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FINAL ENVIRONMENTAL ASSESSMENT PLAN BUILDING S-50 UST MILLINGTON SUPPACT TN

5/28/1993

ENSAFE/ALLEN & HOSHALL

(16)

FINAL
ENVIRONMENTAL ASSESSMENT PLAN

NAS MEMPHIS BUILDING S-50 UST
NAVAL AIR STATION MEMPHIS
MILLINGTON, TENNESSEE

CONTRACT N62467-89-D-0318
CTO-068

Submitted To:

SOUTHDIVNAVFACENGCOM

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ACRONYMS AND ABBREVIATIONS

The following list contains many of the acronyms, abbreviations, and units of measure used in this report.

ACGIH	American Council of Governmental and Industrial Hygienists
ADI	Average Daily Intake
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society of Testing and Materials
BW	Body Weight
CAG	Carcinogenic Assessment Group
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator (Explosimeter)
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	USEPA Contract Laboratory Program
CNS	Central Nervous System
COC	Chain-of-Custody
CPC	Chemical-Protective Clothing
CPR	Cardiopulmonary Resuscitation
CSEP	Confined Space Entry Permit
CV	Coefficient of Variation
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
DP	Duplicate (sample)
DQO	Data Quality Objective
E/A&H	EnSafe/Allen & Hoshall
EAP	Environmental Assessment Plan
EAR	Environmental Assessment Report
EFD	Engineering Field Division
EIC	Engineer-in-Charge

EP	Extraction Procedure/Exposure Period
EPA	United States Environmental Protection Agency
FB	Field Blank
FID	Flame Ionization Detector
GC	Gas Chromatography
GW	Groundwater (sample)
HASP	Health and Safety Plan
Hcl	Hydrochloric Acid
HSWA	Hazardous and Solid Waste Amendments of 1984
ID	Inside Diameter
IDLH	Immediately Dangerous to Life and Health
IR	Average Soil Ingestion Rate or Infrared Spectrophotometer
LEL	Lower Explosive Limit
LQAC	Laboratory Quality Assurance Coordinator
M^3	Cubic Meter of Air
mg/kg	Milligrams/Kilogram
mg/L	Milligrams/Liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSA	Mine Safety Administration
MSDS	Material Safety Data Sheet
msl	Mean Sea Level
MW	Monitoring Well
NAD	North American Datum
NAS	Naval Air Station
NAVFACENGCOM	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Contingency Plan
NCR	NEESA Contract Representative
NEESA	Naval Energy and Environmental Support Activity
NFA	No Further Action
NIOSH	National Institute of Occupational Safety and Health
OD	Outer Diameter

OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer
PEL	Permissible Exposure Limit
Ph	Negative log of the Hydrogen Ion Concentration
PID	Photoionization Detector
ppb	Parts per Billion
PPE	Personal Protective Equipment
ppm	Parts per Million
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAO	Quality Assurance Officer
QAP	Quality Assurance Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
R	Acceptable Incremental Lifetime Cancer Risk
RB	Rinsate Blank
RCRA	Resource Conservation and Recovery Act
RRF	Relative Response Factor
RSD	Relative Standard Deviation
SB	Soil Boring
SCBA	Self Contained Breathing Apparatus
SG	Soil Gas
SOP	Standard Operating Procedure
SOP/QAM	Standard Operating Procedures and Quality Assurance Manual (USEPA Region IV Environmental Compliance Branch)
SOUTHDIV	Southern Division, Naval Facilities Engineering Command
SOW	Statement of Work
STEL	Short-Term Exposure Limit
SVOC	Semivolatile Organic Compounds
TB	Trip Blank
TCLP	Toxicity Characteristic Leaching Procedure
TDEC	Tennessee Department of Environment and Conservation

TDS	Total Dissolved Solids
TLV	Threshold Limit Value
TN	Tennessee
TPH	Total Petroleum Hydrocarbons
TWA	Time-Weighted Average
UEL	Upper Explosive Limit
μg/L	Micrograms/liter
UST	Underground Storage Tank
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds
WGBT	Wet Globe Bulb Temperature Index

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1.0 FIELD INVESTIGATION

1.1 Project Objective and Overview

This Environmental Assessment Plan (EAP) outlines the procedures that will be used during the field investigation of a UST site at NAS Memphis. The purpose of the field investigation is to assess the extent of any contamination remaining after the removal of a 560-gallon UST at Building S-50. The vicinity of the site being investigated is shown on Figure 1-1.

This assessment was requested by the Tennessee Department of Environment and Conservation Underground Storage Tank (TDEC UST) Division. The procedures that will be used to conduct this assessment comply with the requirements in the current TDEC Environmental Assessment Guidelines dated January 1992 and all pertinent NEESA and EPA documents.

The objective of this EAP is to assess the vertical and lateral extent of any contamination in the shallow soil zone and water table resulting from the Building S-50 UST system. To accomplish this objective, the EAP has been designed to produce data that can be used to evaluate the current site conditions and recommend corrective action as needed.

The EAP, as outlined here, proposes a series of five soil borings at the site. All five are to be converted to monitoring wells. Soil samples will be collected during the completion of all soil borings and groundwater samples will be collected from all completed monitoring wells. The sampling rationale is detailed in Section 1.4.

1.2 Project Organization

This EAP was prepared by EnSafe/Allen & Hoshall (E/A&H) of Memphis, Tennessee under contract N62467-89-D-0318 to Southern Division (SOUTHDIV) Naval Facilities Engineering Command, Charleston, South Carolina. Interpretation of field and laboratory data and the development of schedules and revisions will be completed by E/A&H in coordination with the SOUTHDIV Engineer-in-Charge (EIC).

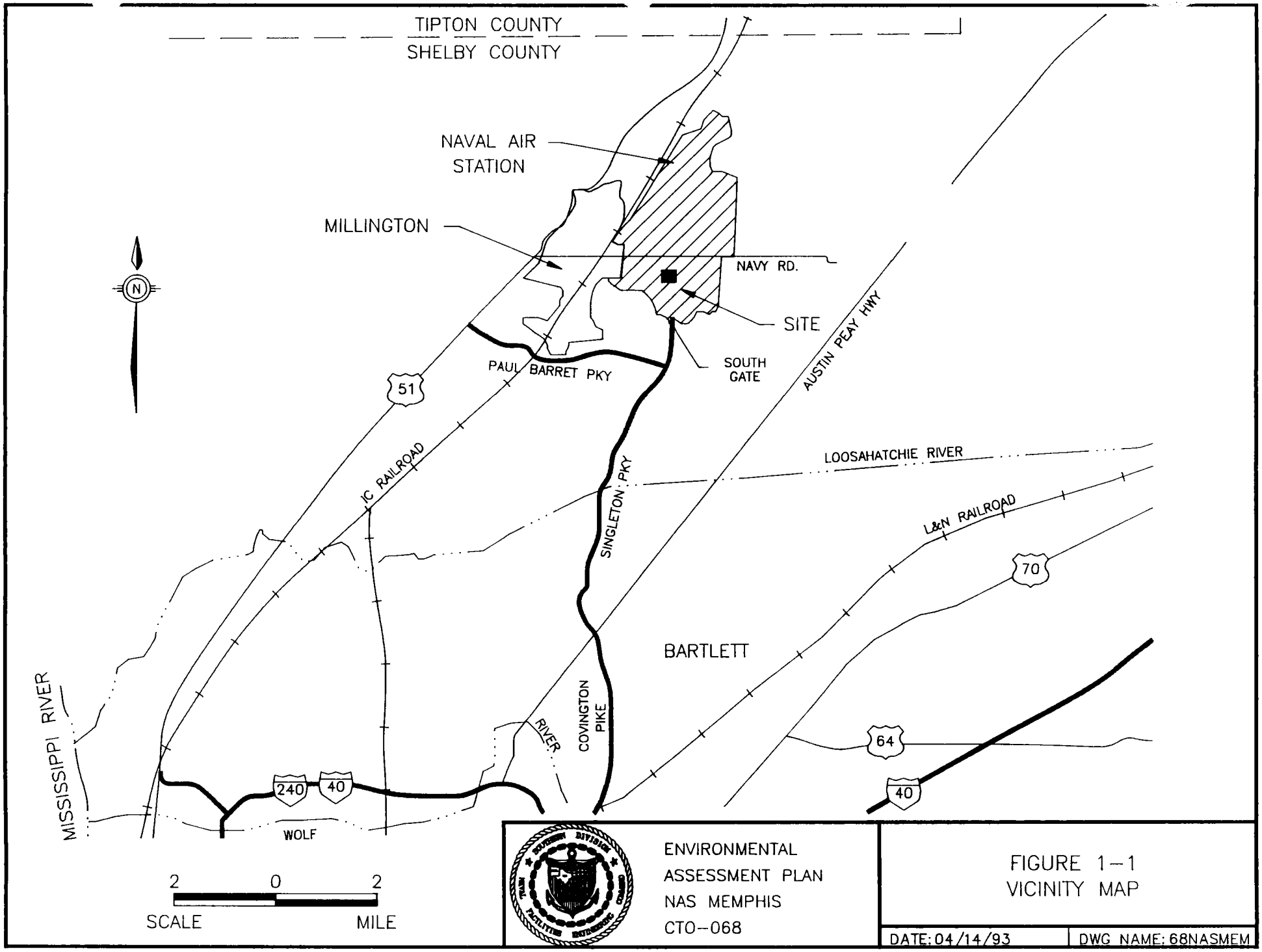

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FIGURE 1-1
VICINITY MAP

DATE: 04/14/93 | DWG NAME: 68NASMEM

1.3 Background — Building S-50 UST

Site Layout

NAS Memphis records show the UST at Building S-50 was used to store diesel fuel as an emergency fuel supply for the building's backup power system. The former location of the tank is in a open area between two wings of Building S-50 (see Figure 1-2).

Previous Studies

In April 1992, National Salvage and Services Corporation was contracted to remove and provide proper closure documentation for the UST. After excavation and removal of the tank, soil samples were taken from the bottom of the pit at each corner and analyzed for both Gasoline Range Organic (GRO) Hydrocarbons (HC) and Diesel Range Organic (DRO) HC. The north east corner of the pit indicated elevated levels of DRO HC. Results for all other analyses were below detection limits. Table 1-1 lists the sample locations and analytical results.

Table 1-1
Previous Analytical Results
Building S-50 UST (ppm)

Sample Location	TPH, DRO (Hi Boil Hydrocarbons)	TPH, GRO (Lo Boil Hydrocarbons)
UST NE Corner	1,150	< 5.0
UST NW Corner	< 5.0	< 5.0
UST SE Corner	< 5.0	< 5.0
UST SW Corner	< 5.0	< 5.0

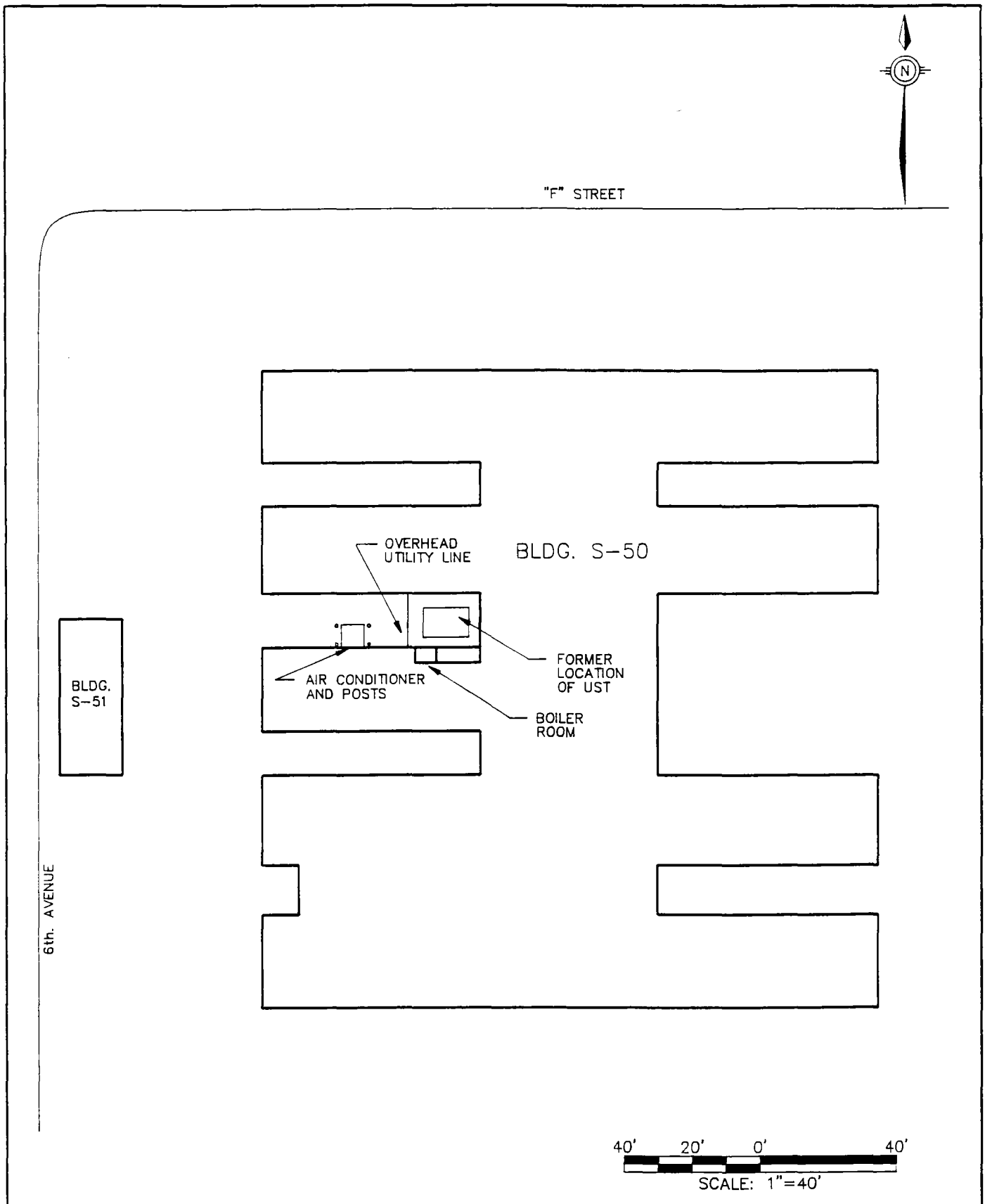

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FIGURE 1-2
SITE SKETCH
BUILDING S-50 UST

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1.4 Rationale for the Placement of Borings/Monitoring Wells

The scope of work for this project includes the installation of five soil borings and the conversion of each boring to a groundwater monitoring well. Boring locations will be placed to define the lateral and vertical extent of contamination. The rationale for placement of soil borings and monitoring wells is dictated by State guidelines and the configuration of Building S-50 (Figure 1-3). Four borings (B1/MW1, B2/MW2, B3/MW3 and B4/MW4) will be installed to surround the former tank location, ensuring coverage in all directions. The fifth boring (B5/MW5) will be as close as possible to the former location of the UST.

