the client and assisting clients with any problems associated with their samples from the point of log-in to the delivery of the final report. This person provides a focal point so that project efforts and communications are efficiently and effectively coordinated. The project manager has dual responsibility with the Login Supervisor in the review of computer login and with the Quality Assurance/Quality Control Officer with final report review. This position reports directly to the Vice President of Laboratory Operations.

2.1.4 Section Supervisors

Section supervisors are responsible for the daily operation of the department, including extractions or analyses, instrument maintenance and troubleshooting, data system programming, scheduling of personnel to meet production requirements, review and approval of data, supply inventory for ordering, training, safety monitoring, writing standard operating procedures, and staffing. This position reports directly to the Vice President of Laboratory Operations.

2.1.5 Log-in Supervisor

The Log-in Supervisor is responsible for the daily operation of sample log-in, including physical and computer log-in, distribution of new log-in to the section supervisors, sample custody and tracking, sample storage and archive, and the assembly of sampling kits. The Log-in Supervisor reports directly to the Vice President of Laboratory Operations.

2.1.6 Analysts/Chemists

Analysts and chemists are responsible for the extraction and/or analysis of samples by EPA SW-846, 600 series, and CLP methodologies, the systematic documentation of extractions and analyses, instrument maintenance and troubleshooting, standard and reagent preparations, glassware preparations, data generation (reduction and report writing), and providing assistance with writing standard operating procedures and new employee training. All analysts and chemists report directly to the appropriate section supervisor.

2.1.7 Technicians

Technicians are primarily responsible for the extraction of samples and glassware preparations. Other duties include performing cleanup procedures, standard and reagent preparations,

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documentation of extractions and other preparations performed, and assisting with the writing of standard operating procedures and new technician training. All technicians report directly to the appropriate section supervisor.

2.1.8 Systems Manager

The Systems Manager is responsible for the management of all computing systems in the laboratory, both analytical and administrative. This includes generating and updating all data deliverables. The Systems Analyst reports directly to the Vice President of Laboratory Operations.

2.1.9 Data Entry Clerks

Data Entry Clerks are responsible for all aspects of data deliverables, which include organization, packaging, copying, and delivery. Additional duties involve the maintenance of the Laboratory Work Status logbook, in-progress project files, data report filing, and report archiving. Data Entry Clerks report directly to the Project Manager.

2.1.10 Receptionist/Secretary

The Receptionist/Secretary is responsible for answering the phone lines and taking messages, typing, filing, ordering office supplies, purchase order tracking, photo-copying and assisting marketing personnel. This position reports directly to the Vice President of Laboratory Operations.

For a more detailed description of employee responsibilities and qualifications, see Appendix A, Resumes of Key Personnel.

2.2 Training

New employees at PDP Analytical Services receive training in three distinct areas to initiate orientation to new surroundings and modes of operation. While the training program is informal yet comprehensive, the program is structured towards both short-term and long-term goals. All training is documented on a Training Attendance Sheet (see Figure 2-2) and placed in each employee's personnel file. Each employee's line of training is unique, dependent upon scientific background and work experience. PDP strives to maintain the most productive and technically functional employees in its work force. Efficient and effective training facilitates a smooth transition of new employees in terms of function and competence and functionality within the defined responsibilities of the position.

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PDP ANALYTICAL SERVICES
24900 PITKIN DRIVE, SUITE 300, SPRING, TX 77386

TRAINING ATTENDANCE SHEET

TRAINING PERFORMED BY: ______________________ DATE: ______________

TOPIC DESCRIPTION: ____

____

IN ATTENDANCE:	(print name)	(signature)
	______________________	______________________
	______________________	______________________
	______________________	______________________
	______________________	______________________
	______________________	______________________
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	______________________	______________________
	______________________	______________________

Figure 2-2
Training Attendance Sheet

2.2.1 Areas of Training

2.2.1.1 Human Resources

The Vice President of Operations covers information pertaining to benefits, salary, vacation and sick time, and pay days with the new employee. Those matters pertaining to holiday schedule, anti-drug policy, W-4 forms, and forms usage for comp/overtime, sick or vacation leave are covered by the Secretary.

2.2.1.2 Health and Safety

Each new employee receives safety training as part of PDP's Health and Safety program. The initial session is conducted by the Chemical Hygiene Officer (CHO) through the use of video tapes, handbooks, and internal health and safety documents. Each employee receives his/her own personal copy of all written materials to be later consulted as reference documents. Through periodic and repetitive training seminars by the CHO and section supervisors, the health and safety training at PDP is continuous and maintains itself as a natural function within each employees daily routines. All training activities are documented on a PDP Training Attendance Sheet (see Figure 2-2) and placed in each employee's personnel file.

2.2.1.3 Technical

Technical training at PDP is department-dependent and carried out by seasoned analysts/chemists, section supervisors, and/or the Vice President of Operations. However, all information disseminated to laboratory personnel centers around federal and state approved methodologies, Good Laboratory Practices, and internal documents such as the Quality Assurance Plan and standard operating procedures.

To assist each employee in their professional development, PDP utilizes the following training techniques:

- on-the-job training, including computer enhancement;
- specialized training by instrument manufacturers;
- scientific/technical conferences, seminars, and meetings;
- instrument training manuals, published methodologies, and internal standard operating procedures; and,

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- single blind performance evaluation sample analysis.

PDP maintains a firm commitment to its clients to deliver quality data through the employment and training of experienced, highly qualified personnel.

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3.0 FACILITIES AND EQUIPMENT

3.1 Facilities

PDP Analytical Services (PDP) is located in the Rayford Center One building located in the immediate vicinity of Interstate 45 and Rayford Road in Spring, a suburb of Houston, Texas at the following address:

24900 Pitkin Drive
Suite 300
Spring, TX 77386

The facility occupies about 7,000 square feet of floor space, with thirteen distinct work areas (see below). An additional 18,000 square feet is available for expansion. Work areas contain approximately 200 linear feet of bench space and 25 linear feet of hood space.

- Report Generation and Quality Assurance
- Marketing and Customer Service
- Project Management
- Volatiles Room
- Semivolatiles Room
- HPLC/Spectrophotometer Room
- Gas Chromatography Room
- Atomic Spectroscopy Room
- Dishwashing Room
- Organic Extractions Room
- Metals Preparations Room
- Sample Receiving
- Conference Room

Figure 3-1 shows the floor plan of the laboratory.

3.2 Equipment

PDP has service contracts with manufacturers for all major instrumentation. Highly specialized and experienced service personnel provide preventative maintenance instruction to employees, routine maintenance, and quick turnaround for parts and labor to minimize instrument down-time. See Section 11.0 for information on instrument maintenance.

In addition, PDP also keeps an ample supply of spare parts for internal troubleshooting capabilities. The following is a comprehensive list of major instrumentation, support and miscellaneous equipment:

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Item	Quantity
Hewlett-Packard Gas Chromatograph/Mass Spectrometer (GC/MS) Model 5970B with Electron Impact Ionization Detector, Capillary Column, and HP7673 Autosampler.	2
Hewlett-Packard GC/MS Model 5971A with Electron Impact Ionization Detector and Capillary Column.	2
Hewlett-Packard Gas Chromatograph (GC) Model 5890 with Dual Capillary Inlet System, Dual Electron Capture Detectors, Dual Autosamplers, Model HP3396 Integrator, Model HP7673 Controller.	1
ABC GPC Autoprep, Model 10002B, ABC-UVD 1, 254nm Fixed Wave Length Detector with Strip Chart Recorder.	1
Tekmar Model LSC 2000 Automatic Purge and Trap and Dynamic Headspace Concentrator, and Tekmar ALS-2016 Automatic Sampler Module.	2
Tekmar Model LSC 2000 Automatic Purge and Trap and Dynamic Headspace Concentrator, and Tekmar ALS-2032 Automatic Sampler Module.	1
Tekmar Model T90-375 Sonic Disrupter.	1
VG Instruments - Four channel Chromatography server, Minichrom software.	1
Hewlett-Packard GC with PID and FID detector.	1
Hewlett-Packard GC with NPD detector.	1
Perkin-Elmer Sigma 3B with FID detector	1
Hewlett-Packard Model HP1000 - A900 Series Computer	1
Hewlett-Packard Model HP7937XP, 671 MB Hard Drive	1
Hewlett-Packard Model HP9144B Tape Drive	1
Hewlett-Packard Model HP2934 Printers	1
Hewlett-Packard Model HP2623A Terminals	1
Hewlett-Packard Model HP2627A Terminal	1
Hewlett-Packard RTE-A Software	1

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Item	Quantity
Hewlett-Packard DOS-LAN-RTE Systems	2
Gateway 2000, 486/25 Computer System; 200 MB Hard Drive; 2400 Baud Rate internal Modem, 1024 x 728 VGA Color Monitor.	5
Spectraphysics Model 3364 Integrator	1
Dionex High Performance Liquid Chromatograph Model DX300	1
Walk-in Refrigerator	1
Refrigerators	7
Fume Hoods	6
Gas Regulators	10
Deionized Water System	1
Vacuum Pump	1
Drying Ovens	2
Air Compressor	1
Precision Scientific Water Bath	1
Hot Plates	6
Heating Mantles	20
Scientific Balances	6
pH Meter	3
TCLP ZHE	7
TCLP 12 place Rotator	2
"SH 1000" Atomic Absorption Spectrophotometer with Flame, Furnace, Autosampler and Data System	1
"TJA 188" Furnace with "TJA 150" Autosampler	1
"TJA ICP 61E" with "TJA 300" Autosampler	1
BUCK Scientific Model 400A Mercury Analyzer	1
Perkin Elmer 1310 Infrared Spectrophotometer	1

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Item	Quantity
OI Model 700 TOC Analyzer	1
OI Hall ELCD Detector	1

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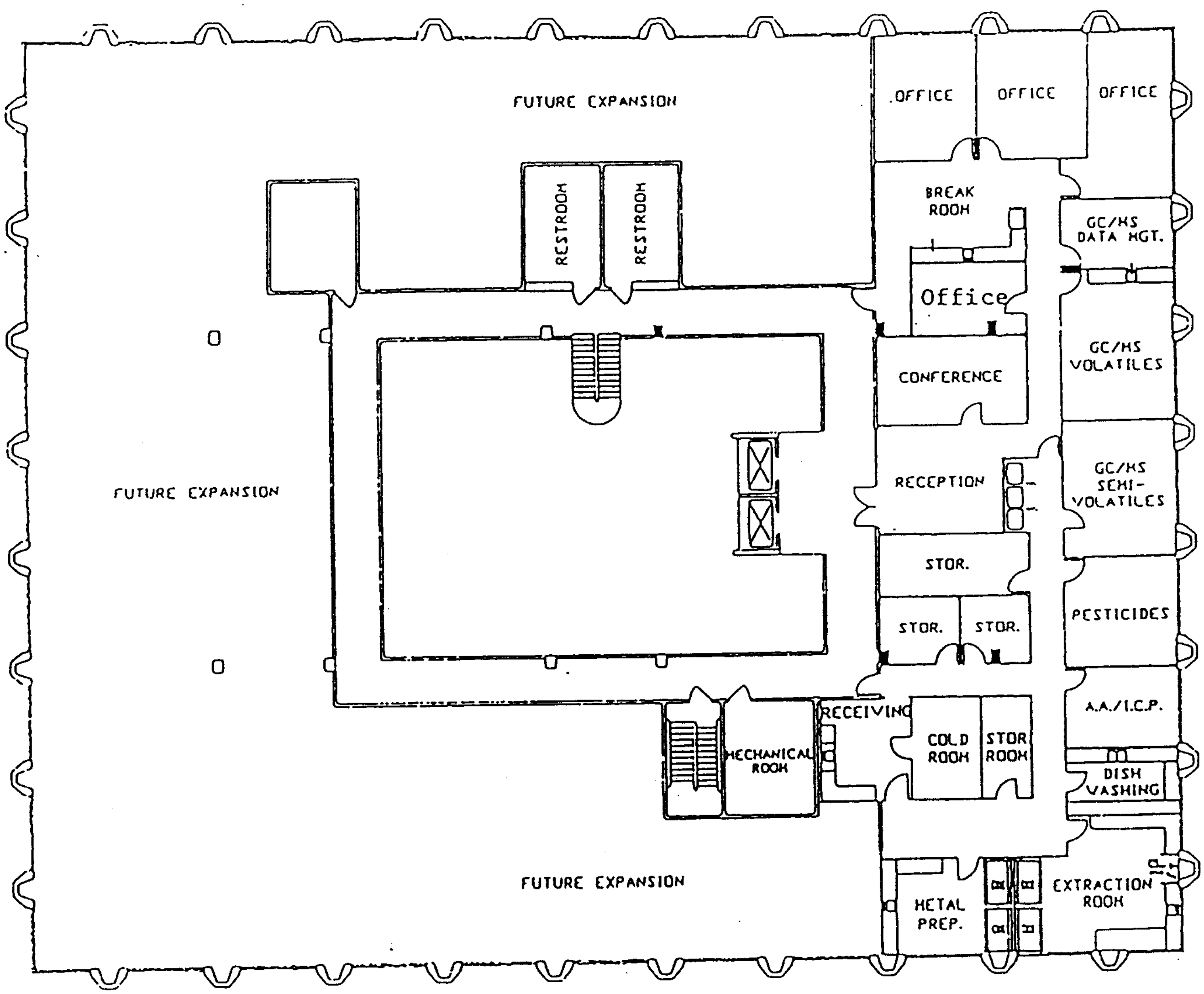