Before conducting any subsurface work, all above and underground utilities, storage tanks and lines must be identified and clearly marked by NAS Memphis personnel. At least one week's notice should be provided to the NAS Memphis Public Works Department so that arrangements can be made to have the utilities marked.

1.5 Soil Borings

Five soil borings are currently proposed for this investigation (Figure 1-3). Soil borings will be installed using 4.25-inch inside diameter (ID) hollow-stem augers. Borings will be advanced to 7 feet below the water table. All soil samples will be collected in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation* and NEESA 20.2-031A, Chapter 4. A field geologist will log each boring during sampling.

1.5.1 Soil Sampling Procedures

Soil samples will be collected through the annulus of the augers during the completion of each boring using a CME continuous sampler or a standard 24-inch split-spoon sampler. Soil samples will be collected continuously from the surface to a depth of 20 feet. Below 20 feet, soil samples will be collected at 5-foot intervals. The last soil sample to be collected for analysis will be at the top of the saturated zone. One to three soil samples will be selected from each

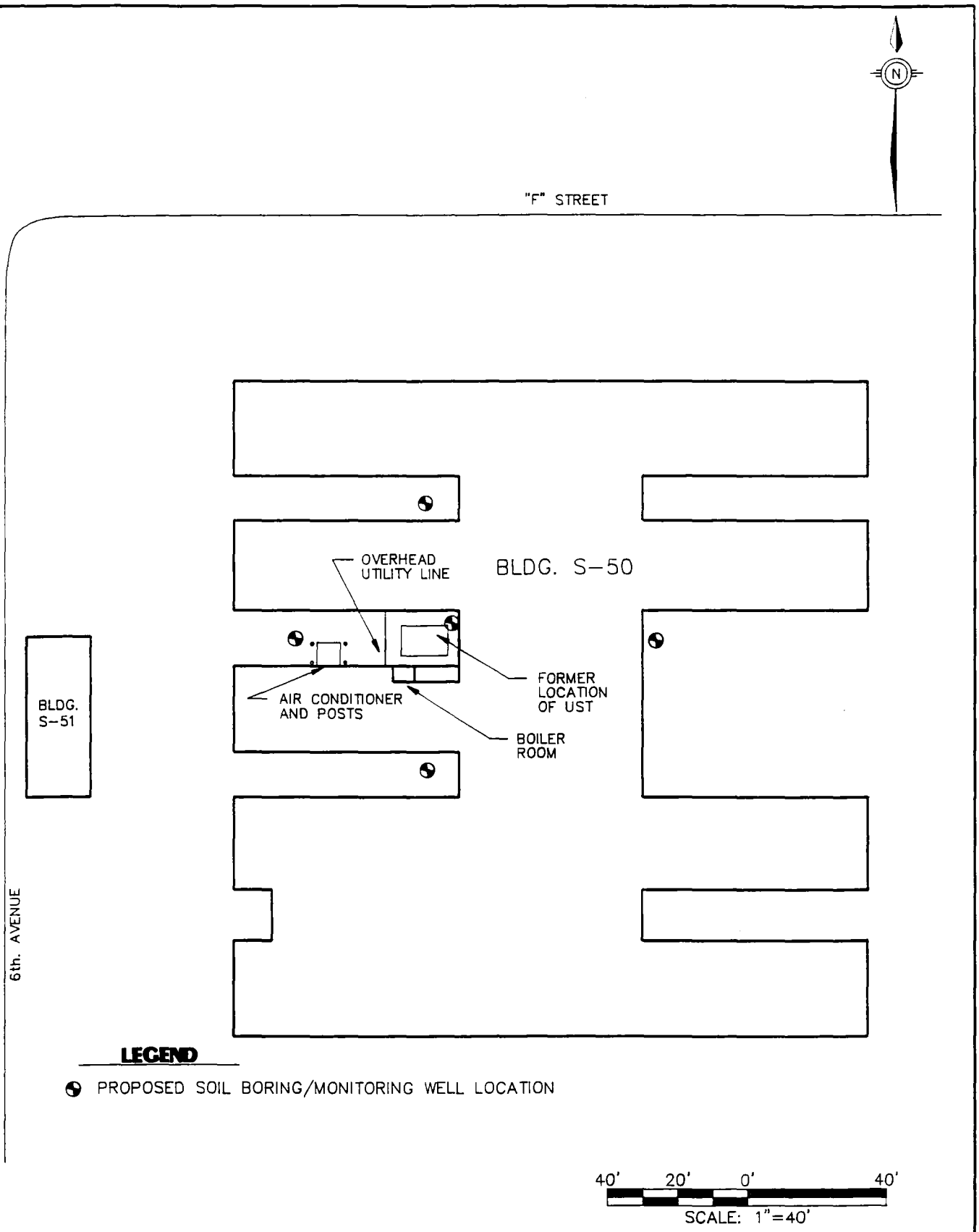

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FIGURE 1-3
PROPOSED SOIL BORING
MONITORING WELL LOCATION MAP
BUILDING S-50 UST

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boring for laboratory analysis based on the criteria described in Section 1.5.2. Soil boring logs will be prepared for each boring advanced beyond a depth of 5 feet.

1.5.2 Laboratory Sample Selection Criteria

The TDEC requires that one to three soil samples per boring be submitted for laboratory analysis. All soil samples will be field screened to determine which ones will be submitted to the laboratory. Screening will be accomplished by splitting each soil sample into two samples. The first subsample will be placed in the appropriate containers and cooled to 4°C (± 2°C) in an ice chest for subsequent laboratory analysis. The second subsample will be placed in an air-tight container leaving some headspace. Each sample will be allowed at least 15 minutes to volatilize at a minimum of 68°F. All samples should be allowed to volatilize for an equal period of time prior to screening. Afterwards, total organic vapors in the headspace will be measured with a photoionization detector (PID).

If the PID reading and other field screening (visual or other) indicate that contamination does not exist in the soil at a boring location, then the deepest sample collected will be submitted for laboratory analysis. The deepest sample may be the one collected immediately above the water table or at the bottom of the boring, whichever occurs first.

If PID readings indicate that contamination does not exist but visual or other observation indicates otherwise, then two samples will be selected for laboratory analysis. The first sample submitted will be the one that indicates the highest level of contamination based on visual or other observation. The second sample submitted will be the one collected above the water table or at the bottom of the boring, whichever is shallower. If one sample meets both of these criteria, then only that sample is required for laboratory analysis.

If the PID reading indicates that contamination is present in the soil at a boring location, then three soil samples from that boring must be submitted for laboratory analysis. In accordance

with TDEC guidance, the samples selected for analysis will be: (1) from the depth where the PID screening indicated the highest level of contamination, (2) the deepest sample in which the PID screening indicated contamination, and, (3) the sample collected immediately above the water table or at the bottom of the boring, whichever comes first. If one soil sample meets more than one of the criteria listed above, then the sample with the second highest PID reading will also be submitted for laboratory analysis.

Sampling procedures are further detailed in the EPA Region IV Environmental Compliance Branch *Standard Operating Procedures and Quality Assurance Manual* (SOP/QAM) (February 1991). The selected samples will then shipped under chain-of-custody via overnight courier to the selected laboratory for analysis.

1.5.3 Determining Soil Permeability

TDEC soil cleanup levels are based on site-specific soil permeability data. Two undisturbed soil samples (Shelby tube) will be collected in the unsaturated zone and within or below the zone of suspected soil contamination. These samples will be collected immediately adjacent to the fifth boring. The first Shelby tube will be collected at the depth that is believed to represent the zone of highest permeability based on the samples obtained from the fifth boring. The second Shelby tube will be collected immediately above the water table. If one soil sample meets both of these criteria, then the second Shelby tube will be taken at the depth where the second highest permeability would be expected. If there is no evidence of contamination in the fifth boring, then the samples should be collected where the highest permeability would be expected. The sample with the highest permeability will govern the stringency of cleanup levels.

The thin-walled tube sampling method (ASTM Method D1587) will be utilized to collect the samples. The permeabilities will be determined utilizing the Triaxial Cell or Pressure Chamber Permeameter Methods, as described in Method 9100 of *Test Methods for Evaluating Solid Waste, Third Edition (SW-846)*. Grain size and porosity will also be determined for each Shelby

tube sample to provide information useful for estimating contaminant migration potential and for remedial design.

1.5.4 Decontamination Procedures

During all phases of drilling, the augers and all downhole equipment will be steam cleaned with a laboratory-grade detergent wash and a potable water rinse, before and after each soil boring. Sampling tools will be decontaminated using a laboratory-grade detergent wash and a triple deionized or distilled water rinse.

1.6 Monitoring Wells

1.6.1 Monitoring Well Installation

Figure 1-3 shows the proposed locations of the five monitoring wells. Each well will be constructed using a 10-foot section of 2-inch diameter, 0.01-inch slot, PVC screen attached to 2-inch diameter, Schedule 40 PVC riser. A 10-foot screen positioned 3 feet above and 7 feet below the top of the water table will ensure adequate screening of "floater" contaminants, while allowing for temporal fluctuations in the water table. If an underlying aquitard is reached prior to a depth of 7 feet below the water table, drilling will be terminated to maintain the integrity of the aquifer. If such an aquitard is encountered at a depth of 2 feet or less below the water table, a 5-foot screen will be used. The 5-foot screen will allow for monitoring of the entire water bearing unit and an additional 3 feet of screen above the water table.

A filter pack of clean 20/40 silica sand will be placed through the annulus of the hollow-stem augers to a depth of not more than 2 feet above the top of the screen with at least 6 inches at the bottom of the boring to support the well casing. The sand is intended to prevent clogging of the screen slots by aquifer material.

A bentonite seal (bentonite pellets hydrated with distilled water) will be installed on top of the sand pack to prevent infiltration of surface water down the outside of the well casing. This seal

will be at least 2 feet thick. After allowing the bentonite seal to cure at least 12 hours, the remaining annulus of the borehole will be grouted to within 2 feet of the surface. The annular grout will consist of a mixture of Portland cement and 4 percent to 6 percent powdered bentonite. During introduction of the sand pack and the bentonite seal, accurate measurements ($\pm$ 0.2 feet) will be made to the top of the pack and the seal with a weighted measuring tape or tremie pipe.

The final 2 feet of the annular space will be filled with concrete terminated by a steel, lockable security casing set over a 2.5-foot PVC riser pipe, and a 4' x 4' x 6" concrete pad constructed around the casing. Four-inch diameter, 3- to 4-foot-high steel posts will be installed at the corners of the concrete pad to a depth of 2 feet below ground surface. The posts will be filled with concrete and painted a high visibility color (e.g., yellow or orange). In high traffic or paved areas, a flush-mount manhole with a watertight, bolt-down, loadbearing cover will be utilized. These manholes will be concreted in place and sloped so that surface drainage will be diverted away from the manhole. All monitoring wells will be marked as such and numbered.

After completion of well construction, all monitoring wells will be surveyed by a State of Tennessee Registered Land Surveyor to the nearest 0.01 foot vertically and located horizontally in reference to the NAS Memphis coordinate grid system. A permanent mark will be located at the top of each well casing to aid in generating accurate and consistent groundwater elevation data. After the wells are properly developed and surveyed, two sets of water level measurements will be recorded to determine groundwater flow direction, groundwater elevation in relation to mean sea level (msl), and to construct a potentiometric surface diagram for the area of investigation.

1.6.2 Monitoring Well Development

The grout will be allowed to cure for at least 24 hours following completion before development will begin. Wells will be developed by hand bailing, surge block, pumping or a combination

of any of the above. Development will continue until groundwater is free of sediment and/or Ph, temperature and specific conductance have stabilized. Each well will then remain undisturbed for at least 24 hours to allow the natural conditions in the aquifer to equilibrate after the disturbance caused by well installation and development.

1.6.3 Monitoring Well Sampling Procedures

Sampling of the monitoring wells will involve reading the static water level to calculate well casing volume, purging the well casing of stagnant water, retrieving the sample and placing it into properly labeled sample container(s).

Static Water Level Measurement

Static water level measurements will be performed on all monitoring wells prior to purging and in accordance with NEESA 20.2-031A and the *Southern Division Specifications for Groundwater Monitoring Well Installation and Sampling*. The measurements will be used to determine groundwater flow direction. The TDEC requires that water level measurements be taken on two separate dates.

The procedure is as follows:

1. Test the water level meter before use to ensure proper operation.

2. Decontaminate the probe before each measurement with a deionized or distilled water rinse.

3. Lower the probe into the annulus of the monitoring well until the buzzer indicates the probe has intersected the groundwater surface.

4. Measure the depth to water to the nearest 0.01 foot relative to the permanent mark established at the wellhead. Record the depth to water in a bound field notebook and note the date and time.

Monitoring Well Purging

Each well will be purged of stagnant water immediately before sampling to ensure proper functioning and representative groundwater samples. During well purging, select water quality measurements will be made, including Ph, temperature, and specific conductance (conductivity). Well purging procedures will be in accordance with NEESA 20.2-031A.

These procedures are outlined below:

1. Purge at least three casing volumes from each well. Calculate the water volume in the well casing before purging by subtracting the depth to water from the total depth of the casing and multiplying the product by the appropriate factor (0.163 gallons per foot for a standard 2-inch PVC well casing).

2. Purge the wells by bailing or pumping. Bailing will be conducted with a PVC, single-check valve bailer which is manually lowered into the well, filled with water and then retrieved. Pumping may be completed with a hand pump or an electrical submersible pump.

3. If a well bails to dryness before an adequate purge volume is removed, enter the volume removed in the site log book. The well will be sampled as soon as possible after recovery.

Sample Collection

Groundwater samples will be collected in accordance with NEESA 20.2-031A, Chapter 7-Ground-Water Sampling and *Southern Division Specifications for Groundwater Monitoring Well*

Installation and Sampling. All monitoring wells will be sampled unless 0.01 foot or more of free product is encountered. Groundwater samples will be collected using a dedicated or disposable PVC single check valve bailer and nylon bailing rope.

Sampling procedures are as follows:

- Place a sheet of clean plastic on the concrete platform and around the security casing to prevent possible contact between the bailer and bailer rope with the ground surface.

- Slowly lower the bailer into the water column to minimize water column disturbance.

- After the bailer has filled with water, manually retrieve it and immediately transfer the samples to appropriate sample containers.

- While in the field and during transport to the laboratory, retain all samples in a field cooler with ice packs.

1.6.4 Groundwater Sampling Equipment Decontamination

Equipment used in measuring and sampling groundwater monitoring wells will be decontaminated in accordance with *Southern Division Guidelines for Groundwater Monitoring Well Installation*, Part 3.5 and NEESA 20.2-031A, Chapter 3.3. Before site activities begin, it will be necessary for all bailers and the water level indicator to be decontaminated using a laboratory-grade detergent wash, followed by three distilled water rinses, then allowed to air dry. Measurement equipment will be decontaminated in the same manner between samples. This procedure will be followed to minimize the potential for cross-contamination of samples between sampling locations. Disposable gloves will be worn during all measurement and sampling activities. A new pair of disposable gloves will be donned for each water sample and/or measurement.

1.7 Groundwater Classification

Should groundwater contamination be detected, it will be necessary to classify the groundwater as a "drinking water" or "non-drinking water" supply in order to determine the applicable TDEC cleanup level. The groundwater classification procedure is a three-step process which must be performed in sequence. It provides information on use, water quality, and yield of the affected aquifer or water supply. If at any point during the classification procedure the aquifer is classified as a drinking water supply, no further steps shall be completed.

Water Use Survey — A water use survey is conducted in the area around the UST site. The area to be surveyed is based on the direction of groundwater flow and the geologic characteristics of the affected area. Field surveys, personal contacts, and a records search are performed as part of the survey. If the affected aquifer or water supply is being used by the citizens of the state, the water source must be classified as a "drinking water supply."

Analytical Sampling — If the water source is not classified as a drinking water supply by the water use survey, a water sample from the monitoring well upgradient of the location of the leak will be analyzed for selected primary and secondary drinking water standards of TDEC rule 1200-5-1. If the water fails to meet any of the primary or secondary standards, it may be classified as a "non-drinking water supply." Failure to meet the primary or secondary standards cannot be the result of petroleum contamination, unless naturally occurring.

Pump Test — If the groundwater meets the primary and secondary drinking water standards, the yield of the aquifer or water supply will be determined. According to TDEC guidance, "a suitable pump test method shall be used to determine if the affected aquifer or water source is capable of providing a yield of at least one-half gallon per minute." All monitoring wells shall be tested until all wells have been tested or one well yields at least one-half gallon per minute. If the affected aquifer is not able to produce water at the rate of one-half gallon per minute, it may be classified as a "non-drinking water supply."

The benzene cleanup level is 0.005 ppm for drinking water and 0.070 ppm for non-drinking water. TPH cleanup levels are 0.100 ppm for drinking water and 1.000 ppm for non-drinking water.

1.8 Slug Tests

Hydraulic parameters other than yield may be needed to properly design a remediation system. Slug tests will be conducted on the wells to provide additional hydrogeologic information. Rising and falling head slug tests are performed on wells to characterize the hydraulic conductivity (K) of aquifer materials. Before a slug test is started, the static water level in the well is measured using an electronic water level indicator. A stainless steel cylinder of known volume is then introduced "instantaneously" into the well, at which time, the water level and time "T_o" is recorded. Periodically, water level/elapsed time measurements are recorded as the head falls back to the original level. Similarly, a rising head slug test is performed by removing the slug and recording water level/elapsed time measurements as the head rises back to normal. The time required for a slug test to be completed is a function of the volume of the slug and the hydraulic conductivity (K) of the aquifer.

For this investigation, an In-Situ, HERMIT 1000B data logger and a 50 psi pressure transducer will be used to record "T_o" and water level/elapsed time measurements during each slug test. For purposes of graphing data, the instrument will be programmed to record measurement on a logarithmic time scale. The slug will consist of a 5-foot, 1.25-inch diameter stainless steel cylinder with a stainless steel ring welded on one end from which to suspend the slug.

1.9 Laboratory Analysis

Soil — Selected soil samples will be analyzed for DRO-TPH based on headspace readings. The number of soil samples submitted for laboratory analysis will be determined by TDEC guidelines which require one to three samples per boring depending on organic vapor detector (PID or FID) reading and visual or olfactory observations. The proposed borings could require analysis of

up to 15 soil samples. One sample will also be analyzed for total organic carbon, microbial plate count, nitrate-nitrite-nitrogen, and phosphorus to facilitate the evaluation of remedial design alternatives.

Groundwater — A groundwater sample will be collected from each of the proposed monitoring wells and analyzed for DRO-TPH. A sample from what is believed to be the least impacted well will be analyzed for total iron, total manganese, and turbidity as part of the process used to classify groundwater as either a "drinking water" or "non-drinking water" supply. The resulting classification will determine applicable groundwater cleanup levels. The sample from the least impacted well will also be analyzed for total suspended solids, alkalinity, microbial plate count, nitrate-nitrite-nitrogen and phosphorus to facilitate the evaluation of remedial design alternatives.

Quality Control — The number and types of QC samples are outlined in the Quality Assurance Plan (Section 2).

1.10 Quality Assurance

Sample documentation, chain-of-custody procedures, field records, sample containers and preservation, analytical methods, etc, are also discussed in Section 2.

1.11 Investigation Derived Waste (IDW)

Borehole cuttings and development and purge water will be containerized in DOT 17-C open-top 55-gallon drums, permanently labeled by boring number and stored in a location designated by the Activity. A representative sample of the soil cuttings will be subjected to the Toxicity Characteristic Leaching Procedure (TCLP) and the resulting extract analyzed for lead, benzene, and TPH to determine if the soil can be disposed of in a sanitary landfill. A sample of the development/purge water will be analyzed for TCLP lead to determine if it should be disposed of as a hazardous or non-hazardous waste. The test results will be provided to Activity personnel who will arrange for disposal of the investigation-derived waste.

1.12 Environmental Assessment Report

A draft and final Environmental Assessment Report (EAR) will be completed according to the guidance provided by the TDEC Division of Underground Storage Tanks. Following SOUTHDIV review and comment on the draft EAR, the final EAR will be prepared for submittal to SOUTHDIV and the TDEC.

EAR Report Format:

Executive Summary — The executive summary will describe the overall findings of the project including conclusions and interpretation of data generated during the assessment.

Introduction — The introduction will summarize and delineate the objectives of the POA, give a brief site history and provide any new or revised information not previously stated in earlier reports.

Site Location — Vicinity, site and topographic maps, as well as a description of the local topography and any effects it may have on contaminant migration.

Soil Investigation — A description of the soil investigation including, but not limited to:

- Rationale for number and placement of soil borings
- Regional and Site Geology
- Soil/Bedrock Boring Results
  - — Drilling and sampling methods
  - — Boring logs
- Analytical Results
- Soil Cleanup Levels
  - — Permeability sampling and testing
  - — Cleanup level determination
- Soil Contaminant Plume Maps

Groundwater Investigation — A discussion of the groundwater investigation, including:

- Rationale for the number and placement of wells
- Hydrogeology
- Monitoring Wells
  - — Construction
  - — Identification
  - — Surveying
  - — Development
- Analytical Results
- Water Level Data
- Groundwater Classification Procedures
  - — Water Use Survey Data
  - — Analytical Sampling Data
  - — Yield and/or Slug Test Data
  - — Applicable Cleanup Levels
- Groundwater Contaminant Plume Maps

Signature Page — This page will be signed by a Professional Geologist registered in the State of Tennessee.

1.13 Corrective Action Plan

In accordance with TDEC requirements, a Corrective Action Plan (CAP) will be prepared and submitted in final form upon completion of the EAR. Before the final CAP is prepared for submittal to the TDEC, a draft CAP will be prepared according to TDEC guidance and submitted to SOUTHDIV for review and comment. The CAP will discuss the three most technologically feasible and reliable corrective action options which were considered and will detail the specifications and estimated itemized cost of the corrective action chosen. If no soil or groundwater contamination above the applicable cleanup levels was found during the

environmental assessment, no further action will be necessary and a CAP will not need to be submitted to the TDEC.

1.14 Project Schedule

The schedule below has been prepared to show the order of investigative tasks and the relative elapsed time for each major task. The schedule assumes that laboratory turnaround times will not exceed four weeks. The schedule begins on Day 0, defined as the date approval of the final EAP is received from SOUTHDIV.

To remain cost effective while maintaining a high degree of confidence in the data generated by the study, contingency scheduling may be necessary. The sequence and schedule of field activities presented in this document will be maintained unless the Task Order Manager determines that schedule alterations are required due to changes in the scope of work, uncontrollable factors such as weather or site access, or similar problems. Schedule changes will be closely coordinated with the EIC and Activity personnel.

A draft EAR will be submitted to the SOUTHDIV EIC within 20 working days after receipt of analytical results from the laboratory. Assuming there are no unexpected delays, submittal will be approximately 50 days from the startup of field work. A final EAR will be prepared for submittal to SOUTHDIV within 10 working days following comments from SOUTHDIV on the draft EAR. A draft Corrective Action Plan (CAP) will be submitted to SOUTHDIV within 20 working days of submittal of the draft EAR. The final CAP will be submitted to SOUTHDIV within 10 working days of receipt of comments on the draft CAP.

ESTIMATED PROJECT SCHEDULE

Week 0	SOUTHDIV approval of final EAP
Week 1	Coordinate field investigation
Week 2	Field start up
Week 4	Complete field work and ship samples to laboratory for analysis
Week 8	Receive analytical results from laboratory
Week 12	Submit draft EAR to SOUTHDIV/Begin work on draft CAP
Week 14	Receive comments on draft EAR from SOUTHDIV
Week 16	Submit final EAR/draft CAP to SOUTHDIV
Week 17	Receive SOUTHDIV comments on draft CAP
Week 18	Submit final CAP to SOUTHDIV

2.0 QUALITY ASSURANCE PLAN

2.1 Introduction

This section presents policies, project organization and objectives, functional activities, and quality assurance/quality control measures intended to achieve data quality goals of the EAP at NAS Memphis.

This document is intended to fulfill requirements for ensuring that all work will be conducted in accordance with quality assurance/quality control protocols and field procedural protocols for environmental monitoring and measurement data as established in the following documents.

Applicable Guidance Documents:

- Naval Energy and Environmental Support Activity (June 1988). (NEESA 20.2-047B) *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program*, Port Hueneme, California

- Naval Energy and Environmental Support Activity (February 1985). (NEESA 20.2-031A) *Ground-Water Monitoring Guide*, Port Hueneme, California

- Southern Division Engineering Command, Revision 4 (March 1989). *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation*

Where specific NEESA guidelines do not exist, applicable EPA and/or TDEC UST Division guidelines and methods will be applied. These regulations are referenced in specific subsections of this section (where applicable).

2.2 Project Description

E/A&H will perform a site investigation to determine the vertical and horizontal extent of possible soil and groundwater contamination at the Building S-50 site, which is the former

location of an underground diesel fuel storage tank. The field investigation proposes the installation and sampling of five soil borings which are all to be completed as groundwater monitoring wells.

2.3 Project Quality Assurance Objectives

In general, quality assurance (QA) objectives of E/A&H projects conducted as part of the Navy technical services contract are to assess and document the precision, accuracy, representativeness, completeness, and comparability of all sampling and analysis performed. Quality criteria are outlined here to assure suitability of data obtained during projects for its intended use, and to meet goals established by NEESA. The Navy has stipulated that Level C quality control (QC) criteria are to be used as a *guideline* for this investigation as outlined in NEESA 20.2-047B. The following is a discussion of project-specific level of effort for QA and data quality criteria.

2.3.1 Field Measurements

QA objectives for parameters to be measured in the field by E/A&H personnel are presented in Table 2-1. Field measurements will include pH, temperature, specific conductance, and static groundwater level.

Table 2-1
Field Measurements

Measurements Parameter	Reference	Matrix	Precision	Accuracy	Completeness
pH	EPA 150.1[a]	Water	± 0.05 std. units	± 0.2 std. units	90%
Temperature	EPA 170.1[a]	Water	± 0.1° C	± 0.2° C	90%
Static Water Level	SOP[b]	Water	± 0.01 ft.	± 0.005 ft.	90%
Specific Conductance	EPA 120.1[a]	Water	± 10%	± 10 umhos/cm (<1000 umhos/cm) ± 100 umhos/cm (>1000 umhos/cm)	90%
Photoionization Detector	SOP[c]	Air	± 10 ppm	± 20 ppm	90%
Well Survey Points	SOP[d]	Spatial	± 5%	± 0.5 feet	90%
	SOP[d]	Vertical	± 0.05 feet	± 0.01 feet	90%

Notes:
a - Methods for Chemical Analysis of Water and Wastes, EPA-600/4/79-020, Revised March 1983.
b - Manufacturer's SOP for static water level measurement.
c - Manufacturer's SOP for operation of photoionization detector.
d - Standard land surveying methods as employed by Registered Land Surveyors.