Figure 3-1
PDP Analytical Services Floor Plan

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4.0 SAMPLE CUSTODY

4.1 Chain of Custody

Chain of custody procedures document the history of samples and constitute a crucial part of sampling and analysis programs. Chain of custody documentation assists and enables the identification and tracing of a sample from the time of collection through the time of analysis.

When sample bottles are supplied by the laboratory, chain of custody forms (see Figure 4–1) accompany the containers to the field. As samples are collected, entries are made on the chain–of–custody forms by the sampler. PDP recommends to the sampler to include the following information:

- Date and time of sampling, per field ID
- Sample IDs
- Sample description
- Client/program
- Container and preservative
- Analyses required
- Special instructions/notes
- Sampler's signature

The following information is recommended for sample container labels:

- Date
- Sample description
- Preservatives
- Analyses required
- Client/program
- Sample ID numbers

4.2 Sample Receipt

When samples are received at the laboratory, a sample custodian signs for receipt of the samples, verifies each and every sample against the chain of custody (COC) forms, and notes any discrepancies or losses of samples. All COC documents are signed and dated and air bill numbers are recorded on a Sample Receipt and Login Checklist (SRLC)(see Figure 4–2).

Samples are inspected for integrity and any field documentation is reviewed for accuracy and completeness. If chain of custody forms do not accompany the samples, the sample custodian initiates these forms. When samples are received with missing or deficient chain of custody forms, the client is contacted at the time of sample receipt by Project Management and all pertinent information is requested. If this is not possible, the date and time of sample receipt is considered the date and time of sample collection.

Chain of custody and sample integrity problems are noted and recorded during sample log-in on the SRLC. For container, preservative, and holding time requirements, see Tables 4-1 and 4-2. The client is immediately informed by Project Management of the deficiencies is asked to advise the laboratory on the desired disposition of the samples. Chain of custody forms, SRLC, and deficiency notes are maintained in the client file.

Each sample that is received by the laboratory is assigned a unique sequential sample number which identifies the sample in the laboratory's internal tracking system.

References to a sample in any communication includes the assigned sample number to specify which sample is of concern. Samples remain under the control of the sample custodian until transferred to the analysts for analysis.

4.3 Sample Storage and Tracking

Samples are stored in a walk-in locked refrigerator at 4 °C, with the exception of samples for the analysis of volatile compounds and all sample extracts (stored in a separate refrigerators). A breakdown of sample and extract storage location is provided below.The temperature of the storage refrigerators are monitored and recorded daily by a sample custodian. Sample fractions and extracts are also stored under these same conditions in separate refrigerators. Whenever the samples are checked out for analysis, a sample control record sheet is signed to indicate the date, time and person checking the sample out and the same information documented when the sample is returned.

Refrigerator	Location	Contains
A	Receiving Room (Walk-in)	Samples
B	Semivolatiles Room	Sample extracts
C	Main Hall	GC and GC/MS analyzed samples and extracts
D	Main Hall	New GC samples
E	Main Hall	New GC/MS samples
F	Main Hall	GC Extracts

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4.4 Sample Retention and Disposal

Samples are retained in the refrigerator for thirty (30) calendar days after the date of final report submission. Unless a written request is received for retaining samples beyond this period, the samples are returned to the client or disposed off properly.

PDP

PDP Analytical Services
24900 Pitkin Drive, Suite 300 ▪ Spring, Texas 77386 ▪ Phone (713) 363-2233 ▪ Fax (713) 298-5784

Chain of Custody Record

Client Name / Address:

Send Report to:

Project Number:

Project Name

Samplers (Signature)

P.O. Number

Sta. No.	Date	Time	Comp.	Grab	Station Location	Number of Containers	Matrix							Remarks

Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time	Remarks:
Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time	
Relinquished by (Signature)	Date / Time	Received for Laboratory by (Signature)	Date / Time	
Method of Shipment:				PDP Quote Number:

Distribution: Original accompanies shipment; Copy to coordinator and field files

Figure 4-1
Chain-of-Custody Form

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PDP Analytical Services

SAMPLE RECEIPT AND LOGIN CHECKLIST

EPISODE #:________ DATE/TIME REC'D:________ # OF COOLERS REC'D:________ COOLER TEMP.:________

CLIENT NAME:________ # OF AQUEOUS SAMPLES RECEIVED:________

PROJECT NAME/NUMBER:________ # OF SOIL SAMPLES RECEIVED:________

DESCRIBE PACKING USED IN COOLER:________ # OF OTHER (SPECIFY):________

COOLER CHAIN OF CUSTODY SEALS: PRESENT ABSENT INTACT BROKEN

HOW MANY & WHERE:________ SEAL DATE:________ SEAL NAME:________

SAMPLE CONTAINER SEALS: PRESENT ABSENT INTACT BROKEN

	YES	NO
SHIPPING SLIP PRESENT (AIRBILL, ETC.)? CARRIER NAME:________ AIRBILL NO.:________		
WERE SAMPLES SCREENED FOR RADIOACTIVITY USING A GEIGER COUNTER?		
CHAIN OF CUSTODY PRESENT?		
WERE CUSTODY PAPERS SEALED IN A PLASTIC BAG AND TAPED INSIDE THE LID?		
CHAIN OF CUSTODY SIGNED AND DATED?		
WERE CUSTODY PAPERS FILLED OUT PROPERLY (INK, SIGNED, ETC.)?		
WAS PROJECT IDENTIFIABLE FROM CUSTODY PAPERS?		
WERE ALL BOTTLES SEALED IN SEPARATE PLASTIC BAGS?		
CHAIN OF CUSTODY AGREES WITH BOTTLE COUNT?		
WERE BOTTLE LABELS COMPLETE (ID, DATE, TIME, SIGNATURE, PRESERVATIVE, ETC.)?		
CHAIN OF CUSTODY AGREES WITH LABELS?		
BOTTLES BROKEN OR LEAKING?		
WERE CORRECT CONTAINERS USED FOR THE TESTS INDICATED?		
WERE CORRECT PRESERVATIVES ADDED TO SAMPLES?		
VOA SAMPLES FILLED COMPLETELY? IF NO, LIST SAMPLE #'S:________		
AQUEOUS VOA SAMPLES PRESERVED?		
WAS A SUFFICIENT AMOUNT OF SAMPLE SENT FOR TESTS INDICATED?		
SHORT HOLDING TIME PARAMETERS?		
SEDIMENT PRESENT IN AQUEOUS SAMPLES?		
PROJECT MANAGER CALLED AND STATUS DISCUSSED? IF YES, GIVE DETAILS IN THE COMMENTS & RESOLUTIONS.		
WHO WAS CALLED?________ BY WHOM?________ DATE:________		

COMMENTS & RESOLUTIONS:________

LOGGED IN BY:________ DATE:________

Figure 4–2
Sample Receipt and Login Checklist

Table 4-1
Required Containers, Preservatives, and Holding Times for Aqueous Samples

Name	Containers[1].	Preservatives	Holding Time[2].
Bacterial:			
Coliform (Total/Fecal)	P,G 200 mL	Cool, 4 °C, 0.008% $Na_2S_2O_3$	6 hours
Streptococci (Fecal)	P,G 250 mL	Cool, 4 °C, 0.008% $Na_2S_2O_3$	6 hours
Inorganics:			
Acidity	P,G 250 mL	Cool, 4 °C	14 days
Alkalinity	P,G 250 mL	Cool, 4 °C	14 days
Ammonia	P,G 1000 mL	Cool, 4 °C, H_2SO_4 to pH<2	28 days
Biochemical Oxygen Demand	P,G 1000 mL	Cool, 4 °C	48 hours
Biochemical Oxygen Demand (Carbonaceous)	P,G 1000 mL	Cool, 4 °C	48 hours
Bromide	P,G 500 mL	None required	28 days
Carbon (Total Organic)	P,G 500 mL	Cool, 4 °C, HNO_3 or H_2SO4 to pH<2	28 days
Chemical Oxygen Demand	P,G 500 mL	Cool, 4 °C, H_2SO_4 to pH<2	28 days
Chloride	P,G 500 mL	None required	28 days
Chlorine (Total Residual)	P,G 500 mL	None required	Analyze immediately
Color	P,G 500 mL	Cool, 4 °C	48 hours
Conductivity (Specific Conductance)	P,G 500 mL	Cool, 4 °C	28 days
Cyanide (Reactive)	P,G amber, 1000 mL	None recommended	Analyze immediately
Cyanide (Total and Amenable to Chlorination)	P,G 1000 mL	Cool, 4 $_o$C, NaOH to pH>12 0.6 g ascorbic acid	14 days
Fluoride	P 500 mL	None required	28 days
Hardness	P,G 250 mL	HNO_3 or H_2SO4 to pH<2	6 months
Nitrate	P,G 250 mL	Cool, 4 °C	48 hours
Nitrate-Nitrite	P,G 250 mL	Cool, 4 °C, H_2SO_4 to pH<2	28 days
Nitrite	P,G 250 mL	Cool, 4 °C	48 hours
Nitrogen (Total Kjeldahl)	P,G 1000 mL	Cool, 4 °C, H_2SO_4 to pH<2	28 days
Oil and Grease	G 1000 mL	Cool, 4 °C, H_2SO_4 to pH<2	28 days
Oxygen (Dissolved Probe)	G bottle and top 250 mL	None required	Analyze immediately
Oxygen (Winkler)	G bottle and top 500 mL	Fix on site, store in dark	8 hours
Petroleum Hydrocarbons (Total)	G 1000 mL	Cool, 4 °C, HCl to pH<2	28 days
pH (Hydrogen ion)	P,G 250 mL	None required	Analyze immediately
Phenols (Total, wet method)	G 1000 mL	Cool, 4 °C, H_2SO_4 to pH<2	28 days
Phosphate (Ortho-)	P,G 250 mL	Filter immediately, cool, 4 °C	48 hours
Phosphate (Total)	P,G 250 mL	Cool, 4 °C, H_2SO_4 to pH<2	28 days
Phosphorus (Elemental)	G 250 mL	Cool, 4 °C	48 hours
Phosphorus (Ortho-)	P,G 250 mL	Filter immediately, cool, 4 °C	48 hours
Phosphorus (Total)	P,G 250 mL	Cool, 4 °C, H_2SO_4 to pH<2	28 days
Residue (Total; Total Solids)	P,G 500 mL	Cool, 4 °C	7 days

[1] (P) polyethylene/plastic, (G) glass
[2] Recommended holding times from 40CFR136, EPA SW-846, and/or Standard Methods, 18th edition.