2.3.2 Sampling and Analysis for Contamination Level

Project QA objectives of analytical parameters for soil and groundwater will be as stipulated in their respective analytical methods, and as determined by the analytical laboratory's historical data quality evaluation for the methods. The NEESA laboratory approval process seeks to ensure that laboratory method QA/QC standards are appropriate to meet goals for intended data uses. Anticipated general QA goals for these methods are presented in Table 2-2.

Table 2-2
Laboratory Measurements

Parameter/Analytical Method	Matrix	Precision (%)	Accuracy (% Recovery)	Completeness (%)
DRO-TPH Modified EPA Method 8015/TN DRO	Water	± 35	± 55	90
	Soil	± 35	± 55	90

2.3.3 Precision and Accuracy

Methods of assessing precision and accuracy measurements are discussed in Section 2.16 of this document. General precision and accuracy goals for laboratory analytical procedures (NEESA Level C) are also provided in Table 2-2.

2.3.4 Representativeness

The goal of this investigation is to assess the extent of any soil and groundwater contamination and recommend corrective action, as needed. By properly collecting soil and groundwater monitoring well samples, and measuring well parameters in accordance with NEESA protocol and the EPA Region IV Environmental Compliance Branch *Standard Operating Procedures and Quality Assurance Manual (SOP/QAM)* (February 1991), samples collected during this investigation will be more representative of the area of concern.

2.3.5 Completeness

The completeness goals for field and laboratory measurements take into consideration unavoidable non-attainment of QA goals which may occur over the course of the assessment. Efforts will be made to maintain soil and groundwater data completeness levels above the 90 percent level.

2.3.6 Comparability

Comparability is improved through the use of established methods of sampling and analysis as specified in NEESA 20.2-031A and NEESA 20.02-047B, as well as other accepted methods outlined in the EPA SOP/QAM.

2.4 Project Organization and Responsibilities

Overall responsibility for projects conducted in accordance with NEESA guidelines will be vested in NEESA (or its approved representative). Therefore, project coordination responsibilities lie with the SOUTHDIV EIC. The following sections describe the project chain-of-command as established in NEESA 20.2-047B.

2.4.1 Oversight

Navy Energy and Environmental Support Activity

NEESA is responsible for ensuring that the quality of laboratory analyses performed during the various phases of CLEAN is acceptable. NEESA is also responsible for managing the NEESA Contract Representative (NCR).

Engineering Field Division

The EIC at the Engineering Field Division provides the site information and history, and logistical assistance, specifies the sites requiring investigation and reviews results and recommendations. Mr. John Karlyk, SOUTHDIV, Naval Facilities Engineering Command, Charleston, South Carolina, serves as the EIC for this project.

Engineer in Charge

The EIC is responsible for coordinating procurement, finance, and reporting; for ensuring that all documents are reviewed by the NCR; for communicating comments from the NCR and other technical reviewers to the subcontractors; and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

NEESA Contract Representative

The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans, work plans, submits performance sample data, provides field and laboratory audits, and reviews data from the site. Questions from subcontractors and the EIC regarding specific field and laboratory QC practices are directed to the NCR.

State or Local Oversight

The TDEC will also serve in an oversight capacity for this investigation. The EAP will be prepared in accordance with TDEC requirements and guidelines. The investigation results will be presented to the TDEC in the form of an Environmental Assessment Report (EAR). This field investigation has been requested in accordance with the requirements of the TDEC's Division of Underground Storage Tanks *Environmental Assessment Guidelines* (January 1992).

2.4.2 Investigation Performance

The following individuals or firms will be responsible for the implementation of all work plan activities.

Engineering Subcontractor

E/A&H will serve as the Engineering Subcontractor for this project. As such, E/A&H is responsible for designing and implementing the field investigation. The E/A&H Task Order Manager is Mr. Lawson Anderson. The E/A&H Quality Assurance Officer is Mr. Andrew Kim.

Analytical Laboratory

The analytical laboratory employed by E/A&H must be a State-approved laboratory and adhere to the laboratory requirements in NEESA 20.2-047B (or other QA and method requirements as specified). For NEESA approval, the laboratory is required to prepare and submit a laboratory QA plan, to analyze and submit the results of proficiency testing, to submit to an onsite

inspection, and to correct any deficiencies cited during the inspection by the NCR. The laboratories are required to identify a Laboratory QA Coordinator (LQAC) responsible for overall QA. The LQAC must not be responsible for schedule, costs, or personnel other than QA assistants. It is preferred that the LQAC report to the Laboratory Director. The LQAC must have the authority to stop work on projects if QC problems arise which affect the quality of the data produced.

In addition to conforming to all NEESA guidelines, work will be performed in a manner consistent with the following regulations:

Applicable Regulations

- The Resource Conservation and Recovery Act of 1976 (RCRA).
- The Hazardous and Solid Waste Amendments of 1984 (HSWA).
- The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended.
- The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 Code of Federal Regulations (CFR), Part 300, as amended.
- Other appropriate federal, state, and local guidelines, rules, regulations, and criteria.

2.5 Soil Borings

The following sections address the sampling, analytical and decontamination procedures to be employed at the sites.

2.5.1 Soil Sampling

As described in Section 1.5, five soil borings will be installed and sampled in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation* and NEESA 20.2-031A, Chapter 4 - Monitor Well Drilling. The specific sampling method is discussed in Section

4.2.3.3 - Split Spoon Samples. One to three soil samples per boring will be submitted for laboratory analysis.

2.5.2 Soil Sample Analyses

The TDEC has established that for petroleum hydrocarbon releases, soil samples should be analyzed for Total Petroleum Hydrocarbons (TPH). Because of the type of fuel stored in the tank at this site, the Diesel Range Organics (DRO) method will be used for TPH analyses (Modified EPA Method 8015/TN DRO). In accordance with TDEC requirements, all results will be reported in parts per million. Analytical methods for remedial design and disposal parameters discussed in Sections 1.9 and 1.11 are provided in the table included as Appendix A.

2.5.3 Soil Sample Documentation

Soil samples will be documented in accordance with NEESA 20.2-031A, Chapter 6 - Monitoring Well Data Record Requirements. E/A&H personnel will use site-specific, bound logbooks for the maintenance of field records pertaining to the investigation. These records will document visual observations, calculations, and equipment calibrations. Entries will be dated and the time for each entry noted. The logbooks are accountable documents that will be properly maintained and retained as part of the project files. In addition, soil boring logs (Figure 2-1) will be produced for all soil borings advanced onsite. Information to be included on boring logs includes: total depth of boring, lithologic descriptions of each geologic formation encountered, water-bearing zones, and any subsurface obstructions encountered during boring advancement (with explanations, if available). Field logs will be retained in their original condition in the E/A&H project file.

2.5.4 Soil Sampling Equipment Decontamination

Equipment used for the collection of soil samples (e.g., continuous samplers, sampling rods, hollow-stem auger flights) will be high pressure, steam cleaned before onsite activities begin.

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
	DRILLING METHOD:		BORING NO.
			SHEET
	SAMPLING METHOD:		OF
			DRILLING
			START / FINISH
	WATER LEVEL		TIME / TIME
	TIME		
	DATE		DATE / DATE
	CASING DEPTH		

DRILLING CONTR _____

DATUM _____ ELEVATION _____

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

BY _____ CHK BY _____

DATE _____

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NAS MEMPHIS
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FIGURE 2-1
SOIL BORING LOG

DATE: 04/14/93 | DWG NAME: 68CLENBL

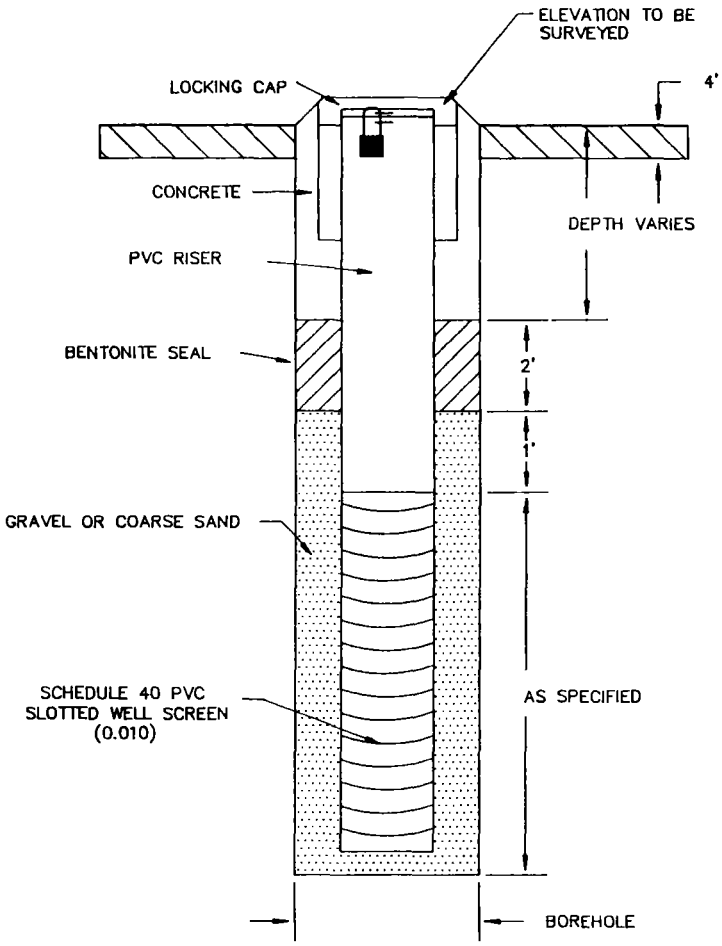
Decontamination of all augers and downhole equipment (e.g., auger flights, sampling rods) will be performed between each boring through a steam cleaning detergent wash and potable water rinse. Continuous samplers will be decontaminated between samples using a detergent wash and triple deionized or distilled water rinse. The samplers will be allowed to air dry. This procedure will be followed to minimize the potential for cross-contamination of soil samples. These procedures are in accordance with TDEC requirements.

2.6 Monitoring Well Installation

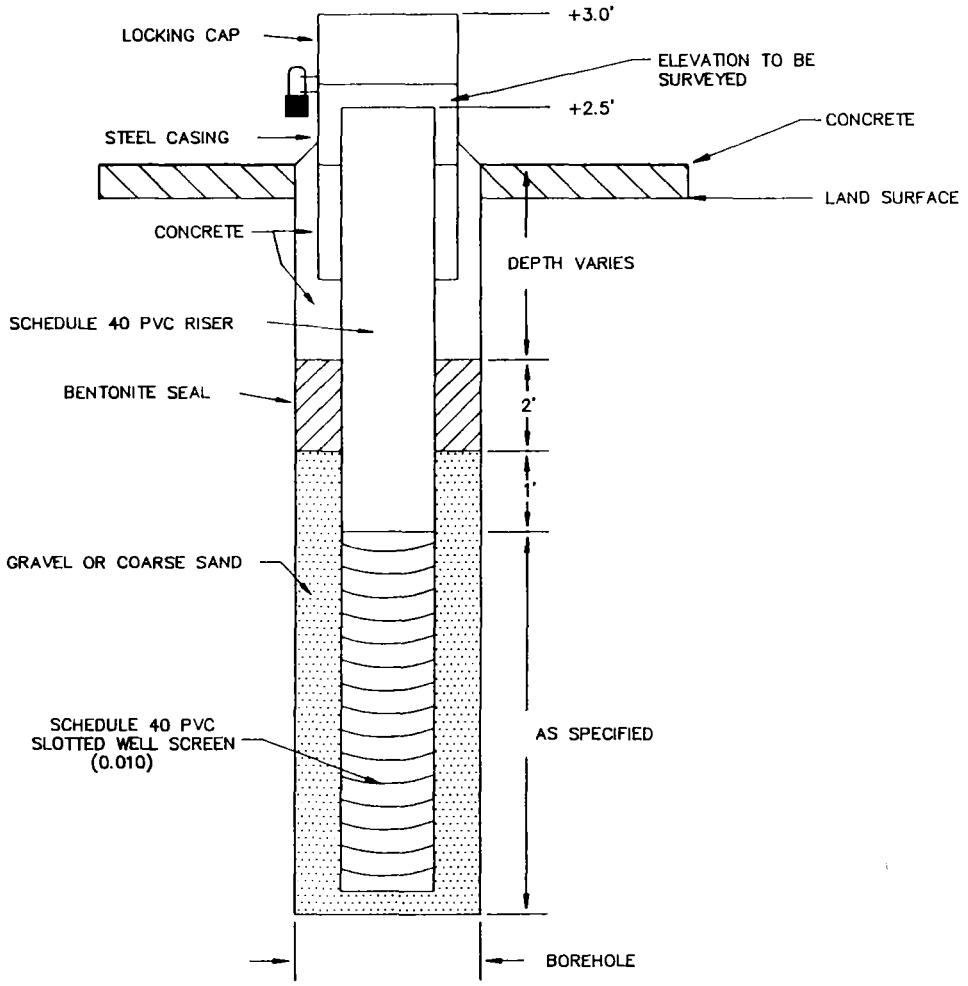
Monitoring well installation procedures are described in Section 1.6.1. Figure 2-2 is a schematic drawing of typical monitoring well construction. All monitoring well installation notes, calculations, descriptions, and observations will be recorded in the project logbook. In addition, well construction logs will be produced accurately depicting all components of the finished monitoring wells (e.g., total depth, depth to water, depth of filter pack, thickness of bentonite seal).

2.7 Monitoring Well Development

Upon completion of the monitoring wells, each well will be developed in accordance with the EPA Region IV Environmental Compliance Branch *Standard Operating Procedures and Quality Assurance Manual (SOP/QAM)* (February 1991). Each well will be developed to remove the residual materials remaining in the wells after installation has been completed, and to re-establish the natural hydraulic flow conditions of the well. The new well will be developed until the column is free of visible sediment, and/or the pH, temperature, and specific conductance have stabilized. Development will be accomplished by combining the use of a hand-bailer, surge block, hand-pump, and/or a pneumatic pump.



FLUSH MOUNT WELL



ABOVE GROUND WELL

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FIGURE 2-2
MONITORING
WELL SCHEMATIC

DATE: 04/14/93 | DWG NAME: 68KTWELL

2.8 Groundwater Sampling

The following sections describe the procedures for groundwater sampling to be employed during this field investigation.

2.8.1 Static Water Level Measurement

Two sets of static water level measurements will be performed on all monitoring wells in accordance with NEESA 20.2-031A and the EPA SOP/QAM. Static water level measurements will be used to determine groundwater flow direction and to construct potentiometric surface diagrams of the area of investigation for inclusion in the EAR. The first set of water level measurements will be taken at least 24 hours after completion of well development, but prior to well purging. Additional discussion of water level measurements is included in Section 1.6.3.

2.8.2 Monitoring Well Purging

Before samples are collected, each well will be purged of standing water to ensure that groundwater samples representative of the aquifer under investigation are obtained. The groundwater obtained will be considered stabilized and thus representative when the criteria outlined below have been met.

pH	$= \pm 0.5$ units
Temperature	$= \pm 1°$ C
Conductivity	$= \pm 10\%$

At least three casing volumes (as calculated from static water level) will be purged from each well. If a well bails to dryness before three casing volumes are removed, the purged volume will be noted in the site log book and the well will be sampled as soon as possible after recovery. Well purging will be performed using a PVC bailer which is manually lowered and removed from the well.

2.8.3 Groundwater Sampling Procedures

A groundwater sample will be collected from each of the proposed wells in accordance with NEESA 20.2-031A, Chapter 7 - Ground-Water Sampling. Groundwater samples will be collected using a PVC bailer and nylon bailing rope. The bailer will be slowly lowered into the water column to minimize water column disturbance and possible loss of volatile parameters. The bailer will be manually retrieved and the samples will be immediately transferred to appropriate sample containers. The sampling process is discussed in further detail and outlined in the EPA SOP/QAM.

2.8.4 Groundwater Sample Analyses

The TDEC has established that for petroleum hydrocarbon releases, groundwater samples should be analyzed for TPH. Because of the type of fuel stored in the tank at this site, the DRO method will be used for TPH analyses. Modified EPA Method 8015/TN DRO will be used to conduct the DRO-TPH analyses. In accordance with TDEC requirements, all results will be reported in parts per million. Analytical methods for remedial design and disposal parameters discussed in Section 1.9 and 1.11 are provided in the table included as Appendix A.

2.8.5 Groundwater Sample Documentation

Groundwater samples will be documented in accordance with NEESA 20.2-047B, Chapter 3 - Site-Specific QC Requirements and NEESA 20.2-031A, Chapter 6 - Monitoring Well Data Record Requirements. E/A&H personnel will use site-specific, bound logbooks for the maintenance of field records pertaining to the investigation. These records will document visual observations, calculations, field measurements, and equipment calibrations. Entries will be dated and the time for each entry noted. The logbooks are accountable documents that will be properly maintained and retained as part of the project files.

2.8.6 Groundwater Sampling Equipment Decontamination

Equipment used in measuring and sampling groundwater monitoring wells will be decontaminated in accordance with TDEC and NEESA 20.2-031A, Chapter 3.3 - Aquifer Protection requirements. Before site activities begin, it will be necessary for all bailers and the water level indicator to be decontaminated using a potable water/detergent wash, followed by a triple deionized or distilled water rinse. Dedicated bailers will be used to prevent cross-contamination between wells. Disposable gloves will be worn during all measurement and sampling activities. A new pair of disposable gloves will be donned for each water sample and/or measurement.

2.9 Sample Containers, Preservation, Identification, and Labelling

Sample containers will be provided pre-cleaned by the laboratory. E/A&H will receive the containers from an approved laboratory that has followed NEESA 20.2-047B, Chapter 3.5 - Sample Container Cleaning Procedures (and/or other applicable protocol), and the containers will remain in the custody of E/A&H personnel.

Sample preservation will be conducted in accordance with the analytical method designated. All TPH groundwater samples to be preserved by acidification will have the proper pH verified using litmus paper or a portable pH meter. Sample containers, preservation and holding times for contaminant parameters are summarized in Table 2-3. The table included as Appendix A provides the same information for the remedial design and disposal parameters discussed in Sections 1.9 and 1.11.

Table 2-3
Sample Containers, Preservatives, & Holding Times

Analytical Method	Sample Matrix	Sample Container	Preservative	Holding Time
DRO-TPH Modified EPA Method 8015/TN DRO	Water	1 liter glass jar	pH<2; 1:1 HCl; Chill: 4°C	7 days
	Soil	125 ml wide glass jar	Chill: 4°C	7 days

Sample identification will be accomplished using sample labels applied to each sample container. Each sample label will contain such pertinent data as: site name, sample location, time/date of collection, and preservation method. An example of the sample label to be used can be found in Figure 2-3. Each sample will be logged in the field log book at the time of collection.

2.9.1 Sample Chain-of-Custody

E/A&H will follow strict chain-of-custody procedures in accordance with NEESA 20.2-047B, Chapter 3.8, and corporate Standard Operating Procedures for chain-of-custody. Any changes to the chain-of-custody forms will be made using a single line through the error with the correction made to the side and initialed by the sampler. An explanation of any changes will be given in the Comments section of the form. EnSafe/Allen & Hoshall will use chain-of-custody forms for transferring sample shipments to the laboratory (see Figure 2-4). Documentation of all samples will also be kept in the project field logbook.

Upon transfer of custody, the chain-of-custody form will be signed by the E/A&H field sampling team leader, with the date and time the samples were relinquished noted on the form. Because common carriers will not sign chain-of-custody forms, the chain-of-custody records will be

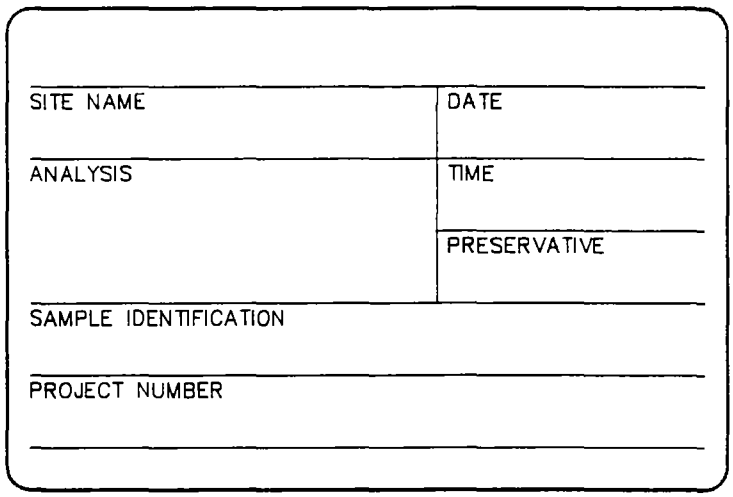

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FIGURE 2-3
SAMPLE BOTTLE LABEL

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FIGURE 2-4
CHAIN OF CUSTODY RECORD

LABORATORY: _____

ATTENTION: _____

PROJECT NO.: _____

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CLIENT NAME

COLLECTED BY

SAMPLE ID	DATE	TIME	comp	grab	well	SAMPLE LOCATION	#of containers	MEDIA (X) SOIL	WATER	SEDIMENT	GROUNDWATER	SAMPLE ANALYSIS (X)									REMARKS

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:

RELINQUISHED BY:	DATE	TIME	RECEIVED AT LAB BY:	DATE	TIME	REMARKS

68CLNCUS

sealed within each shipping container. All chain-of-custody forms received by the laboratory must be signed and dated by the laboratory sample custodian and returned to E/A&H following receipt or as part of the data reporting package.

2.9.2 Field Records

E/A&H personnel will maintain field records in bound field logbooks with pages that cannot be removed without tearing them out. Waterproof paper is preferred.

A logbook should be dedicated to an individual project. The field sampling team leader's and all team member names, project name and project code should be entered on the inside of the front cover of the logbook. Entries should be dated and the time recorded. At the end of each day's activity, or entry of a particular event if appropriate, a sampling team member should draw a diagonal line at the conclusion of the entry and initial indicating the conclusion of the entry or the day's activity. Sample collection and handling procedures, as well as visual observations shall be documented in the field logbooks. Sample collection equipment (where appropriate), field analytical equipment, and equipment utilized to make physical measurements will be identified in the field logbooks. Calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment will also be recorded in the field logbooks. Field analyses and measurements must be traceable to the specific piece of field equipment used and to the field sampling team member(s) collecting the sample, making the measurement, or analyses.

All entries in field logbooks shall be dated, legible, and contain accurate and inclusive documentation of an individual's project activities. Because field records are the basis for later written reports, language should be objective, factual, and free of personal feelings or other terminology which might prove inappropriate. Once completed, these field logbooks become accountable documents and must be maintained as part of project files.

2.9.3 Document Control

The term *document control* refers to the maintenance of investigation project files. Documents as outlined below shall be kept in project files. E/A&H personnel may keep their own files, however, all official and original documents relating to investigations shall be placed in the official project files.

Contents of Project File:

- A copy of the study plan.
- Original chain-of-custody records and bound field logbooks.
- A copy of the receipt for sample forms.
- All records obtained during the investigation.
- A complete copy of the analytical data and memos transmitting analytical data.
- All official correspondence received by or issued by E/A&H relating to the investigation including records of telephone calls.
- One copy of the draft report (without review comments).
- One copy of the final report and transmittal memorandum(s).
- Any other relevant documents related to the original investigation or follow up activities related to the investigation.

Under no circumstances are any personal observations or irrelevant information to be filed in the official project files.

2.10 Calibration Procedures and Frequency

The analytical laboratory will perform analytical instrument calibration in accordance with NEESA 20.2-47B (and specific instrument methods by reference). Adherence to proper calibration procedures will be determined by the NCR during the onsite laboratory inspection.

E/A&H plans to calibrate field equipment such as pH, specific conductance, and temperature meters and PIDs according to their manufacturer's standard operating procedures. Field equipment for which SOPs are not in force will be calibrated and operated in accordance with the manufacturer's recommendations. All field instruments will be calibrated at the beginning and end of each work day.

2.11 Analytical Procedures

This investigation will follow the analytical procedures described below.

2.11.1 Field Analyses

Static water level measurements will be performed on all monitoring wells subsequent to well development with adequate time allowed for well recharge. In addition, pH, temperature, and conductivity will be measured in the field during well purging. Monitoring well casing tops will be surveyed (spatial and horizontal orientation) by a State of Tennessee Registered Land Surveyor. The survey measurements will be recorded relative to the NAS Memphis base coordinate grid system.

All field measurements will be recorded in a dedicated field logbook and/or appropriate E/A&H field activity log (e.g., boring log, well construction log, etc.).

2.11.2 Laboratory Analyses

Groundwater samples collected during this investigation will be analyzed using Modified EPA Method 8015/TN DRO for DRO analysis. The purge/development water from each site will be analyzed for TCLP lead to assist in determining proper disposal options.

One groundwater sample from what is believed to be the least-contaminated well will be analyzed for total iron, total manganese, and turbidity as part of the process used to classify the groundwater as either a "drinking water" or "non-drinking water" supply. Total iron and total

manganese will be determined using EPA Method 6010 and turbidity will be determined using EPA 180.1. A groundwater sample collected from the least contaminated well will also be analyzed for total suspended solids, alkalinity, microbial plate count, nitrogen, and phosphorus to facilitate the evaluation of remedial design alternatives.

Soil samples collected during this investigation will be analyzed for DRO-TPH using the Modified EPA Method 8015/TN DRO. A composite sample of borehole cuttings from each site will be analyzed for TCLP Lead, Benzene, and TPH to aid in soil disposal. One soil sample per site will be analyzed for total organic carbon, microbial plate count, nitrogen, and phosphorus to facilitate the evaluation of remedial design alternatives.

2.12 Data Reduction, Validation, and Reporting

Laboratory procedures for data reduction and reporting will be based on standard operating procedures dictated by the requirements of NEESA 20.2-047B, Chapters 7 - Analytical Methods and 8 - Maintaining Laboratory Approval. The specific procedures for data reduction, validation and reporting will be based on those outlined for Level C QC data in NEESA 20.2-047B, and the NCR-approved laboratory QA Plan.

E/A&H's use of the laboratory will be accomplished by a services agreement. This contract will specify the scope of services to be performed by the laboratory, the specific analytical quality assurance requirements to be met, and the information to be developed and reported.

2.13 Field and Laboratory Quality Control Checks

Internal laboratory control checks used by the laboratory will be conducted in the laboratory by the laboratory staff. E/A&H will conduct internal quality control checks of sampling procedures and laboratory analyses. These checks will consist of preparing and submitting sampling equipment rinsate blanks, trip blanks, field blanks, and field duplicates for analysis, and evaluating the laboratory analytical package. The data validation checklists, included as

Appendix B, will be used as guides in evaluating data collection, field records, and analytical performance, and in identifying valid data.

The types and frequency of blank and other control check samples were determined using NEESA Level C as a guideline. The required control check samples frequencies are outlined in NEESA 20.2-047B, Chapter 3 - Site-Specific QC Requirements and Chapter 7 - Analytical Methods. For Level C QC, quality control measures can be discussed for sampling and analysis as follows.

2.13.1 Field Data Quality

Field work will be conducted and/or supervised by E/A&H personnel to ensure that proper procedures are followed. Field records will be kept of all activities that take place during the investigation and these records will be maintained at the E/A&H office in Memphis, Tennessee. These records will include any obstacles that may be encountered during the investigation.