Table 4-1 (continued)
Aqueous

Name	Containers[1]	Preservatives	Holding Time[2]
Residue (Filterable; Total Dissolved Solids)	P,G 500 mL	Cool, 4 °C	7 days
Residue (Non-filterable; Total Suspended Solids)	P,G 500 mL	Cool, 4 °C	7 days
Residue (Settleable; Settleable Solids)	P,G 1000 mL	Cool, 4 °C	48 hours
Residue (Volatile; Total Volatile Solids)	P,G 500 mL	Cool, 4 °C	7 days
Residue, (Volatile Suspended; Volatile Suspended Solids)	P,G 500 mL	Cool, 4 °C	7 days
Silica	P 500 mL	Cool, 4 °C	28 days
Metals:			
Chromium VI	P,G 1000 mL	Cool, 4 °C	24 hours
Mercury	P,G 1000 mL	HNO_3 to pH<2	28 days
Metals (except Chromium VI and Mercury)	P,G 1000 mL	HNO_3 to pH<2	6 months
TCLP Mercury	P,G 1000 mL	Cool, 4 °C	28 days to TCLP extraction 28 days after extraction
TCLP Metals (except Mercury)	P,G 1000 mL	Cool, 4 °C	180 days to TCLP extraction 180 days after TCLP extrctn.
Organics:			
Acrolein and Acrylonitrile	2–40 mL vials with Teflon–lined septum	Cool, 4 °C, 0.008% $Na_2S_2O_3$ Adjust pH to 4–5	14 days
Dioxins (TCDD)	G 1000 mL, Teflon–lined cap	Cool, 4 °C, 0.008% $Na_2S_2O_3$	7 days to extraction 40 days after extraction
Pesticides/PCBs (Organochlorine)	G 1000 mL, Teflon–lined cap	Cool, 4 °C, pH 5–9	7 days to extraction 40 after extraction
Polynuclear Aromatic Hydrocarbons (PAHs)	G 1000 mL, Teflon–lined cap	Cool, 4 °C, 0.008% $Na_2S_2O_3$, store in the dark	7 days to extraction 40 days after extraction
Semivolatiles (BNAs)	G 1000 mL, Teflon–lined cap	Cool, 4 °C	7 days to extraction 40 days after extraction

[1] (P) polyethylene/plastic, (G) glass
[2] Recommended holding times from 40CFR136, EPA SW–846, and/or Standard Methods, 18th edition.

Table 4-1 (continued)
Aqueous

Name	Containers[1]	Preservatives	Holding Time[2]
TCLP (Semivolatiles)	G 1000 mL, Teflon-lined cap	Cool, 4 °C	14 days to TCLP extraction 7 days from TCLP extraction to BNA extraction 40 days after BNA extraction
TCLP (Volatiles)	2-40 mL vials with Teflon-lined septum	Cool, 4 °C	14 days to TCLP extraction 14 days after extraction
Total Organic halogens	G 1000 mL, Teflon-lined cap	Cool, 4 °C, H_2SO_4 to pH<2	28 days
Volatiles	2-40 mL vials with Teflon-lined septum	Cool, 4 °C, HCl to pH<2	14 days
Radiological:			
Alpha, Beta and Radium	P,G 1000 mL	HNO_3 to pH<2	6 months

[1] (P) polyethylene/plastic, (G) glass
[2] Recommended holding times from 40CFR136, EPA SW-846, and/or Standard Methods, 18th edition.

Table 4-2
Required Containers, Preservatives, and Holding Times for Solid Samples

Name	Containers[1]	Preservatives	Holding Time[2]
Metals:			
TCLP Mercury	P,G 120 mL WM	Cool, 4 °C	28 days to TCLP extraction 28 days after extraction
TCLP Metals (except Mercury)	P,G 1000 mL	Cool, 4 °C	180 days to TCLP extraction 180 days after TCLP extrctn.
Organics:			
Acrolein and Acrylonitrile	G 120 mL WM vials with Teflon-lined septum	Cool, 4 °C	14 days
Dioxins (TCDD)	G 250 mL WM, Teflon-lined cap	Cool, 4 °C	14 days to extraction 40 days after extraction
Pesticides/PCBs (Organochlorine)	G 250 mL WM, Teflon-lined cap	Cool, 4 °C	14 days to extraction 40 after extraction
Polynuclear Aromatic Hydrocarbons (PAHs)	G 250 mL WM, Teflon-lined cap	Cool, 4 °C, store in the dark	14 days to extraction 40 days after extraction
Semivolatiles (BNAs)	G 250 mL WM, Teflon-lined cap	Cool, 4 °C	14 days to extraction 40 days after extraction
TCLP (Semivolatiles)	G 250 mL WM, Teflon-lined cap	Cool, 4 °C	14 days to TCLP extraction 7 days from TCLP extraction to BNA extraction 40 days after BNA extraction
TCLP (Volatiles)	G 120 mL WM vials with Teflon-lined septum	Cool, 4 °C	14 days to TCLP extraction 14 days after extraction
Total Organic halogens	G 120 mL WM, Teflon-lined cap	Cool, 4 °C	28 days
Volatiles	G 120 mL WM vials with Teflon-lined septum	Cool, 4 °C	14 days

[1] (P) polyethylene/plastic, (G) glass
[2] Recommended holding times from 40CFR136, EPA SW-846, and/or Standard Methods, 18th edition.

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5.0 CALIBRATION PROCEDURES AND FREQUENCY

5.1 Standard/Reagent Preparation

The most important step in the generation of quality data is the purity/quality and traceability of the standard solutions and reagents used in the analytical processes. PDP continually monitors the quality of reagents and standard solutions through a series of well-documented procedures. Certified standards with data packages are obtained.

To ensure the highest purity possible, all primary reference standards and standard solutions used by PDP are obtained from the National Institute of Standards and Technology, the EPA Repository or other reliable commercial sources. Standards are prepared and recorded in a log book with unique identification in order to trace the standards to their source. All solvents and reagents are dated as soon as they are received.

5.2 Instrument Calibration

Before any instrument is used as a measurement device, the instruments response to known reference materials is determined. The manner in which the various instruments are calibrated depends upon the particular instrument and the intended uses of the instrument. All sample measurements are made within the calibrated range of the instrument. Preparation of all reference materials used for calibration are documented in a standards preparation notebook.

Laboratory balances are checked before use on a daily basis by a designated analyst and calibrated annually by a certified outside company. A record of calibrations and daily checks are kept in the balance log.

Oven thermometers are calibrated annually against a National Bureau of Standards certified thermometer in the range of interest. Annual calibrations are recorded in a calibration notebook. Daily readings are recorded with the respective analysis (e.g., the solids book).

5.2.1 Gas Chromatography/Mass Spectroscopy (GC/MS)

5.2.1.1 GC/MS Instrument Performance Documentation

Mass spectrometers are tuned on a daily basis and every 12 hours of analysis with decafluorotriphenylphosphine (DFTPP) or 4-bromo-fluorobenzene (BFB) for semi-volatiles or volatiles, respectively. Ion abundances must fall within the windows dictated by the specific program requirements. Once an instrument has been tuned, initial calibration curves for analytes (appropriate to the analyses to be performed) are generated from three to five levels containing known concentrations of authentic standards of compounds of interest. The calibration curve brackets the anticipated working range of analyses.

Calibration data, to include linearity verification determined by response factor evaluation are maintained in the laboratory's permanent records of instrument calibrations.

5.2.1.2 GC/MS Method Performance Documentation

Each day and every 12 hours of analysis, a midpoint calibration standard is analyzed to verify that the instrument responses are still within the initial calibration determinations.The relative percent difference (%RPD) is calculated and recorded. If %RPD exceeds the method criteria, appropriate corrective actions are taken.

All GC/MS analyses include the analysis of a method blank, a matrix spike, matrix spike duplicate and a laboratory control standard in each lot of twenty or fewer samples. In addition, appropriate surrogate compounds specified in EPA methods are spiked into each sample and all QC samples. Recoveries from method spikes and surrogate compounds are calculated and recorded.

5.2.2 Gas Chromatography (GC)

5.2.2.1 GC Instrument Performance Documentation

The calibration procedures for GC are very similar to those of a GC/MS. Initial calibration curves for analytes (appropriate to the analyses to be performed) are generated by three to five levels of concentrations (dependent upon EPA methodologies) for all compounds of interest. The calibration curve brackets the anticipated working range of analyses. Should the responses of the daily midpoint calibration check standard fall outside ± 15% (or other method specifications) of the initial calibration responses, then a full recalibration is necessary. For Pesticide analyses, a Performance Evaluation Standard is analyzed daily to monitor levels of endrin and DDT breakdown (up to 20% breakdown allowed for each compound). The results of simultaneous sample injections on two columns must fall within a 25% difference for confirmation.

Calibration data, to include linearity verification determined by response factor evaluation is maintained in the laboratory's permanent records of instrument calibrations.

5.2.2.2 **GC Method Performance Documentation**

All GC analyses include the analysis of a method blank, matrix spike, matrix spike duplicate, and a laboratory control standard in each lot of twenty or fewer samples. In addition, appropriate surrogate compounds specified in EPA methods will be spiked into each sample and all QC samples. Recoveries from method spikes and surrogate compounds are calculated and recorded.

5.2.3 **Atomic Absorption Spectrophotometry (AA)**

5.2.3.1 **AA Calibration**

Atomic absorption spectrophotometer is calibrated prior to each day of use. Calibration standards are prepared from appropriate reference materials, and working calibration standards are prepared fresh daily. The working standards include a blank and a minimum of three (3) concentrations to cover the anticipated range of measurement.

Duplicate injections are made for each concentration. At least one of the calibration standards is at or slightly above the desired instrument detection limit. The correlation coefficient of the plot of known versus found concentrations must meet at least 0.996 in order to consider the responses linear over a range. If a correlation coefficient of 0.996 is not achieved, the instrument is recalibrated prior to the analysis of samples.

Calibration data, including the correlation coefficient, is entered into laboratory notebooks maintaining a permanent record of instrument calibrations.

5.2.3.2 **AA Quality Control**

At least one method blank and two method blank spikes (laboratory control samples: LCS) are included in each laboratory lot of samples. Regardless of the matrix being processed, the LCS and blanks are in aqueous media. The LCS is at a concentration of approximately five (5) times the practical quantitation limit.

The method blanks are examined to determine if contamination is being introduced in the laboratory and are analyzed at a frequency of one per analytical lot or five (5) percent of the samples, whichever is more. If the analyte of interest is detected in the blank at a concentration above the detection limit, the batch of samples containing that blank must be re-digested and analyzed. The LCS, matrix spikes and matrix spike duplicates are examined to determine both precision and accuracy. Accuracy is measured by the percent recovery (% R) of the spikes and LCS. The recovery must be within the range 80–120 percent to be considered acceptable, with the exception of antimony and silver, due to documented method deficiencies in achieving reliable recovery.

Precision is measured by the reproducibility of both LCS and matrix spike duplicates and is calculated as relative percent difference (% RPD). Results must fall within twenty percent RPD in order to be considered acceptable.

5.2.4 Inductively Coupled Plasma Spectroscopy (ICP)

5.2.4.1 ICP Calibration

The inductively coupled plasma spectrometer is calibrated prior to each day of use. Calibration standards are prepared from reliable reference materials and contain all metals for which analyses are being conducted. Working calibration standards are prepared fresh daily. Quarterly, a calibration is performed with a blank and a minimum of five concentrations to cover the anticipated range of measurement. Duplicate readings are made for each concentration . At least one of the calibration standards must be at or slightly above the desired instrumental detection limit. The correlation coefficient of the plot of responses versus concentrations must be at least 0.996 in order to consider the responses linear. If a correlation coefficient of 0.996 cannot be obtained, the spectrometer will be recalibrated prior to the analysis of samples. This calibration is done quarterly to verify the linear range of the instrument.