Field samples will be collected per the procedures outlined in Sections 2.5 and 2.8. Precision will be assessed by evaluating the results of duplicate and matrix spike duplicate samples. Accuracy will be assessed by evaluating the analyses of field blanks, trip blanks, laboratory matrix and surrogate spikes, and laboratory reagent blanks and blank spike samples.

Duplicates are samples identical to the original, collected from the same location (e.g., well) at the same time under identical conditions. Duplicate samples are analyzed along with the original sample to obtain sample procedure precision and inherent sample source variability. Duplicate samples (water and soil) will be collected at a 10 percent frequency. The same samples used for field duplicates shall be split by the laboratory and used as the matrix spike (MS) and matrix spike duplicate (MSD). Therefore, for the designated duplicate sample, there will be analyses of the normal sample, the field duplicate, and the laboratory MS/MSD.

Field sampling personnel will need to coordinate with the laboratory in advance to ensure that sufficient QC sample volumes are collected and that QC samples are numbered in a manner that is compatible with the laboratory sample tracking system (to prevent misidentification of samples).

Field blanks are sample containers filled with the source water used in the decontamination of equipment in the field. They are prepared, preserved and stored in the same manner as the other field samples. The field blanks are analyzed along with the field samples for the parameters of interest to check for contamination imparted to the samples by the water, sample containers or other outside sources. One field blank per water source per sampling event will be prepared. One field blank will consist of potable water and one field blank will consist of deionized or distilled water.

Rinsate (or equipment) blanks are collected by retaining rinsate from sampling equipment. The equipment is rinsed with distilled water after full decontamination procedures have been performed. Rinsate samples are collected in the same type of container as the other field samples and preserved in the same manner. One rinsate sample will be collected and submitted for each analytical parameter of concern. Rinsate blanks will be collected weekly. The rinsate blank is analyzed along with the field samples for the parameters of interest to check for contamination imparted to the samples by the sampling equipment, containers, decontamination procedures or other outside source.

Trip blanks are sample containers prepared in the laboratory with organic-free water and transported unopened with the sample bottles. Upon return to the laboratory, they are opened and analyzed along with the field samples for volatile parameters of interest. Trip blanks for all volatile parameters will be submitted to the laboratory at a frequency of one per sample shipping cooler.

The collection frequencies for quality control sample collection are summarized in Table 2-4.

Table 2-4
Sample Collection Frequencies

Measurement Parameter and Analytical Method	Sample Matrix	Regular Samples	QC Samples					Total Samples
			TB	RB	FB	DUPL	MS/MSD	
DRO-TPH Modified 8015/TN	Water	5	0	1	2	1	1/1	**11**
	Soil	15	0	1	2	2	1/1	**22**

2.13.2 Analytical Data Quality

Analytical data quality is assured through the use of NEESA guidelines for QA/QC as set forth in NEESA 20.2-047B. The guidelines include analysis and evaluation of matrix spikes and matrix spike duplicates.

MS/MSD samples are prepared by the laboratory to assess the accuracy of the analytical method relative to matrix effects. Matrix effects are those sample components which interfere with the analysis of the contaminant of concern. Analysis of matrix spike duplicates will provide a basis for determining method precision specific to the matrix under investigation. Precision is measured as Relative Percent Difference (%) between duplicate analysis. Matrix spikes and matrix spike duplicates will be analyzed at a frequency of one per 20 samples per matrix.

2.13.3 Field Data Package

The field data package will include field records and measurements obtained at a site by E/A&H personnel in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation*, and NEESA 20.2-047B, Chapter 7.2 - Deliverables and NEESA 20.2-031A, Chapter 6 - Monitoring Well Data Record Requirements. The package, including all field records and measurements obtained at the site by E/A&H sampling personnel, may be validated by conducting procedures outlined below.

Review of Field Data:

- A review of field data contained on water and soil sampling logs for completeness. Failure in this area may result in the data being invalidated for litigation or regulatory purposes.

- A verification that field blanks, sampling equipment rinsate blanks, and trip blanks were properly prepared, identified, and analyzed. Failure in this area may compromise the analytical data package and result in some data being considered qualitative or invalid.

- A check on field analyses for equipment calibration and condition. Failure in this area may result in the field measurements being invalidated.

- A review of chain-of-custody forms for proper completion, signatures of field personnel and the laboratory sample custodian, and dates. Failure in this area may result in the data being invalidated for litigation or regulatory purposes.

The field data package may be reviewed by the project QA Officer for completeness and accuracy using the checklist in Appendix B as a guideline.

2.13.4 Analytical Data Package

Review of the analytical data package will be performed by the project QA Officer. The review steps will be performed by applying as guidance the EPA Laboratory Data Validation Functional Guidelines for Evaluating Organics and Inorganics Analyses (Technical Directive Document No. HQ-8410-01) and EPA precision and accuracy statements for the analytical methods employed. NEESA 20.2-047B, Chapter 7.3 guidelines will be applied to all Level C data validation procedures. An Analytical Data Validation Checklist (Appendix B) will be used for this purpose. The analytical data package review procedure includes the procedures outlined below.

Review of Analytical Data:

- Comparison of the data package to the reporting level requirements designated for the project, to confirm completeness.

- Comparison of sampling dates, sample extraction dates, and analysis dates to check that samples were extracted and/or analyzed within the proper holding times. Failure in this area may render the data unusable.

- Review of analytical methods and required detection limits to verify that they agree with the QAP and the laboratory contract. Failure in this area may render the data unusable.

- Review of field and laboratory blanks will be done to evaluate possible contamination sources. The preparation techniques and frequencies, and the analytical results (if appropriate) will be considered.

- Evaluation of all blanks (rinsate blanks, field blanks, trip blanks, reagent blanks, method blanks, and extraction blanks) must confirm freedom from contamination at the specified detection limit. All blank contaminants must be explained or the data applicable to those blanks labelled suspect and sufficient only for qualitative purposes.

2.14 Performance and System Audits

Audits will be performed before and during the work to evaluate the capability and performance of the entire system of measurement and reporting, i.e., experimental design, sampling (or data collection), analysis, and attendant quality control activities.

2.14.1 Field System Audits

The Site Project Manager is responsible for evaluating the performance of field personnel and general field operations and progress. The Site Project Manager will observe the performance

of the field operations personnel during each kind of activity such as water-level readings and sampling rounds. A formal systems audit of field operations personnel by the corporate QA officer will be performed on a biannual basis (for all projects) and a field audit report of each sampling team members will be maintained on file by E/A&H. Where applicable, these audits will ensure that field operations are being conducted in accordance with NEESA 20.2-031A guidelines.

2.14.2 Laboratory Systems Audit

A laboratory systems audit is routinely conducted at least biannually by E/A&H. These audits test methodology and assure that systems and operational capability are maintained. They also verify that quality control measures are being followed as specified in the laboratory written standard operating procedures and quality assurance plans (QAP). The Systems Audit Checklist used by the EPA Contract Laboratory Program (CLP) forms the procedural basis for conducting these audits.

Laboratory-initiated audits will be conducted in accordance with guidelines set forth in NEESA 20.2-047B, and the laboratory QAP as approved by the NCR. Under NEESA 20.2-047B guidelines, the project NCR is also responsible for laboratory inspections to ensure compliance with NEESA laboratory requirements.

2.14.3 Performance Evaluation Audits

A performance evaluation (PE) audit evaluates a laboratory's ability to obtain an accurate and precise answer in the analysis of known check samples by a specific analytical method. Following the analytical data validation described in Section 2.12, a performance evaluation audit of the laboratory may be conducted by E/A&H. This audit may be conducted if it is determined that the quality assurance data provided are outside acceptance criteria control limits. PE audits may include a review of all raw data developed by the laboratory and not reported (laboratory non-reportables) and the submission of blind spiked check samples for the analysis

of the parameters in question. These check samples may be submitted disguised as field samples (the laboratory will not know the purpose of the samples), or the samples may be obvious (known) check samples (EPA or National Bureau of Standards traceable).

PE audits may also be conducted by reviewing the laboratory's results from "round-robin" certification testing and/or EPA CLP evaluation samples. An additional component of PE audits includes the review and evaluation of raw data generated from the analysis of PE samples and actual field samples that may be in question.

2.14.4 Regulatory Audits

It is understood that E/A&H field personnel and subcontract laboratories are also subject to quality assurance audits by the EPA and the NCR. The NCR (under NEESA guidelines) will conduct laboratory inspections prior to approval for participation in any NEESA project, and will provide performance samples to the laboratory for approval purposes.

2.15 Preventive Maintenance

The field testing and monitoring equipment employed by E/A&H during an investigation that may require preventive maintenance will be checked for proper operation before and after each use on a daily basis. These checks will be conducted at the beginning and end of each day. Any preventive maintenance, replacements, or repairs will be made as needed in accordance with manufacturer's instructions.

Records of calibration and maintenance activities for each piece of non-rental equipment are contained in logbooks assigned to the equipment. Records for rental equipment will be kept in the site logbook. Preventive maintenance to be performed by the analytical laboratory will be performed in accordance with laboratory SOPs as established in an NCR-approved QAP.

2.16 Precision, Accuracy, and Completeness

Precision is an estimate of the reproducibility of a method, and is estimated by several statistical tests: the Standard Deviation of the error distribution, the Coefficient of Variation and the Relative Percent Difference between replicate (duplicate) samples. E/A&H will determine the precision of a method by analyzing replicate data.

Precision is then defined by the Coefficient of Variation (CV), which expresses the Standard Deviation as a percentage of the mean. An indicator of CV, Relative Percent Difference will serve as quality criterion for classification of data resulting from this investigation. Specific statistical comparison of duplicate samples (field and laboratory), as a measure of precision evaluating both sample collection procedures and laboratory instrument performance, may be accomplished by first comparing the obtained duplicate results with the published EPA criteria for method precision (Relative Percent Difference).

The accuracy of a method is an estimate of the difference between the true value and the determined mean value. Specific statistical comparison of Percent Recovery values reported by the laboratory as a measure of method accuracy will be compared with the published EPA (or other appropriate regulatory entity) criteria for the accuracy of an individual method.

Data completeness will be expressed both as the percentage of total tests conducted and required in the scope of work that are deemed valid. Methods for assessing data precision, accuracy, and completeness by the laboratory will be outlined in the approved laboratory QAP.

2.17 Corrective Action

During the course of any investigation, field personnel are responsible for seeing that field instruments and equipment are functioning properly and that work progresses satisfactorily. The field personnel are also responsible for ensuring performance of routine preventive maintenance and quality control procedures, thereby ensuring collection of valid field data. If a problem is

detected by the field personnel, the project manager shall be notified immediately, at which time problem correction will begin. Similarly, if a problem is identified during a routine audit by the project QA officer or the regulatory QA officer (or NCR), an immediate investigation will be undertaken and corrective action deemed necessary will be taken as early as possible.

If corrective action is required by the analytical laboratory, it should be conducted in accordance with their NCR-approved QAP following guidelines provided in NEESA 20.2 - 047B, Chapter 4.5 - Out-of-Control Events.

2.18 Quality Assurance Reports

The laboratory is required to submit a monthly QC progress report to the NCR. E/A&H will provide a data quality summary (QC Data Report) within the draft EAR for each site. The draft EARs will be submitted to the SOUTHDIV EIC with 15 working days after the receipt of analytical results from the laboratory. Assuming there are no unexpected delays, submittal will be approximately 55 days from the start up of field work.

3.0 SITE HEALTH AND SAFETY PLAN

3.1 Introduction

The following Health and Safety Plan is written in conjunction with the Environmental Assessment Plan (EAP) to be conducted at the Building S-50 UST site located at Naval Air Station (NAS) Memphis in Millington, Tennessee. The project contract number is N62467-89-D-0318. The monitoring program is being conducted to characterize the extent of contamination (soil and groundwater) at the site, and to determine if follow up action (i.e., cleanup or monitoring) is required to maintain compliance with environmental regulations.

Applicability

The provisions of the plan are mandatory for all onsite personnel engaged in the environmental assessment and any visitors to the site who will be exposed or have the potential to be exposed to onsite hazardous substances. All personnel will operate in accordance with the most current requirements of 29 CFR 1910.120, *Standards for Hazardous Waste Workers and Emergency Responders*. These regulations include the following provisions for employees exposed to hazardous substances, health hazards or safety hazards: training as described in 120(e), medical surveillance as described in 120(f), and personal protective equipment as described in 120(g).

All field personnel assigned to field activities for the project must read this plan and sign the plan acceptance form before the start of site activities. Subcontractors will hold E/A&H harmless from, and indemnify it against all liability in the case of any injury. At a minimum, all provisions of the E/A&H health and safety plan will be followed.

E/A&H will suspend the site work and will instruct the subcontractor to evacuate the area under the following conditions:

If inadequate safety precautions are taken by the subcontractor or DOD oversight personnel

or

If it is believed that the subcontractor or DOD oversight personnel are or may be exposed to an immediate health hazard.

Health and Safety training certificates for E/A&H employees who may visit the site are provided in Appendix C. Current OSHA refresher training certificates will be available on site for all employees involved in field activities whose refresher course requirements come up for renewal before the project begins.

3.2 Site Characterization

3.2.1 Work Areas

Site control will be established and maintained according to the recommendations in the EPA's *Interim Standard Operating Safety Guides*, Revised September, 1982. Three general zones of operation will be established to reduce the potential for contaminant migration and risk of personnel exposure:

- The exclusion zone.
- The contamination reduction zone.
- The support zone.

The exclusion zone will be located so that the area between the decontamination station and the work area entrances will be included. The contamination reduction zone will include the decontamination station and the support zone will be located beyond the contamination reduction zone. Only authorized personnel with a minimum of 40 hours health and safety training meeting the requirements of OSHA 29 CFR 1910.120 are permitted within the exclusion and contamination reduction zones. The exclusion zone will be the area within 20 feet of either side or the rear of the drill rig.

All personnel within the exclusion zone must use the prescribed level of personal protection. A checkpoint will be established at the edge of the exclusion zone to regulate the flow of personnel and equipment in and out of the area. The exclusion zone boundary is the hotline. All personnel crossing the hotline into the exclusion zone must use the buddy system.

The person entering the exclusion zone must be accompanied by a person who is able to:

- Provide his or her partner with assistance.
- Observe his or her partner for signs of chemical or heat/cold exposure.
- Periodically check the integrity of his or her partner's protective clothing.
- Notify the shift supervisor, his representative or others if emergency help is needed.

During Level B activities, at least one person shall remain outside the exclusion zone and have available at least the same level of personal protective equipment (PPE) as the buddies who are entering the exclusion zone. The person outside the exclusion zone will act as the safety observer and perform the security duties described in the section labeled Work Area Access/Egress of this section.

The contamination reduction zone serves as a buffer between the exclusion zone and the support zone and is intended to prevent the spread of contaminants from the work areas. All decontamination procedures will be conducted in this area. Personnel will leave the support zone and enter the contamination reduction zone through a controlled access point. They must wear the prescribed personal protective equipment. Exiting the contamination reduction zone requires the removal of all contaminants through compliance with established decontamination procedures.

The support zone is the outermost area and is considered a non-contaminated or clean area. The support area will be equipped with an appropriate first-aid station and equipment to perform gross decontamination of equipment.

3.2.2 Work Area Access/Egress

All personnel entering the site exclusion zone must:

- Check in with the E/A&H Field Project Manager or representative.

- Provide the E/A&H Field Project Manager with the following information:
  - The names of individuals entering the site work area.
  - Destination in the site work area.
  - Activity to be performed at that location.
  - Duration of the planned activity.

- The Field Project Manager will inform persons entering the site work area of the location of other activities taking place during the scheduled entry. If the Field Project Manager determines it is not safe for the scheduled entry, he or she can reschedule the entry or stop all other activities to perform the specific task.

- When leaving the site work area, proceed directly to the decontamination station and check out with the Field Project Manager or his representative. All exits from the site work area must be made through the decontamination station.

- Perform all necessary decontamination before leaving the decontamination station.

3.2.3 Site Work Zones

As stated in Section 3.2.1, the exclusion zone will extend 20 feet to the rear and sides of the drill rig. The exclusion zone will be clearly defined using yellow caution tape if the entry of non-authorized personnel is likely.

The limit of the exclusion area and location and limit of the decontamination corridor and support area is based on existing physical assets such as location of utilities, buildings, roads, and security assets (See Section 3.2.1).

3.3 Site Activities

The activities to be performed during the investigation include the drilling and sampling of five soil borings/monitoring wells. Subsequent activities will include well purging, development, and sampling as required. Boring/well installations and associated field work descriptions are provided in Sections 1 and 2.

3.4 Hazard Evaluation

The field investigation will provide data needed to assess the extent of contamination at these sites, and to determine if follow-up action (i.e., cleanup or monitoring) is required to maintain compliance with environmental regulations. The investigation will focus around the former location of the underground storage tank (UST) at Building S-50.

3.4.1 Chemical Hazards

Due to the complex composition of suspected compounds, listing each individual component is impractical. Listed below are the potential chemical hazards posed by these substances and their most critical components (from a health and safety standpoint), and safety data associated with them.

Benzene is considered a human carcinogen by NIOSH (among others). As a result, all appropriate precautions should be taken to avoid or, at the very least, limit exposure to benzene. Signs and symptoms of exposure include: dizziness, weakness, euphoria, headache, nausea, vomiting, tightness of the chest, staggering. More severe exposure may result in blurred vision, tremors, shallow and rapid respiration, ventricular irregularities, paralysis, and unconsciousness.

The OSHA PEL-TWA for benzene is 1 part per million (ppm). The STEL for benzene is 5 ppm.

Toluene is considered a moderate health hazard by the NFPA. Symptoms of exposure include: dizziness, exhilaration, and confusion at lower acute exposure levels, and incoordination, ataxia, unconsciousness, and death (eventually) may occur at high level acute exposures.

The OSHA PEL-TWA for toluene is 100 ppm with an STEL concentration of 150 ppm.

Xylenes occur as ortho-, meta-, and para- isomers, but for sake of discussion will be covered as a group. Signs and symptoms of exposure include: skin, eye, and mucous membrane irritation, euphoria, headache, giddiness, vertigo, ataxia, tinnitus, confusion, stupefaction, and coma at progressively higher exposure levels.

The OSHA PEL-TWA for xylenes (total) is 100 ppm with a PEL-STEL of 150 ppm.

Material Safety Data Sheets (MSDS) for benzene are included in Appendix D.

3.4.2 Drilling Safety

A Drilling Safety Guide has been included as Appendix E of this EAP. The guide covers the following topics:

- Drilling Safety Guide
- Drill Rig Safety Supervisor
- Drill Rig Personal Protective Equipment
- Drill Rig Housekeeping
- Maintenance Safety
- Safe Use of Hand Tools
- Safety During Drilling Operations
- Working on Derrick Platforms
- Working on the Ground
- Wire Rope Safety
- Cathead and Rope Hoist Safety
- Auger Safety
- Rotary and Core Drilling Safety

3.4.3 Heavy Equipment Operations

Self-propelled equipment, such as drill rigs and trucks, must be inspected by the subcontractor and the equipment operator before being placed in operation. Defects that affect safety will be corrected in a timely manner to prevent a hazard to humans. When defects do make continued operation hazardous to humans, the defective equipment will be taken out of service. A tag indicating that the equipment shall not be operated nor the tag removed shall be placed in a conspicuous location on the equipment. The tag shall remain until it is demonstrated to the individual deadlining the equipment that it is safe to operate.

Defects that affect safety will be reported to the E/A&H site representative if they are not corrected immediately. The site representative will keep a log that will include the date the defect was reported, the identification of the piece of equipment, a description of the defect, and the date of repair.

Operators of self-propelled mobile equipment will maintain control of the equipment while it is in motion. Speed will be consistent with conditions of roadways, grades, clearances, visibility, and traffic and the type of equipment used. Equipment will be operated at speeds that permit stopping and maneuvering in the tight work area determined by the site topography and layout.

Humans will **not** be transported:

- In or on dippers, clamshells or buckets.
- In beds of mobile equipment.
- On top of loads in mobile equipment.
- Outside cabs, equipment operators stations, and beds of mobile equipment.
- To or from work areas in over crowded equipment (i.e., the vehicle will not carry more persons than the number of seats on that vehicle).

All self-propelled mobile equipment will have a service brake system capable of stopping and holding the equipment with its typical load on the maximum grade it travels. (This does not apply to equipment that was not originally equipped with brakes). If equipped, the parking brake on self-propelled mobile equipment will be capable of holding the equipment under typical load conditions on the maximum travel grade. All braking systems installed on self-propelled mobile equipment will be maintained in a functional condition.

Repair or maintenance of equipment will be performed only after the power is off and the equipment blocked against hazardous motion. Starting or moving the equipment is allowed for adjusting or testing, provided that precautions are taken to protect the people involved.

Seat belts will be provided and worn in all site vehicles. They will be maintained in functional condition and replaced when necessary to assure proper performance. Furthermore, seat belts will meet the requirements of SAE J386, *Operator Restraint Systems for Off-Road Work Machines*, (1985).

Mobile equipment will not be left unattended unless the controls are placed in the park position and the parking brake, if provided, is set, and the ignition turned off. Persons will not work on top of, under, or from mobile equipment in a raised position until the equipment has been blocked or secured to prevent it from rolling or falling accidently.

All mobile drill rigs will be moved only when the drill rig boom is in the down position. Care will be taken to locate all overhead power lines before raising the drill rig boom. Under no circumstances, should the drill rig boom (or any other part of it) be positioned within 10 feet of exposed and energized electrical wires. The drill rig operator will be sure that there is enough overhead clearance before raising the drill rig through careful planning, (i.e., the drill rig will not hit or touch any overhead obstruction when raised, nor will it hit or touch any object while being raised).

3.4.4 Physical Hazards During Operations

Personnel conducting drill rig operations shall keep clear of all moving parts. Loose clothing shall not be worn to prevent entanglement with the drill rig. When conducting operations or survey work on foot, personnel will walk at all times. Running greatly increases the probability of slipping, tripping, and falling. When working in areas that support habitat for poisonous snakes, personnel shall wear protective chaps made of a heavy material designed to prevent snake bites to the legs.

3.5 Employee Protection

Employee protection for this project includes standard safe work practices, personal protective equipment, procedures and equipment for extreme weather conditions, work limitations, and exposure evaluation.

3.5.1 Standard Safe Work Practices

Standard safe work practices that will be followed include:

- Eating, drinking, chewing gum or tobacco, smoking or any activity that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated, unless authorized by the Site Health and Safety Officer.

- Hands and face must be thoroughly washed upon leaving the work area.

- No contact lenses will be worn in work areas while invasive actions are conducted.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate or discolored surfaces; or lean, sit, or place equipment on drums, containers, or on soil suspected of being contaminated.

- Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on cleanup or response operations where the potential for absorption, inhalation or ingestion of toxic substances exists unless specifically approved by a qualified physician. Consumption of alcoholic beverages shall be avoided during operations.

- Due to the possible presence of overhead power lines, adequate side and overhead clearance should be maintained to insure that the drill rig boom does not touch or pass close to any overhead lines.

- Due to the possible presence of underground utilities (including electric, natural gas, water, sewer, telephone, etc.), the activity and local utility representatives should be contacted and requested to identify all lines at the ground surface using characteristic spray paint or labelled stakes. A 3-yard buffer zone should be maintained during all subsurface investigations.

- Due to the flammable properties of the potential chemical hazards, all spark or ignition sources should be bonded and/or grounded or mitigated before soil boring advancement or other site activities begin.

3.5.2 NAS Memphis General Rules of Conduct

- Liquor, firearms, cameras, narcotics, tape recorders, and other contraband items are not permitted on the premises.

- Any violation of local, state, or federal laws, or conduct which is outside the generally accepted moral standards of the community is prohibited.

- Violation of the Espionage Act, willfully hindering or limiting production or sabotage is not permitted.

- Willfully damaging or destroying property, or removing government records is forbidden.

- Misappropriation or unauthorized altering of any government records is forbidden.

- Securing government tools in a personal or contractors tool box is forbidden.

- Gambling in any form, selling tickets, articles, taking orders, soliciting subscriptions, taking up collections, etc. is forbidden.

- Doing personal work in government shop or office, using government property or material for unauthorized purposes, or using government telephones for unnecessary or unauthorized local or long distance telephone calls is forbidden.

- Compliance with posted signs and notices is required.

- Boisterousness and noisy or offensive work habits, abusive language, or any verbal, written, symbolic, or other communicative expression which tends to disrupt the work of others or morale is forbidden.

- Fighting or threatening bodily harm to another is forbidden.

- Defacing any government property is forbidden.

- Wearing shorts of any type and/or offensive logos, pictures, or phrases on clothing is forbidden. Shirts, shoes and pants or slacks or coverall-type garments will be worn at all times on government property.

- All persons operating motor vehicles will obey all NAS Memphis traffic regulations.

3.5.3 Personal Protective Equipment (PPE)

Field activities which disturb soils will be initiated in Level D protection. Level D protection consists of hard hat, appropriate chemical resistant gloves, eye protection, and chemical resistant, steel toed and shank boots. This level of protection was chosen because petroleum contamination present at this site presents a significant skin absorption hazard.

Air monitoring for volatile organic compounds will be performed continuously during all sampling activities. Instruments will be continuous reading and intrinsically safe. Additional PPE upgrades to Level C will be initiated if airborne concentrations warrant respiratory protection. Level C will be initiated if concentrations of any contaminant exceeding 50 percent of the OSHA Permissible Exposure Limit (PEL) are encountered. See Table 3-1 for the specific criteria for use and equipment for each level of protection.

Selection of Personal Protective Equipment

It is important that personal protective equipment be appropriate to protect against the potential or known hazards at each cleanup or investigation site. Protective equipment will be selected based on the types, concentrations, and routes of personal exposure that may be encountered. In situations where the types of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the personal protective equipment required, based on past experiences and sound safety practices.

The appropriate level of protection will be determined before the initial entry based on the best available information. Subsequent information, (e.g., sampling results and site observations), may require changes in the original level selected.

The levels of personal protection were determined by the USEPA and are to be used in selecting equipment for onsite activities. The levels are designated as Level A, B, C, and D. They correspond with the work areas in the exclusion zone and are consistent with the levels of protection described in Appendix E of OSHA 1910.120.

Table 3-1
Level of Protection and Criteria

Level of Protection	Criteria for Use	Equipment
Level B	• When work areas contain less than 19.5 percent oxygen	• Chemical resistant clothes, long sleeves, hooded, one or two pieces • Full-faced positive-pressure supplied air breathing apparatus or airline system with a 30 minute escape bottle • Hard hat • Inner gloves and chemical resistant gloves • Steel toe and shank boots • Optionally: coveralls and disposable outer boots
Level C	• When airborne particulates (dust) warrant respiratory protection • When work areas contain at least 19.5 percent oxygen • When concentrations of any contaminant exceed 50% of PEL	• Chemical resistant clothes, long sleeves, hood optional, one or two pieces • Full-faced piece, air purifying respirator equipped with cartridges suitable for the hazard • Hard hat • Inner gloves and chemical resistant gloves • Steel toe and shank boots • Coveralls and disposable outer boots
Level D	• When level B or C is not indicated • When airborne particulates do not warrant respiratory protection • When work areas contain at least 19.5 percent oxygen	• Inner gloves and chemical-resistant gloves needed to handle soil or water samples • Steel toe and shank boots • Hard hat (ANSI Z891-1969 standard) • Eye protection (ANSI Z87.1-1968) standard • Optionally: coveralls and disposable outer boots

Notes:

Level B protection will be selected when the highest level of respiratory protection is needed,but cutaneous exposure to the small unprotected areas of the body, (neck and back of head) is unlikely, or where concentrations are not known to be within acceptable standards. Additionally, the permissible limit for exposure to mixtures of all site gases will be checked using the requirements of 1910.1000(d)(2)(i) to ensure that PEL is not exceeded. If the value calculated using this method exceeds 1.0, Level B PPE is required.