Calibration data, to include the correlation coefficient, are entered into laboratory notebooks maintaining a permanent record of instrument calibrations.

On a daily basis, the instrument is calibrated using a standard at the high end of the calibration range and a blank. The calibration is verified with a mid-range calibration check standard which is prepared from a different source than the instrument calibration standard. This standard must not deviate more than ± 10 percent from the target value. In addition, a linear range check at approximately two times the instrument detection limit is analyzed to verify linearity near the detection limit.

5.2.4.2 ICP Quality Control

At least one method blank and two method blank spikes (laboratory control samples: LCS) are included in each laboratory lot of samples. Regardless of the matrix being processed, the LCSs and blanks will be in aqueous media. The LCS concentration are approximately five (5) times the detection limit.

The method blanks are examined to determine if contamination is being introduced in the laboratory.

The LCS results are examined to determine both precision and accuracy. Accuracy is measured by the percent recovery (% R) of the spikes. The recovery must fall within the range 80–120 percent to be considered acceptable.

Precision will be measured by the reproducibility of both LCS and matrix spike duplicate and will be calculated as relative percent difference (% RPD). Results must agree within twenty (20) percent RPD in order to be considered acceptable.

5.2.5 Total Organic Carbon (TOC)

5.2.5.1 TOC Calibration

The total organic carbon analyzer is calibrated prior to each day of use. Calibration standards are prepared from potassium hydrogen phthalate, and working calibration standards are prepared fresh daily. The working standards include a blank and a minimum of five (5) concentrations to cover the anticipated range of measurement.

At least one of the calibration standards is at or slightly above the desired instrument detection limit. The correlation coefficient of the plot of known versus found concentrations must be at least 0.996 in order to consider the responses linear over a range. If a correlation coefficient of 0.996 cannot be achieved, the instrument is recalibrated prior to analysis of samples. Calibration data, to include the correlation coefficient, is entered into the laboratory notebooks to maintain a permanent record of instrument calibrations.

5.2.5.2 TOC Quality Control

At least one method blank and two method spikes are included in each laboratory lot of samples. Method spikes are at a concentration of approximately five (5) times the method detection limit.

The method blanks are examined to determine if contamination is being introduced in the laboratory. The method spikes are examined to determine both precision and accuracy. Accuracy is measured by the percent recovery (% R) of the spikes. The recovery must be within the range 80–120 percent to be considered acceptable.

Precision is measured by the reproducibility of both method spikes and will be calculated as relative percent difference (% RPD). Results must agree within twenty (20) percent RPD in order to be considered acceptable.

5.2.6 Spectrophotometric (Colorimetric) Methods

5.2.6.1 Spectrophotometer Calibration

Spectrophotometers are calibrated prior to each day of use. Calibration standards are prepared from reference materials appropriate to the analyses being performed, and working calibration standards are prepared fresh daily. The working standards include a blank and a minimum of five (5) concentrations to cover the anticipated range of measurement. At least one of the calibration standards is at or below the desired instrument detection limit. The correlation coefficient of the plot of know versus found concentrations must be at least 0.996 in order to consider the responses linear over a range. If a correlation coefficient of 0.996 cannot be achieved, the instrument is recalibrated prior to the analysis of samples.

Calibration data, to include the correlation coefficient, is entered into laboratory notebooks to maintain a permanent record of instrument calibrations.

5.2.6.2 Spectrophotometer Quality Control

At least one method blank and two method spikes are included in each laboratory lot of samples. Regardless of the matrix being processed, the method spikes and blanks are in aqueous media. Method spikes concentrations are approximately five (5) times the method detection limit. The method blanks are be examined to determine if contamination is being introduced in the laboratory.

The method spikes are examined to determine both precision and accuracy. Accuracy is measured by the percent recovery (% R) of the spikes. The recovery must be in the range (80–120 percent) in order to be considered

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acceptable. Precision is measured by the reproducibility of both method spikes and is calculated as relative percent difference (% RPD). Results must fall within twenty (20) percent RPD in order to be considered acceptable.

5.2.7 Methods Development

When standard (published) methods of analyses are not applicable to analyses to be performed, methods can be developed to achieve the desired information. However, the lack of a historical data base does not obviate the necessity for documented quality control data to demonstrate the validity of the generated results. Reference material sources must be identified, and proof of compound identity and purity must be available. Instrumental operating parameters as well as calibration data must be documented, and specific procedures (to include sampling, if applicable) must be noted. Quality control samples (method blanks, method spikes, method spike duplicates, matrix spikes, and matrix duplicates) should be analyzed with greater frequency than with standard analytical methods to demonstrate the certainty and uncertainty of generated data. Exact requirements for demonstrating the reliability of developed methods are normally dictated by the specific program.

5.2.8 Reference Materials

Whenever possible, primary reference materials are obtained from the National Institute of Standards and Technology (NIST) or the U.S. Environmental Protection Agency (EPA). In the absence of available reference materials from these organizations, other reliable sources are sought. These reference materials are used for instrument calibration, quality control spikes, and/or performance evaluations. Secondary reference materials may be used for these functions provided that they are traceable to an NIST standard or have been compared to an NIST standard within the laboratory.

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6.0 ANALYTICAL PROCEDURES

Most analyses performed by PDP are driven by regulatory concerns. Therefore, methods used at PDP predominantly originate from regulatory agencies. Generally the methods used are those specified by the U.S. EPA and other federal agencies, state agencies, and professional organizations, as demonstrated below:

- Current EPA (CLP) protocols for the analysis of organic hazardous substances including chlorinated dioxins and dibenzofurans.
- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, Final Rule and Technical Amendments" Federal Register, Volume 56, No. 195, October 8, 1991.
- Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020 (revised March, 1983).
- "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," EPA-600/4-82-057 (July, 1982).
- "Test Methods for Evaluating Solid Waste" (SW-846), 3rd Edition (1986) and Updates, Office of Solid Waste and Emergency Response, U.S. EPA.
- "Standard Methods for the Examination of Water and Wastewater," 17th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington, DC.
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water," U.S. EPA, Environmental Monitoring and Support Laboratory - Cincinnati.
- American Society for Testing and Materials (ASTM), Philadelphia, PA.

7.0 DATA REDUCTION, VALIDATION, AND REPORTING

7.1 Data Reduction and Validation

7.1.1 Data Generation and Reduction

All analysts are responsible for the generation and reduction of analytical data. This is accomplished through extracting required information from laboratory worksheets, run logs, and instrument printouts and making necessary calculations to reduce the data to its final reporting concentrations. This information is then entered via computer into a data spreadsheet, printed as a preliminary report, reviewed, and submitted to the department supervisor for approval. The preliminary report contains the necessary calculations, dilution factors, prep factors, and all other pertinent information to allow the supervisor to properly assess the extraction, analytical, and data reporting procedures.

7.1.2 Data Validation

All analytical data generated within PDP is checked for accuracy and completeness through a multi-tier data review system (see Figure 7-1). Data review consists of various steps required for the approval and submittal of reports to the client. These include:

- Review by the analyst who generates the data
- Review by supervisor
- Review by data clerks for completeness and accuracy of data package
- Review by the QA/QC Officer
- Final review by project manager
- QA audits

The analyst initiates the validation process by reviewing the data for completeness, accuracy and QC performance. Each method standard operating procedure outlines the method-specific performance criteria, calculations, and documentation requirements which must be met in order for the data to be deemed valid. Also, the analyst generates preliminary report forms which serve as an error check for the supervisor, QA/QC Officer, and data entry clerks upon generation of the forms for final results. If any problems are detected he/she reports it to the appropriate supervisor for corrective action. See Section 13.0 for corrective action procedures. A "Data Review Checklist and Case Narrative" form is also completed, signed, and submitted with the data set (see Figure 7-2).

The supervisor review is carried out by the department supervisor or second analyst deemed qualified to review the data. The data set is checked to determine that:

- the documentation supports the methodology employed;
- calculations were carried out correctly for results and QC sample data;
- units, detection limits, prep information, method references, dates/times of extractions and analyses, and other technical information were reported correctly;
- no transcription errors from raw data sheets or printouts to the preliminary report sheets were made;
- all appropriate supporting documents (extraction logs, run logs, worksheets, etc.) are present, complete, legible, and were signed by the analysts;
- QC data are complete and acceptable;
- project requirements, if any, were met; and,
- anomalies were documented, a Corrective Action form was generated, and comments were made on the Data Review Checklist form.

If any problems are detected, the data goes back to the operators for remediation. Once all corrective actions have been carried out and accepted, the supervisor signs the Data Review Checklist and releases the data set to the data entry clerks for final report generation.

The first level QC review process of the data set is similar to the supervisor review. All aspects of proper documentation procedures, completeness of logsheets, acceptable QC, anomalies and corrective actions performed, data entry accuracy, adherence to EPA recommended or CLP holding times, and case narrative comments are addressed. A checklist is used to facilitate this complete review process (see Figure 7-3). In addition, the raw data review for calibration requirements, QC frequency, and transcription to final report is carried out on a 10% basis.

Data clerks are responsible for the assembly of data together for submission to the client. They check to see if all the pages are enclosed, if necessary generate forms, perform a contract compliance screen, and then submit the report to the QA/QC Officer for final review of the data.

Once the entire report is assembled, the QA/QC Officer reviews this document for project completeness. This includes a comparison of chain-of-custody requests and special requirements, if any, to what was reported by the laboratory, proper order of report, legibility, technical assessment of data relationships, if any, and the accuracy and completeness of the Case Narrative. Upon approval, the checklist and project folder is signed by the QA/QC Officer.

The project manager performs the final review prior to submitting the reports to the client. The report is reviewed for adherence to specific project requirements, data relationships, adherence to holding times, and completeness. Upon approval, the report is signed by the

Project Manager and submitted to the client.

7.2 Data Reporting

A variety of reporting formats, from computerized data tables, to a CLP-deliverables package, are available. In general, PDP reports consist of:

1. Narrative
2. Client information and identification
3. Analytical data and PQL limits
4. QC information such as blanks, surrogates, matrix spikes, and duplicate data
5. Matrix and methodologies references

PDP also provides a raw data package upon request.

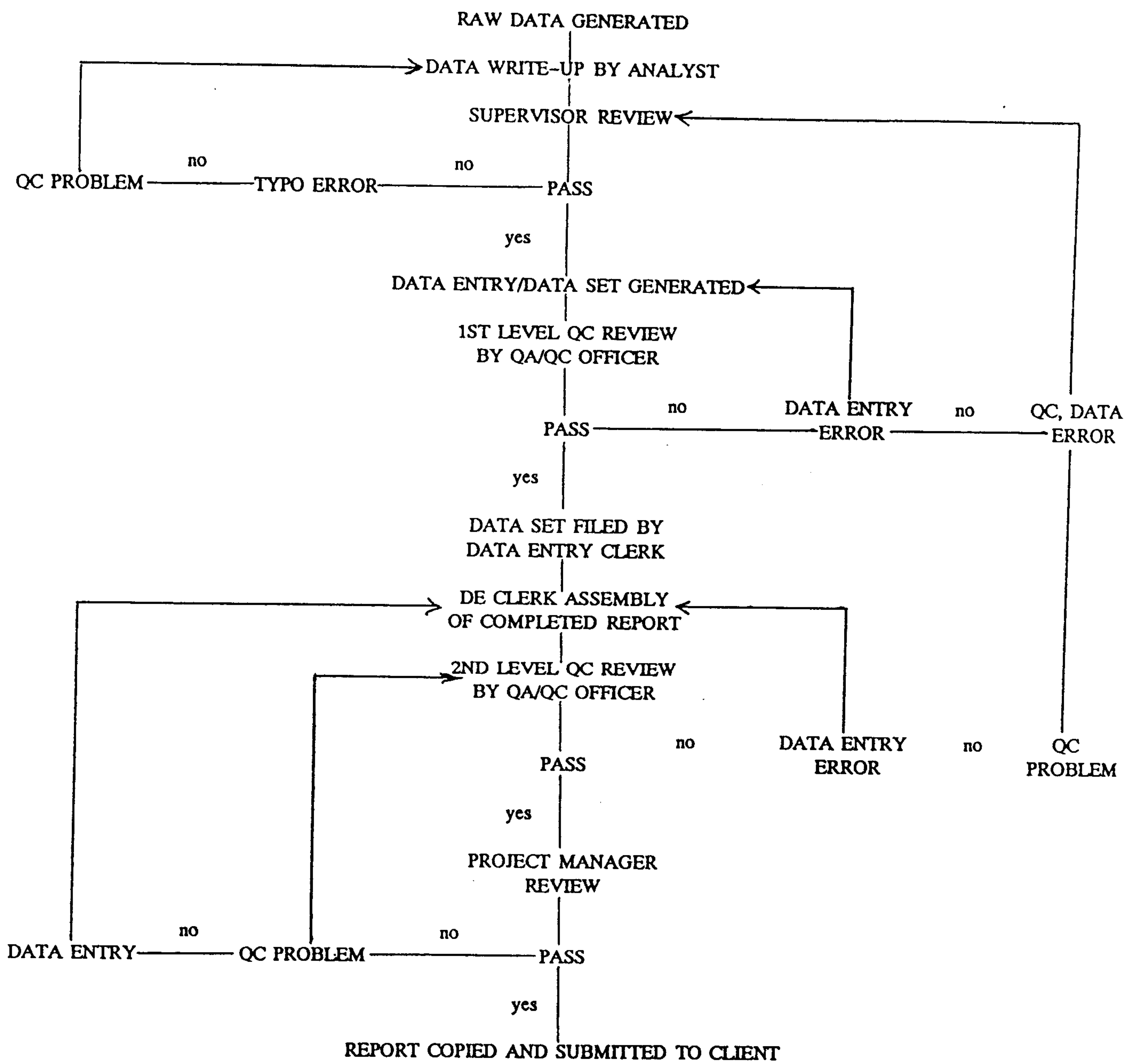

Figure 7-1
Data Validation Scheme

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DATA REVIEW CHECKLIST AND CASE NARRATIVE

EPISODE:________________ PARAMETERS/TESTS: ________________

DEPARTMENT:________________

DATA REPORT REVIEWED BY:________________ DATE:________________

DATA REPORT CHECKLIST

DOES REPORT CONTAIN:

Y	N	NA	COPIES OF ALL EXTR/PREP LOG SHEETS?	Y	N	NA	ALL RAW LCS/LCSD DATA?
Y	N	NA	ALL RAW SAMPLE DATA?	Y	N	NA	ALL RAW BLANK DATA?
Y	N	NA	ALL RAW DUP/MS/MSD DATA?	Y	N	NA	ALL CALIBR. AND QC DATA?

ANALYST NOTES:________________

I certify that all data generated are in accordance with required methodologies and/or standard operating procedures except for the conditions detailed on this page.

____
Analyst

CASE NARRATIVE

____

QA/QC OFFICER REVIEW:________________ DATE:________________

Figure 7-2

Data Review Checklist and Case Narrative

PDP ANALYTICAL SERVICES

FINAL REPORT REVIEW CHECKLIST

EPISODE NO.:____________________

Y N NA Is Chain-of-Custody signed, dated and time recorded by individual receiving samples?

Y N NA Does Login sheet agree with CoC?

Does Report agree with Login sheet:

Y N NA Client ID's vs. PDP ID's?

Y N NA Parameters performed that were requested?

Y N NA Holding times met?

Y N NA TAT met?

Y N NA Special instructions noted?

Y N NA Has raw data been transcribed correctly to report?

Y N NA Are significant figures correct?

Y N NA Are all method blanks included and acceptable?

Y N NA Are all duplicate results included and acceptable?

Y N NA Are all matrix spikes included and acceptable?

Y N NA Are all matrix spike duplicates included and acceptable?

Y N NA Are all analysis dates correct?

Y N NA Are all observations present in Case Narrative?

Y N NA Is report in correct order?

Y N NA Is raw data requested and included?

Y N NA Is cover letter present?

FINAL REPORT APPROVAL:____________________ DATE:______________

Figure 7-3
Final Report Review Checklist

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8.0 INTERNAL QC CHECKS

The QA/QC Officer at PDP maintains the data base for internal QC checks. The QA/QC Officer looks at trends for surrogate recoveries, laboratory control samples, and matrix spike data to see if laboratory operations are in control. The information is subjected to statistical analysis for data quality assessment.

8.1 Laboratory Quality Control Checks

8.1.1 Laboratory Duplicates

Laboratory duplicate samples are analyzed to monitor for intralaboratory precision of data generated. These samples are analyzed on no less than 5 % basis with at least one replicate if fewer than ten samples are analyzed for any particular parameter.

8.1.2 Spiked Samples

Matrix Spike and Matrix Spike duplicate samples are analyzed to monitor for accuracy of data due to interferences which may be present in the sample and thus influence the reported result. These spiked samples are tested on no less than a 5% basis for any particular parameter.

8.1.3 Method Blanks

Method Blanks are accomplished by treating Type II reagent water or sodium sulfate in the same manner as samples, to monitor potential contamination of samples from solvents, reagents, glassware or laboratory equipment. Method blanks are included with each set of samples.

8.1.4 Laboratory Control Standards (LCS)

Laboratory Control Standards are analyzed to monitor for accuracy of data generated. LCS will be analyzed at a frequency of 5% of the samples.

8.1.5 Surrogate Standards

Surrogate standards are analyzed in accordance with EPA guidelines for organic analyses. Deuterated standards are analyzed along with unknown samples to insure recovery of these compounds in analysis. Surrogates are added to all samples, method blanks, matrix spikes, and LCSs.

8.1.6 DFTPP Criteria Test

The DFTPP criteria test is utilized for the GC/MS instrument prior to Base/Neutral or Acid Fraction analyses. The instrument is certified according to EPA protocol by injecting with

DFTPP (decafluorotriphenylphosphine) and comparing the relative ion abundances for key ions. The instrument is adjusted and calibrated until all criteria are met.

8.1.7 BFB Criteria Test

The BFB criteria test is utilized daily to check the performance of the GC/MS system for volatile organic analyses (VOA). The instrument is injected with BFB (bromofluorobenzene) and the relative abundances of key ions are compared. The instrument is adjusted until the prescribed criteria are met.

8.1.8 Reagent Checks

Reagent checks are accomplished by treating known laboratory blanks in the same manner as samples and reviewing data to verify no contamination has been introduced as a result of reagents.

9.0 DATA QUALITY OBJECTIVES

The QA program is measured by the quality of data generated by the laboratory. Data quality is judged in terms of its precision, accuracy, representativeness, completeness and comparability. These terms are described as follows:

9.1 Precision

Precision is the degree to which the measurement is reproducible. Precision is assessed by replicate measurements of MS/MSD, reference materials, or environmental samples. PDP routinely monitors precision by comparing the RPD between duplicate control sample measurements with method established control limits at plus three standard deviations from the mean RPD of historical MS/MSD data.

Precision is frequently determined by comparison of replicates. The standard deviation of "n" measurements of "X" is commonly used to estimate precision.

Standard deviation (s) is calculated as follows:

$$s=\sqrt{\frac{\sum_{1}^{n}(X_i-\overline{X})^2}{n-1}}$$

where a quantity "X" (e.g., a concentration) is measured "n" times and "X" is the arithmetic mean. The relative standard deviation, **RSD** (or sample coefficient of variation, CV), which expresses standard deviation as a percentage of the mean, is generally useful in the comparison of three or more replicates (although it may be applied in the case of n = 2).

$$RSD = 100\ (s/\overline{X})$$

$$CV = 100\ (s/\overline{X})$$

where: RSD = relative standard deviation
CV = coefficient of variation
s = standard deviation
X = mean

In the case of duplicates, the RPD between the two samples may be used to estimate precision.

$$RPD = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100$$

Where: RPD = relative percent difference
D_1 = first sample value
D_2 = second sample value (duplicate)

9.2 Accuracy

Accuracy is a determination of how close the measurement is to the true value. Accuracy is assessed using laboratory control samples, standard reference materials, or spiked environmental samples. Unless specified otherwise in special contract, PDP monitors accuracy by comparing LCS results with method established control limit at plus or minus three standard deviation units from the mean of historical LCS results.

9.3 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Analytical data should represent the sample analyzed regardless of the heterogeneity of the original sample matrix. PDP strives to accommodate all sample matrices. Some samples may require the analysis of multiple phases to obtain representative results.

9.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions. PDP's completeness goal is 95%.

To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to determine if the database is sufficient.

9.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured through the use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, etc.), consistency in reporting units (ppm, ppb, etc.), and analysis of standard reference materials.

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10.0 PERFORMANCE AND SYSTEM AUDITS

PDP is committed to participate in a variety of federal and state certification programs, including the U.S. EPA CLP, that subjects the laboratory to stringent system and performance audits on a regular basis.

10.1 Systems Audits

A systems audit is a review of laboratory operations conducted to verify that the laboratory has the necessary facilities, equipment, staff and procedures in place to generate acceptable data. This type of audit is conducted by external agencies and clients as well as PDP's QA/QC Officer. Target investigations are to:

- Verify that testing procedures comply with Contract requirements.
- Verify that facilities and testing equipment are available and comply with testing standards.
- Check test instrument calibration data against certified standards.
- Verify that recording forms, including all of the test documentation requirements, have been prepared.

The QA/QC Officer conducts a systems audit quarterly or more frequently if necessary.

10.2 Performance Audits

10.2.1 Measurements Parameter Performance Audits

A performance audit verifies the ability of the laboratory to correctly identify and quantify compounds in blind check samples. Measurement parameter performance audits, as part of the daily analytical scheme in terms of laboratory control sample, are conducted on a routine basis. This includes a review of each measurement parameter procedure by the QA/QC Officer on a semiannual basis.

10.2.2 Interlaboratory Performance Evaluation Studies

PDP participates in EPA proficiency studies as well. The Water Pollution Study and the Water Supply Study are submitted semiannually; target analyte categories are listed on the following page. In addition to the above, PDP from time to time participates in proficiency evaluation studies conducted by other governmental agencies and private industries.

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EPA Water Pollution Studies

Trace Metals
Minerals
Nutrients
PCBs
Pesticides
Volatile Halocarbons
Volatile Aromatics
Miscellaneous general chemistry

EPA Water Supply Studies

Trace Metals
Minerals
Nutrients
Pesticides
Herbicides
PAHs
Volatile Organic Compounds
Miscellaneous general chemistry

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11.0 PREVENTIVE MAINTENANCE

11.1 Preventative Maintenance Tasks

Preventative maintenance tasks are carried out routinely to prevent or minimize downtime of analytical equipment. All preventive maintenance tasks such as column clipping, septum change are recorded in the instrument maintenance log or run log.

11.1.1 Instrumentation

All instrumentation is periodically subjected to the preventative maintenance tasks outlined in that particular piece of equipment's operations manual. In addition, major instruments are under service contract with the manufacturers.

11.1.2 Wet Chemical Methods

For wet chemistry methods, the glassware utilized is kept in a clean ready-to-use condition at all times, with extra glassware available should replacement of damaged glassware be necessary. A surplus of all reagents is maintained, along with a local secondary supplier, should in-house supplies ever be exhausted or their integrity questioned.

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12.0 CORRECTIVE ACTION

Laboratory personnel are alerted that corrective actions may be necessary when performance criteria are not met. Performance criteria are specified through methodologies and good laboratory practices via internal standard operating procedures. A minimum requirement of each standard operating procedure generated by PDP is a QA/QC section which explicitly describes quality control requirements and corrective action procedures. For example, PDP SOP No. PDP-MSS-100 for semivolatile analyses (based on EPA SW-846 method 8270 requirements) requires that when surrogate recoveries are determined outside of the method-specific control limits, then the samples must be re-extracted and reanalyzed. Analysts and extraction personnel are required to conform to the SOP-stated QC criteria and corrective action procedures. In general, corrective actions may be necessary if:

- QC data are outside the acceptable windows for precision and accuracy;
- Blanks contain contaminants above acceptable levels;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;
- Deficiencies are detected by the QA/QC Officer during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received from clients.

Corrective action procedures are initiated at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If quality control failures occur, as specified in the specific standard operating procedure, then a Corrective Action Request form must be generated (see Figure 12-1) and submitted to the department supervisor. A copy is submitted to the QA/QC Officer to allow for the review of the adequacy of the corrective action procedures as they are carried out.

The department supervisor and analyst ascertain what corrective actions are needed. The QA/QC Officer may be consulted for recommendations based on the information provided. The original Corrective Action Request form travels with the data to its ultimate resting place in the final project file. Once the completed, original form is submitted in the appropriate data set, it is approved and signed by the QA/QC Officer.

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CORRECTIVE ACTION REQUEST

INITIATED BY: ____________________ DATE: ________________

EPISODE ID/SAMPLE NUMBERS: ____

REASON FOR REQUEST: ____

____

____

____

____

SUPERVISOR/ANALYST SIGNATURE: ______________________

CORRECTIVE ACTIONS SUGGESTED: ______________________________________

____

____

____

CORRECTIVE ACTIONS TAKEN: ____

____

____

____

SUPERVISOR/ANALYST SIGNATURE: ______________________

QA/QC OFFICER APPROVAL: __________________ DATE: ______________

Figure 12-1
Corrective Action Request Form

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13.0 LABORATORY DOCUMENTATION

Completed and accurate documentation of analytical and procedural information is an important part of the QA program. The following describes different types of documentation used at PDP.

13.1 Standard Operating Procedures

Details of analytical and QC protocols are contained in standard operating procedures. SOPs are documents that contain detailed information on the requirements for the correct performance of a laboratory procedure, based upon federal and state approved methodologies and Good Laboratory Practices. PDP has five categories of laboratory SOPs:

- SOPs for Performance of an Analytical Method (preparations, analyses, instrument operation/maintenance, supporting equipment operation, etc.);
- SOPs for Sample Tracking and Management (physical login, identification, storage, archive, disposal, sampling kits, etc.);
- SOPs for Quality Control Checks and Quality Assurance Procedures;
- SOPs for Safety
- SOPs for Administrative Operations (data management, etc.)

13.2 Laboratory Notebooks

All information is recorded in PDP generated, bound log books at the respective labs. Any unusual observations are noted in the comments section. All log books are initialed and dated. The supervisors of the respective laboratories audit the log books in all areas of the laboratory and return them to the QA/QC Officer. The QA/QC Officer reviews them at this time (and during inspections) for adherence to Good Laboratory Practices.

13.3 Control Charts

PDP's is in the process of setting up and maintaining a control charts program to visually track the LCS precision and accuracy data. Specifically, control charts are used to identify trends in the analyses which may indicate a problem with the analytical procedure. Should an adverse trend be detected, the analysis will be stopped and a corrective action undertaken.

RCS NO.:	*REVISION NO.:*	*EFFECTIVE DATE:*	*SUPERSEDES:*
PDP-QAP-0394	*ORIGINAL*	*03-01-94*	*PDP-QAP-1093, R.1*

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The QA/QC Officer is responsible for reporting to management activities pertaining to PDP's Quality Assurance Program.

14.1 Monthly Reports to Management

The QA/QC Officer prepares a formal report on QA/QC and Health and Safety issues observed on a monthly basis. The report for the previous month is issued to the President and Vice President of Operations by the fifth day of the following month. Both QA and Management review the document together to access the effectiveness of the QA Program, clarify needed details, and to work out corrective actions which may be necessary.

The format for each report is provided on the following page. This information is accessed through formal and informal internal audits and reviews, external audits, final data report reviews, single blind performance evaluation sample results, corrective action reports, and communications from operations personnel.

14.2 Operations Review of the Quality Assurance Program

In addition to the QA/QC Officer, the responsibility of the review of the adequacy and effectiveness of the QA Program lies with laboratory management and all other members of operations. Each employee is required to familiarize him/herself with the QA Program through the Quality Assurance Plan. Any changes in operations noted by PDP employees must be reported to the QA/QC Officer. Any recommendations for enhancing quality and safety procedures are encouraged.

RCS NO.:	*REVISION NO.:*	*EFFECTIVE DATE:*	*SUPERSEDES:*
PDP-QAP-0394	*ORIGINAL*	*03-01-94*	*PDP-QAP-1093, R.1*

MONTHLY REPORT OUTLINE FOR QA/QC AND SAFETY

1.0 *Quality Assurance*

1.1 *Activities to Improve Quality*

Description of changes in documentation, protocol, and general practices which may improve quality.

1.2 *Resolutions to Quality Problems*

Description of any resolutions to quality problems from the previous month(s) and/or the current month.

1.3 *Quality Problems*

Description of any problems which arise that may affect quality.

1.4 *Certifications*

Description of any changes in a state certification status. This includes applications, maintenance issues, and renewals. CLP is also addressed in this section.

1.5 *Training*

Description of what training seminars were given and/or individual training sessions.

1.6 *Distribution of Controlled Documents*

List of those external individuals who received the QA Plan; also a general notification of internal distribution.

1.7 *Quality Measurements*

1.7.1 *Control Charts/Limits*

Description of control charting activities, including summaries of runs, trends, etc. which may have occurred; generation of control limits is summarized.

1.7.2 *Defects Study*

Statistical review of the data rejection rate (data rejected by QA from operations). This will not be implemented until the QA/QC Officer's training is completed and the review is deemed necessary.

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MONTHLY REPORT OUTLINE FOR QA/QC AND SAFETY
(continued)

1.8 QA Assessments

1.8.1 Internal Audits/Inspections

Summary of discrepancies noted during monthly inspections and/or semiannual audits.

1.8.2 External Audits/Inspections

1.8.2.1 Synopsis by external agencies, clients, etc.

1.8.2.2 Synopsis of subcontract laboratories

1.8.3 Performance Evaluation Studies

1.8.3.1 Summary of single blind performance

1.8.3.2 Summary of double blind performance

1.9 Holding Times Missed

Summary of those parameters and episode numbers affected by missed extraction and/or analysis EPA recommended/CLP holding times.

1.10 Projects Scheduled For Next Month

Overview of projected projects and tasks for the coming month.

2.0 Safety

2.1 Activities to Improve Safety

Description of changes in documentation, protocol, and general practices which may improve safety.

2.2 Resolutions to Safety Issues

Description of any resolutions to safety issues from the previous month(s) and/or the current month.

2.3 Safety Issues

Description of any problems which arise that may affect safety.

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MONTHLY REPORT OUTLINE FOR QA/QC AND SAFETY
(continued)

2.4 *Training*

Description of what training seminars were given and/or individual training sessions.

2.5 *Distribution of Controlled Documents*

List of those external individuals who received the Chemical Hygiene Plan and Emergency Action Plan; also a general notification of internal distribution.

2.6 *Safety Assessments*

2.6.1 *Internal Audits/Inspections*

Summary of discrepancies noted during weekly housekeeping checks, monthly inspections and/or semiannual audits.

2.6.2 *External Audits/Inspections*

2.6.2.1 *Synopsis by external agencies, clients, etc.*

2.6.2.2 *Synopsis of subcontract laboratories*

2.7 *Projects Scheduled for Next Month*

APPENDIX A

RESUMES OF KEY PERSONNEL

Employee	Title
Afshar, Masoud	GC/MS Chemist
Davis, Dee	QA/QC Officer Chemical Hygiene Officer
Howbert, Bruce	Project Manager Inorganics Supervisor Login Supervisor/Custodian
Kudchadkar, Sachin	Extractions Technician
Madisetty, Homai	Inorganics Analyst
Marquise, Howard	GC Supervisor Extractions Supervisor
Pakanati, Reddy	Vice President of Laboratory Operations Technical Director
Pinnapureddy, S.R.	President
Plattner, Susan	GC Analyst
Saladi, Eswar	Systems Manager
Zhang, Hong	GC/MS Chemist

MASOUD AFSHAR

EDUCATION:

M.S., Chemistry
Sam Houston State University, Huntsville, Texas, 1981

B.S., Chemistry
Razi University, Iran, 1976

EXPERIENCE:

PDP Analytical Services, Spring, Texas
GC/MS Chemist, November, 1993 - Present

Responsible for analyzing samples by GC/MS using EPA SW-846 and CLP methodologies, reviewing data, and generating GC/MS reports.

CH2M Hill, Montgomery, Alabama
Senior GC/MS Chemist, August - November, 1993

Responsible for the independent evaluation, selection, and adaptation of standard methods and techniques, directing projects from initial setup through data interpretation and reporting, training associate chemists, chemists, and technicians, acting as project coordinator for ongoing assignments as liaison between laboratory and clients, operations and method development using GC, GC/MS, HPLC, AA, and ICAP, reviewing data, and preparing final reports.

Betz Laboratories, Inc., The Woodlands, Texas
Research Scientist, April, 1990 - August, 1993

Responsible for GC/MS analysis of environmental samples by EPA methods, data review, detection limit studies, precision and accuracy determination, method development of non-routine analyses, instrument maintenance, and training of new analysts. Also implemented CLP form generation using Formaster software.

Princeton Testing Laboratory, Princeton, New Jersey
GC/MS Supervisor, October, 1987 - April, 1990

Responsible for analysis of environmental samples for volatiles and semivolatiles by specified methods (EPA 600 Series, EPA SW-846) and non-routine analyses.

EXPERIENCE (cont.)

United States Testing Company, Inc., Hoboken, New Jersey
GC/MS Analyst, May, 1985 - October, 1987

Analyzed by CLP protocol soil, water, wastewater, tenax and charcoal tube samples for priority pollutants and TCDD screening.

MEMBERSHIPS:

American Chemical Society (ACS)

SPECIALIZED TRAINING:

- Finnigan Incos 50 GC/MS Operator Course
- Hewlett-Packard RTE-A GC/MS Operator Course
- Finnigan Formaster Software Training Course
- Hewlett-Packard ChemStation (DOS) Operator Course

DEE DAVIS

EDUCATION:

Towards M.A. Biology (90% complete), 1988
Sam Houston State University
Huntsville, Texas

B.S. Biology (minor: chemistry), 1986
Sam Houston State University
Huntsville, Texas

EXPERIENCE:

PDP Analytical Services, Spring, Texas
QA/QC Officer and Chemical Hygiene Officer
August, 1993 - Present

Quality Assurance. Responsible for the implementation, maintenance, and documentation of the quality assurance program. This involves performing internal audits, analytical data review, quality control practices, QA/QC training of employees, inter- and intralaboratory proficiency programs, appraising laboratory management of on-going performance issues and new regulations, and all other practices assuring the legal defensibility and traceability of the data. *Safety.* Responsible for, with the assistance of the Safety Coordinator, the implementation, maintenance, and documentation of the health and safety program. This involves internal audits, assuring the availability of safety equipment and proactive/response procedures to all employees through inspections and training, and communication to employees and laboratory management concerning new policies and OSHA regulations.

Report directly to the President.

AnalytiKEM, Houston, Texas
Quality Assurance Manager and Health and Safety Coordinator
October, 1990 - August, 1993

Quality Assurance. Responsible for the coordination and implementation of the laboratory quality assurance program; inorganics/organics data validation, final client data report approval, state certifications, monitoring laboratory operations/activities (including compliance with state and federal regulations, methodologies, such as EPA SW-846, EPA 600 series, Standard Methods, etc.). Other duties included client

EXPERIENCE (cont):

consulting and customer service, approval and implementation of client QA project plans, writing standard operating procedures and the laboratory QA manual, conducting internal and subcontract laboratory audits, assisting sample receipt, sample kit prep, and data management, controlling personnel records, and supervising the quality control chemists.

Safety. Responsible for the coordination and implementation of the health and safety program. Duties included writing all safety training manuals (the health and safety manual, chemical hygiene plan, hazard communication manual, and the emergency response plan) and standard operating procedures, serving as chairperson for a ten-member laboratory safety committee, supervising the chemical hygiene officer, conducting inspections and audits, employee training, maintaining employee training and accident records for company human resources, and serving as an on-call, 24 hour emergency contact.

Other. As acting Sample/Data Management Supervisor for four months, responsibilities included supervising five technicians and assisting in physical login, login edit review, preliminary data report review, final report distribution and filing, and disposal.

Reported directly to the Corporate QC Manager and/or Technical Director (New Jersey).

ENSR Laboratories (AnalytiKEM), Houston, Texas
Inorganics QA/QC Coordinator
June, 1989 - October, 1990

Quality Assurance. Primarily responsible for the implementation and maintenance of the quality assurance program for the Inorganics Department. Duties involved the second level review of all general chemistry and metals data, client final data report approval, generating quality control charts and limits by statistical interpretation, conducting internal and subcontract laboratory audits, client proposals, and project manager, customer service, and consulting to sister engineering firm and commercial clients. Secondary responsibilities included support instrumentation calibration/control checks, project tracking, approval of QA project plans, and supervising the QC Chemist.

EXPERIENCE (cont):

Safety. Served as the administrative representative on a ten–member laboratory safety committee.

Reported to the Houston Laboratory Director.

ENSR Laboratories (AnalytiKEM), Houston, Texas
Quality Control Officer
October, 1988 - June, 1989

Quality Assurance. General duties included second level review of all general chemistry and metals data, support instrumentation checks, generating control charts and limits for the laboratory, project tracking, assisting the coordinator in audits and client inspections or tours, assisting in project proposals, and waste disposal tracking.

Safety. Assisted in the start–up of the laboratory safety committee; served as a QA representative and secretary.

Sam Houston State University, Department of Life Sciences, Huntsville, Texas
Graduate Assistant Instructor and Laboratory Instructor
January, 1984 - May, 1988

Fellowship and contracted teaching opportunities involved assisting professors and/or serving as sole instructor for freshman, sophomore, junior and senior level laboratory classes (approximately 120 students per semester).

Freshman:	Biology I (Animals and Man) Biology II (Plants and Man)
Sophomore:	Zoology
Junior:	Human Anatomy and Physiology
Senior:	Entomology

Louisiana State University, Baton Rouge, Louisiana
Assistant Archivist Technician
May, 1977 - May, 1981

Position required consistent organizational abilities to archive historical books, periodicals, and pamphlets.

BRUCE D. HOWBERT

EDUCATION:

B.A., Business Administration
Western State College, Gunnison, Colorado, 1983

EXPERIENCE:

PDP Analytical Services, Spring, Texas
Inorganic Laboratory Supervisor, November 1992 - Present

Currently managing all day-to-day activities of the Inorganic Section. Primary duties include the scheduling of personnel to meet production requirements and the review of all inorganic data to assure project specific quality assurance objectives are met. Other duties include inventory and purchasing, instrument maintenance and troubleshooting, and data reporting. Also responsible for sample log-in and sample storage.

Halliburton NUS Environmental Corporation, Houston, Texas
Inorganic Group Leader, July 1991 - November 1992

Supervised inorganic chemistry group performing assorted tests in support of NPDES permits, groundwater assessments and RCRA characterizations. Coordinated twelve analysts performing over 40 test procedures. Responsibilities included the scheduling of analyses to meet holding time and due date requirements, adherence to internal and contractual quality assurance objectives, and the technical review and approval of inorganic data. Directly responsible for staffing and personnel, inventory and ordering, and training.

Analytica, Incorporated, Denver, Colorado
Laboratory Manager/Inorganic Supervisor, October 1987 - January 1991

Managed the effort of a 40 person laboratory performing routine organic and inorganic testing on environmental sampling media for a $2M commercial laboratory. Directly responsible for staffing, scheduling, meeting budgets; and managing projects for the company's principal clients.

Managed the day-to-day operation of the Inorganic Section. Responsible for the technical validity and contractual compliance of work performed under CLP and commercial contracts.

EXPERIENCE: (Cont'd)

ENSECO - Rocky Mountain Analytical Laboratory, Denver, Colorado
Metals Analyst II, November 1985 - October 1987

Analyzed environmental samples for the USEPA CLP program and commercial clients. Promoted from Analyst I in November 1986.

CONE Geochemical, Denver, Colorado
Supervisor, February 1984 - November 1985

Supervised the geochemical section of a commercial laboratory performing analyses in support of the mining industry.

AMAX Exploration, Inc., Denver, Colorado
Technician, May 1976 - August 1978; May 1979 - August 1979

Performed analyses on geologic materials for mineralogical content.

SACHIN KUDCHADKAR

EDUCATION:

M.B.A., Marketing, University of Arkansas, Fayetteville, Arkansas, 1993

M.S., Chemistry
Sam Houston State University, Huntsville, Texas, 1988

Diploma in Technical and Analytical Chemistry, K.C. College, Bombay, India, 1987

B.S., Chemistry
University of Bombay, Bombay, India, 1984

EXPERIENCE:

PDP Analytical Services, Spring, Texas
Analytical Chemist, January, 1994 - present

Responsible for organic extractions, including semivolatiles, pesticides, herbicides, organophosphorus pesticides, TPHs, and oil and grease, and assorted wet chemistry preparations and analyses.

University of Arkansas, Department of Chemistry, Fayetteville, AR
Graduate Teaching Assistant, January, 1989 - May, 1993

Teaching Assistant for general chemistry and organic chemistry laboratories. Conducted drill sessions for students and organized both laboratory operations.

University of Arkansas, Department of Chemistry, Fayetteville, AR
Supervisor, July, 1990 - May, 1993

Supervised and managed a team of 18 Graduate Teaching Assistants in conducting general chemistry laboratories with about 800 students. Assisted in evaluating and selecting experiments to be performed, maintained inventory of chemicals, and acted as a channel of communication between professor in charge, teaching assistants, and students in dealing with problems and laboratory effectiveness.

Sam Houston State University, Department of Chemistry, Huntsville, Texas
Graduate Teaching Assistant, August, 1987 - December, 1988

Teaching Assistant for general chemistry and higher level analytical chemistry laboratories. Conducted drill sessions for students and prepared various solutions and reagents required to perform experiments.

Sandoz Pharmaceutical Ltd, Bombay, India
Chemist, December, 1985 - June, 1986

Worked in the Raw Material and Finished Products, Quality Control Laboratory. Tested and analyzed various chemicals and pharmaceutical products using IR, UV spectroscopy, and HPLC. Performed different tests for identication, heavy metals tests, refractive index, solubility, melting/boiling points and assays.

HOMAI MADISETTY

EDUCATION:

M.S., Dairy/Food Science & Technology
Mississippi State University, Starkville, Mississippi, 1991

B.S., Biological Sciences
Osmania University, Hyderabad, India, 1983

EXPERIENCE:

PDP Analytical Services, Spring, Texas
Analytical Chemist, July 1992 - Present

Currently performing miscellaneous inorganic testing including waste characterization analysis and assorted wet chemistry techniques, metals preparation, mercury analysis, graphite furnace metals analysis, and sample log–in.

Also, responsible for the extraction of semivolatiles, pesticides, herbicides, Organophosphorus pesticides, TPHs, oils and grease. Also responsible for the extraction, concentration and cleanup of Dioxins/Furans. Experience with GPC and Florisil cleanup. Experience in the use and operation of the Perkin–Elmer 1310 Spectrophotometer to analyze TPH samples by Method 418.1.

Southern Testing & Research Laboratories, Inc., Wilson, North Carolina
Section Head - Food Proximates, June 1991 - June 1992

Responsible for distribution of workload, supervising, data analyzing, communication with clients. Also responsible for new method developments and interpreting the results. Experience in polyacrylamide Gel Electrophoresis (Alk–Vrea Page, Borate, SDS, Tube gels and Isoelectric Focusing), High Performance Liquid Chromatography, Spectrophotometry, Lyophilization, Surface Tensionmetry, Protein determination using Kjeldahl, GC, AA and ICP.

HOWARD MARQUISE

EDUCATION:

B.S., Chemistry
University of Houston, Clear Lake, Texas, 1987

EXPERIENCE:

PDP Analytical Services, Spring, Texas
GC Supervisor, January, 1993 - present

Responsible for the daily operation of the GC laboratory including analysis of Pesticides/PCBs, Herbicides, BETX, and TPH by EPA SW-846 methods 8080, 8150, 8020, and 8015 and using EPA-CLP protocol.

Also responsible for instrument maintenance including source cleaning and troubleshooting, performing data reduction and systems programming, and method development.

Betz Analytical Services, The Woodlands, Texas
GC Laboratory Supervisor, August, 1990 - August, 1993

Responsible for the daily operations of the GC laboratory, including the scheduling of analyses, data validation, performing Pesticide and Herbicide analyses, and the oversight of technicians and analysts.

Radian Corporation, Austin, Texas
Analytical Chemist, September, 1989 - August, 1990

Served as a chemist in the Chromatography Group. Responsibilities included soil and water analyses by chromatrography following EPA methods (EPA SW-846 series for solid waste, EPA 500 and 600 series for water) and Contract Laboratory Program protocol.

Southwest Laboratories, Tulsa, Oklahoma
Analytical Chemist, May, 1988 - August, 1989

Analyzed water and soil extracts for organochlorine pesticides by GC following CLP protocol. Responsibilities included scheduling and processing samples as well as interpreting and reporting results. Became experienced with the set-up, maintenance and troubleshooting of several different models of gas chromatographs and their detectors. Also performed analyses for Herbicides, PCBs, and Volatile Organics.

NUS Corporation, Houston, Texas
Chemist I, March, 1987 - May, 1988

Performed GC analyses of water and soil extracts for identification and quantification of Priority Pollutant Pesticides, PCBs, and Herbicides. Became familiar with several EPA methods and CLP protocol. Also analyzed samples for the determination of total hydrocarbon contect by infrared spectroscopy.

MEMBERSHIPS:

American Chemical Society
Water and Wastewater Analysts Association

REDDY R. PAKANATI

EDUCATION:

M.S., Environmental Engineering
Oklahoma State University, Stillwater, Oklahoma, 1984

B.S., Chemical Engineering
Osmania University, Hyderabad, India, 1980

SPECIALIZED TRAINING:

OSHA approved 40 hours Health and Safety Training
Ecology and Environment, Inc., Buffalo, NY, May 9–13, 1988

Chemical Safety Audit Team, SARA Title III Inspector Training
USEPA, Dallas, TX, February 6–10, 1989

QA/QC Guidance for Removal, Training Course
USEPA, Lakewood, CO, April 5–6, 1989

Hewlett–Packard on–site GC/MS Operator Training
Talem, Inc., Fort Worth, Texas, December 1985

EXPERIENCE:

PDP Analytical Services, Spring, Texas
Laboratory Manager, April 1992 - Present

Manage day–to–day operation of the state–of–the–art environmental laboratory. Provide technical assistance to the staff. Coordinate with clients and regulatory agencies. Responsible for successful participation in the U.S. Army Corps of Engineers (MRD) PE sample analysis and obtain laboratory validation.

Quality Assurance Manager, April 1991 - April 1992

Directs and assists over all laboratory production. Participates as a backup analyst in analyses of volatile and semivolatile compounds, pesticides, herbicides, PCBs, BTEX using EPA's CLP and SW846 methods. Also responsible for GC/GC/MS instruments trouble shooting and HP/VG minichrome computer operating systems.

EXPERIENCE: (Cont'd)

PDP Analytical Services, Spring, Texas
QA/QC Officer/Vice President, April 1991 - June 1992

Developed laboratory Quality Assurance/Quality Control Program, Standard Operating Procedures (SOPs) and the Quality Assurance Plan for Environmental Chemical Analysis. Responsible for implementing the QA/QC program throughout the laboratory. Directs QA/QC training and conducts periodic performance and system QA audits of laboratory operations.

PRC Environmental Management, Inc., Dallas, Texas
Senior Environmental Engineer, December 1989 - April 1991

Provided technical assistance to USEPA Region 6 Superfund and RCRA programs in the areas of remedial investigation, permitting, facility investigations and site assessments.

Project Highlights:

Developed a checklist for reviewing RCRA Part B Subpart X Permit applications for EPA Region 6. Conducted a technical review of Part B permit applications for two open burning open detonation (OB/OD) and one landfill facility and drafted Notice of Deficiencies (NOD) to be issued to the facilities. Developed a model permit for use by EPA.

Conducted RCRA Facility Assessment (RFA) at facilities in New Mexico and in Oklahoma.

Designed and implemented a sampling plan at a RCRA facility in Oklahoma to gather data for RCRA Facility Investigation (RFI) case development for EPA Region 6.

Designed and developed a computerized RCRA Corrective Action Prioritization Ranking System (R6CAPS) for the EPA Region 6. This ranking system has been modeled along the Superfund NPL ranking system. The ranking system has been approved by EPA Headquarters for use by Region 6 for ranking RCRA facilities.

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EXPERIENCE: (Cont'd)

Ecology and Environment, Inc., Dallas, Texas
Environmental Engineer, May 1988 - December 1989

Provided technical assistance to USEPA's Emergency Response Branch in the areas of emergency response, site assessment and emergency removal actions at Superfund sites.

Project Highlights:

Played a key role in setting up a mobile lab for analysis of PCBs in soil samples at a Superfund site in Fort Smith, Arkansas. Supervised round-the-clock operation of the laboratory including project quality assurance.

Provided oversight for an $800,000 project involving cleanup of a veterinary pharmaceutical manufacturing plant in Fort Worth, Texas. Activities included identification, inventory and disposal of 69 tons of hazardous materials.

Conducted site assessment and remediation for a $1.25 million dioxin cleanup project in Jacksonville, Arkansas. Provided oversight during the removal of 2,827 cu. yards of the contaminated soil and also during the site-restoration. Performed high volume air sampling to monitor air quality during the removal activities. Conducted post-excavation sampling to verify cleanup.

Evaluated off-site migration potential/extent at a 70 acre inactive lead smelter site in Okmulgee, Oklahoma. Performed perimeter air sampling and conducted surface soil screening for metal contamination using an X-ray Fluorescence (XRF) analyzer.

Identified and evaluated treatment options to cleanup of over 5000 cu. yards of lead contaminated oil sludge at an abandoned oil reprocessing site in Norphlet, Arkansas. Designed and conducted solidification/stabilization treatability studies.

Talem, Inc., Fort Worth, Texas
Project Manager, June 1987 - May 1988

Assisted clients in the areas of hazardous waste profiling, classification, manifesting and disposal. Conducted waste minimization studies. Negotiated Texas Water Commission (TWC) waste reclassification and assisted industries in obtaining city discharge permits. Managed waste water treatment plant monitoring program. Designed and conducted a treatability study to evaluate the pretreatment system at a Superfund hazardous waste site in Texas.

EXPERIENCE: (Cont'd)

Quality Assurance Manager, April 1986 - June 1987

As Quality Assurance Manager, developed and administered the laboratory and field QA/QC program, including in-house personnel training and preventive maintenance of analytical equipment. Provided liaison with representatives of clients, TWC, and USEPA concerning issues related to quality control. Prepared a QA/QC manual and SOPs. Developed project specific QA plans.

Oklahoma State University, Dept. of Civil Engineering, Stillwater, Oklahoma: Research Assistant,April 1982 - May 1984

Evaluated methods for treating acid mine drainage at Tar Creek for the Oklahoma Department of Water Resources. Made an extensive study of the application of air stripping for groundwater treatment and contributed to a report on aquifer restoration that was submitted to the National Council for Ground Water Research.

Performed experiments for optimizing coagulant dosage at the OSU water treatment plant and monitored trihalomethane concentrations in the distribution system.

MGR, Inc., Edmond, Oklahoma
Consultant, Summer 1983

Prepared an operation and maintenance manual for the waste water treatment plant in Tonkawa, Oklahoma.

UNILOIDS LTD., Hyderabad, India
Production Engineer, March 1980 - December 1981

Supervised the production of bulk drugs; Sulfamethoxazole and Metronidazole Responsibilities include process troubleshooting, work planning, and personnel supervision.

PUBLICATIONS:

Pakanati, R.R., 1984, Study of the Effect of Temperature on Air Stripping of Volatile Organic Compounds from Water Using a Packed Tower. Oklahoma State University, Master's Thesis.

Veenstra, J.N.; Pakanati, R.R., et al., 1983, Acid Mine Drainage - Treatability Study, Proceedings of the 39th Annual Purdue Industrial Waste Conference, Lafayette, Indiana.

Kincannon, D.F., Pakanati, R.R., et al., 1983, State-of-the-Art of Aquifer Restoration, Report to National Council for Ground Water Research.

S. R. PINNAPUREDDY

EDUCATION:

M.S., Environmental Engineering
Oklahoma State University, Stillwater, Oklahoma, 1976

B.S., Civil Engineering
Osmania University, Hyderabad, India, 1972

PROFESSIONAL REGISTRATIONS:

Registered Professional Engineer in State of Oklahoma since 1981.

EXPERIENCE:

PDP Analytical Services, Spring, Texas
President, April 1991 - Present

Directs laboratory operations including financial administration, contract negotiations and performance, business development, and management of technical and administrative personnel to assure the delivery of quality analytical services to clients.

MGR, Inc., Edmond, Oklahoma
Vice President/Project Engineer, November 1981 - May 1990

Provided both administrative and technical support for several public and private civil engineering projects. Responsible for contract administration of government related projects involving city, state, and federal agencies including the city of Oklahoma City, Oklahoma State Department of Transportation, Tulsa District Corps of Engineers and Tinker Air Force Base, etc. These projects ranged from a few hundred to several million dollars.

McCaleb & Associates, Edmond, Oklahoma
Associate/Project Engineer, July 1978 - October 1981

Provided design services on water treatment and distribution facilities, wastewater collection and treatment facilities, solid waste disposal facilities and other civil engineering related projects.

EXPERIENCE: (Cont'd)

Oklahoma State Health Department, Oklahoma City, Oklahoma
Engineer I, July 1976 - June 1978

Provided technical assistance to communities in troubleshooting water and wastewater facilities. Also reviewed the plans and specifications for construction of water and wastewater facilities. In charge of review and approval of grant applications, operations and maintenance manuals, etc.

SUSAN M. PLATTNER

EDUCATION:

B.S. Botany, 1976
Eastern Illinois University
Charleston, IL

EXPERIENCE:

PDP Analytical Services, Spring, Texas
GC Chemist
May 1993 - Present

Responsible for analysis of semivolatile and volatile compounds, pesticides, PCBs, herbicides using gas chromatography by EPA's CLP and SW846 methods.

NDRC Laboratories, Houston, Texas
GC Analyst, Organic Department,
September 1991 - July 1992

Analysis of pesticides, PCB's, herbicides, employing EPA methodology; HP5890 and Varian 3400 instrumentation.

Core Laboratories, Houston, Texas
GC Analyst/organic Extraction Group Leader
September 1990 - September 1991

GC analysis of pesticides, PCB's and herbicides; HP5890. Supervision and training in all organic sample preparation of BNA semi-volatiles, pesticides, PCB's and herbicides.

Laboratory Technician - Inorganics
April 1990 to September 1990

Environmental analysis for COD, TOC, TPH, oil and grease, alkalinity, hexavalent chromium, chlorides, phenols, turbidity, conductivity and pH.

EXPERIENCE (Cont'd)

ENSR Consulting & Engineering, Wilmington, MA
Methods Development and Sample Preparation April 1988 – June 1989

Responsibilities included establishing new methods and procedures to bring increased business to the lab, method validation studies, writing SOPs, sample preparation for all non–routine methods and difficult matrices, project management, and QC; GC analysis of herbicides.

Sample Preparation Manager, February 1987 – April 1988

Manager of organic wet lab. Responsibilities included the supervision of 10 technicians, sample flow, training and data review for the extraction and preparation of environmental samples. Heavy hands on involvement. Work primarily involved PCBs, pesticides, BNA and herbicides for water, soil, sludge and air matrices. Instituted several CLP practices and liquid chromatography clean–up columns in the lab.

GeoChem Research, Houston, Texas
Sample Prep Lab Manager, August 1984 – February 1987

Responsibilities included the extraction, prep and liquid chromatography of environmental samples for EPA CLP dioxin contract, PCBs, pesticides, and PAHs on water, soil, and tissue samples for an Army Corps of Engineers contract; and private industry. Some GC work involved. Also assisted in extraction of core samples in the oil services lab.

Laboratory Technician, August 1983 – August 1984

Routine geochemical analysis of potential oil source samples including extraction and liquid chromatography, TOC, Rock Eval II, and GC pyrolysis.

Robertson Research, US, Houston, Texas March 1981 to July 1982 Laboratory Technician III

Routine geochemical analysis of oil source samples including extraction and liquid chromatography, TOC, Rock Eval I, and GC for head space gas.

EXPERIENCE (Cont'd)

Illinois Environmental Protection Agency, Chicago, IL September 1978 – December 1979 Laboratory Technician II

Routine inorganic analysis of drinking water samples including pH, specific conductance, turbidity, oil and grease, CODs, acid digestions for metals, nitrates, phenols, boron by Technicon I system.

HONG ZHANG

EDUCATION:

M.S., Analytical Chemistry
University of Texas, Arlington, Texas, 1992

M.S., Polymer Science
Changchun Institute of Applied Science and Technology of China
Changchun, China, 1989

B.S., Analytical Chemistry
University of Science and Technology of China
Hefei, China, 1986

EXPERIENCE:

PDP Analytical Services, Spring, Texas
GC/MS Chemist, May 1993 - Present

Responsible for analyzing samples by GC/MS using SW846 and CLP methods, reviewing data and generating GC/MS reports.

Triangle Labs, Houston, Texas
GC/MS Chemist, July 1992 - May 1993

Operated and maintained HP high resolution GCs and GC/MSs, VG sector instruments. Familiar with EPA methodologies.

Department of Chemistry, University of Texas, Arlington, Texas
Graduate Research, 1990 - 1992

Gas-phase study of ion-molecule reactions of crown ethers and their analogs. Extrel FTMS-1000 and Finnigan TSQ-70 GC/MS were the main instruments used for the research. Several papers were published on JACS.

Department of Chemistry, University of Texas, Arlington, Texas
Graduate Teaching Assistant, 1990 - 1992

Teaching quantitative analytical chemistry and general chemistry, familiar with GC, HPLC, FT-IR, UV, AA, etc.

EXPERIENCE: (Cont'd)

Department of Chemistry, Changchun Institute of Applied Chemistry, Changchun, China
Analytical Chemist, May - December 1989

Worked as QA/QC chemist. Experienced with GC, IR, DSC, UV, etc.

Department of Chemistry, Changchun Institute of Applied Chemistry, Changchun, China
Graduate Research, 1987-1989

Polypropylene through mechanism transform polymerization. Thermoplastic elastomer processing. Characterization of physical properties of polymer blends.