Level C protection will be selected when the types and concentrations of inseparable material is know, or reasonably assumed to be no greater than the protection factors associated with air-purifying respirators, and exposure to the unprotected areas of the body is unlikely to cause harm.
Dust concentrations require Level C PPE, where the respirable fractions exceed the PEL of 5 mg/m3 or the total concentrations exceed the PEL of 15 mg/m3.

Level D protection will be chosen when measurements of atmospheric concentrations are at background levels and work functions preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemicals.

Chemical-Protective Clothing (CPC)

Chemical-protective clothing is available in a variety of materials that offer a range of protection against different chemicals. The most appropriate material depends on the chemicals present and the tasks to be accomplished. Ideally, the material resists permeation, degradation, and penetration. Permeation is the process by which a chemical dissolves in and/or moves through a protective clothing material on a molecular level. Degradation is the loss of or change in the fabric's chemical resistance or physical properties due to exposure to chemicals, use or ambient conditions (e.g. sunlight). Penetration is the movement of chemicals through zippers, stitched seams or imperfections (e.g. pinholes) in a protective clothing material.

Selection of chemical-protective clothing is a complex task and should be performed by personnel with training and experience. Under all conditions, clothing is selected by evaluating the performance characteristics of the clothing against the requirements and limitations of the site and task-specific conditions. If possible, representative garments should be inspected before purchase and their use and performance discussed with someone who has experience with the clothing under consideration. In all cases, the employer is responsible for ensuring that the personal protective clothing (and all PPE) necessary to protect employees from injury or illness that may result from exposure to hazards at the work site is adequate and of safe design and construction for the work to be performed (see OSHA Standard 29 CFR Part 1910.132 — 1910.137).

Permeation and Degradation

The selection of chemical-protective clothing depends greatly upon the type and physical state of the contaminants. This information is determined during site characterization. After the chemicals have been identified, available sources should be consulted to identify materials that are resistant to permeation and degradation by the known chemicals. One excellent reference, *Guidelines for the Selection of Chemical-Protective Clothing*, (ACGIH, 1985), provides a matrix of clothing material recommendations for approximately 300 chemicals based on an evaluation of permeation and degradation data from independent tests, vendor literature, and raw material

suppliers. Charts indicating the resistance of various clothing materials to permeation and degradation are also available from manufacturers and other sources. It is important to note, however, that no material protects against all chemicals and combinations of chemicals, and that no currently available material is an effective barrier to any prolonged chemical exposure.

In reviewing vendor literature, it is important to be aware that the data provided are of limited value. For example, the quality of vendor test methods is inconsistent. Vendors often rely on the raw material manufacturers for data rather than conducting their own tests, and the data may not be updated. In addition, vendor data cannot address the wide variety of uses and challenges to which CPC may be subjected. Most vendors strongly emphasize this point in the descriptive text that accompanies their data.

Another factor to bear in mind when selecting CPC is that the rate of permeation is a function of several factors, including clothing material type and thickness, manufacturing method, the concentrations of the hazardous substances, temperature, pressure, humidity, the solubility of the chemical in the clothing material, and the diffusion coefficient of the permeating chemical in the clothing material. Thus permeation rates and breakthrough time may vary depending on these conditions. Breakthrough time is the time from initial exposure until hazardous material is detectable on the inside of the CPC.

Most hazardous wastes are mixtures for which specific data are not available to help make a good CPC selection. Due to a lack of testing, only limited permeation data for multi-component liquids are currently available.

Mixtures of chemicals can be significantly more aggressive towards CPC materials than can any single component. Even small amounts of a rapidly permeating chemical may provide a pathway that accelerates the permeation of other chemicals. Formal research is being conducted on these effects. NIOSH is currently developing methods for evaluating CPC materials against mixtures

of chemicals and unknowns in the field. For hazardous waste site operations, CPC should be selected that offers the widest range of protection against the chemicals expected onsite. Vendors are now providing CPC material composed of two or even three different materials laminated together that provide the best features of each material.

Heat Transfer Characteristics

The heat transfer characteristics of CPC may be an important factor in selection. Since most chemical-protective clothing is virtually impermeable to moisture, evaporative cooling is limited. The thermal insulation value, called the *clo* value, of chemical-protective clothing is a measure of the capacity of CPC to dissipate heat loss through means other than evaporation. The larger the clo value, the greater the insulating properties of the garment and, consequently, the lower the heat transfer. Given other equivalent protective properties, clothing with the lowest clo value should be selected in hot environments or for high work rates. Unfortunately, clo values for clothing are rarely available at present.

General Measures

A primary goal of E/A&H is the prevention of all occupationally related injuries and illnesses. The following practices are presented as general precautionary measures for reducing the risks associated with hazardous waste and spill operations. Failure to adhere to the measures will result in disciplinary action.

Personal Protection

- Be familiar with and knowledgeable about standard operating safety procedures.

- Be familiar with, knowledgeable about, and adhere to instructions in site safety plan.

- Identify and arrange for emergency medical assistance. The location, telephone number and transportation capabilities of the nearest emergency medical facilities should be known. For particularly hazardous operations, onsite medical facility alerted.

- Consider fatigue, heat stress and other environmental factors influencing efficiency of personnel.

3.5.4 Procedures and Equipment for Extreme Weather Conditions

Field activities for this investigation are scheduled to last approximately 2 weeks. The seasonal climate can be expected to be warm. If an upgrade to Level C is required, heat stress may be of concern for the health and safety personnel. Adverse weather conditions are important considerations in planning and conducting site operations. Overheating can cause physical discomfort, loss of efficiency and personal injury.

Heat Stress

Heat stress can result when the protective clothing decreases natural body ventilation even when temperatures are moderate. Working under various levels of personal protection may require the wearing of low permeability disposable suits, gloves and boots. This clothing will prevent most natural body ventilation. Discomfort due to increased sweating and body temperature (heat stress) will be expected at the work site.

Heat stress is the metabolic and environmental heat to which an individual is exposed. The manifestations of heat strain are the adjustments made by an individual in response to the stress. The three most important categories of heat-induced illness are: heat exhaustion, heat cramps, and heat stroke. These disorders can occur when the normal responses to increased sweat production are not adequate to meet the needs for body heat loss or when the temperature regulating mechanisms fail to function properly.

Heat exhaustion is a state of collapse brought about by an insufficient blood supply to the cerebral cortex portion of the brain. The crucial event is low blood pressure caused by inadequate heart output and widespread expansion of blood vessels.

Heat Exhaustion Factors — Factors which can lead to heat exhaustion are as follows:

- Increased expansion of blood vessels which causes a decreased capacity of circulation to meet the demands for heat loss to the environment, exercise, and digestive activities.

- Decreased blood volume due to dehydration.

- Reduced blood volume due to lack of physical training, infection, intoxication (from industrial contaminants as well as from drinking alcohol), or heart failure.

Heat Exhaustion Symptoms — The symptoms include extreme weakness or fatigue, dizziness, nausea, or headache. More severe cases may also involve vomiting and possible unconsciousness. The skin becomes clammy and moist, the complexion pale, and the oral temperature stays normal or low but the rectal temperature is usually elevated (99.5°F - 101.3°F). Workers who are unacclimated run the highest risk.

Heat Exhaustion Treatment — In most cases, treatment of heat exhaustion is fairly simple. The victim will be moved to a cool place. If the victim is unconscious, medical assistance must be sought. Mild cases may experience immediate recovery; however, more severe cases may require several days care. No permanent effects have ever been reported.

Heat cramps result when the working muscles go into painful spasms. This may occur in those who perspire profusely in heat and who drink large quantities of water, but who fail to replace their bodies' salt flow. It is the low salt content in the blood that causes the cramping. The abdominal muscles as well as the muscles in the arms and legs may be affected. The cramps

may appear during or even after work hours. Persons on a "low sodium" diet should not be given salt. A physician must be consulted on the care of people with this condition.

Heat stroke is the most serious of the health problems that arise while working in hot environments. It is caused by the breakdown of the thermo-regulatory system under stress. When this happens, perspiration stops and the body can no longer regulate its own temperature.

Heat Stroke Symptoms — A heat stroke victim may be identified by hot, dry, and usually red or spotted skin. The body core temperature can exceed 105°F. Mental confusion, irritability and chills are common. These are all early warning signs of heat stroke; if the sufferer is not removed from the hot environment at once, more severe symptoms can follow, including unconsciousness, delirium, and convulsions, possibly ending in death.

Heat Stroke Treatment — Heat stroke victims must be treated as a major medical emergency; medical assistance must be summoned immediately.
Additional treatment:

- First aid must be administered.
- Individual must be moved to a cool location.
- Individual must be cooled through wetting, fanning, or immersion.

Care should be taken to avoid over-cooling and treatment for shock by raising the legs. Early recognition and treatment of heat stroke are the only means of preventing permanent brain damage or death.

To reduce the potential for heat strokes:

- Drink plenty of fluids (to replace loss through sweating).
- Wear cotton undergarments to act as a wick to absorb moisture.
- Make adequate shelter available for taking rest breaks to cool off.

Additional Measures

In extremely warm weather, the Site Health and Safety Officer may also require these additional measures:

- Wear cooling devices to aid in ventilation. (NOTE: the additional weight may affect efficiency.)
- Install portable showers or hose down facilities to cool clothing and body.
- Shift working hours to early morning and early evening. Avoid the hottest time of the day.
- Frequently rotate crews wearing the protective clothing (if required).

3.5.5 Work Limitations

All site activities will be conducted during daylight hours only. All personnel scheduled for these activities will have completed initial health and safety training and actual field training as specified in 29 CFR 1910.120(e). All supervisors must complete an additional eight hours of training in site management. All personnel must complete an eight-hour refresher training course on an annual basis in order to continue working at the site.

3.5.6 Exposure Evaluation

All personnel scheduled for site activities have had a baseline physical examination which includes a stressing exam of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems, pulmonary function testing, multi-chemistry panel and urinalysis and have been declared fit for duty. An exposure history form will be completed for each worker participating in site activities. An examination and updated occupational history will be repeated on an annual basis and upon termination of employment as required by 29 CFR 1910.120(f). The content of the annual or termination examination will be the same as the baseline physical. A qualified physician will review the results of the annual examination and exposure data and request further tests or issue medical clearances as appropriate.

After any job-related injury or illness, there will be a medical examination to determine fitness for duty or any job restrictions. The site health and safety manager will review the results with the examining physician before releasing the employee for work. A similar examination will be performed if an employee has missed at least three days of work due to a non-job related injury or illness requiring medical attention. Medical records shall be maintained by the employer or the physician for at least 30 years following the termination of employment.

3.6 Monitoring Requirements

Air monitoring will be accomplished using an LEL (lower explosive limit detector) and an HNU (or similar) photoionization detector during all borings and ground water well installations. The PID will be calibrated to measure volatile organic compounds relative to benzene using an isobutylene standard gas. Background (ambient) PID readings in the breathing zone will be collected before commencement of each day's field activities begin. LEL readings will be collected at the mouth of the borehole during all drilling and sampling activities. Air monitoring data will be recorded in the field log book. If volatile organic compounds concentrations (in the breathing zone) exceed background (ambient) readings by *five ppm or more* or percent LEL readings reach 20 percent *(or 19.6 percent oxygen)*, field activities will immediately cease. Upon cessation of site activities, the Field Project Manager must contact the Health and Safety Officer. The Health and Safety Officer will be responsible for reassessing the hazards and prescribing revised health and safety requirements as necessary including upgraded personal protective equipment requirements, revised work schedules, and revised decontamination procedures.

Field technicians will be made aware that they must report any unusual odors or soil discolorations. Each instrument shall be calibrated daily before site activities begin and at the end of each day's work. At the end of each work day and before calibration, each instrument shall be checked to ensure that it is free from surface contamination.

Medical Monitoring Program

All Joint Venture (E/A&H) personnel who enter hazardous waste/spill sites or have the potential for exposure to hazardous materials from these sites must participate in the E/A&H Medical Monitoring Program. The program is conducted by the E/A&H's company doctor with the company Health and Safety Officer. The purpose of the program is to identify any pre-existing illnesses or problems that would put an employee at unusual risk from certain exposures or respirators, and to monitor and evaluate exposure-related events where workers are involved in the handling of hazardous materials. Project managers should consult with the Health and Safety Officer and/or the company doctor concerning the scope of work and known or anticipated chemical hazards associated with each project.

E/A&H maintains the right to exclude certain individuals from particular jobs based on reports from the company doctor. The program will be reviewed on an annual basis to determine its effectiveness.

The company doctor has been employed as an independent contractor to provide medical monitoring for E/A&H. The doctor is responsible for the following aspects of the medical monitoring program:

- Selection and quality assurance of medical and laboratory services involved in carrying out the monitoring program.
- Development of a uniform medical record.
- Record retention.
- Employee notification of examination results.
- Determination of content of the medical and biological monitoring programs.
- Record review and correlation between potential exposure and effect.
- Monitoring job related illness and injury for each employee.

Preplacement Examinations

Each employee will be given a preplacement examination to identify any preexisting illness or problem that would put the employee at an unusual risk from certain exposures; to assure that each employee can safely use negative pressure respirators; and to develop a data base to assess any exposure related events detected during periodic medical monitoring. Data accumulation will include variables such as age, sex, race, smoking, prior employment history, and other conditions that might bear upon the occurrence of subsequent events once employment begins.

The preplacement examination includes:

- Occupational history including previous chemical and carcinogenic exposures.
- Medical history including demographic data, family history, personal habits, past medical history and a current symptomatic review of systems.
- Fertility history.
- Physical examination, stressing examination of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems.
- Physiological parameters including blood pressure and visual acuity testing.
- Pulmonary function testing including FVC, FEVI and FEV 25-75.
- Electrocardiogram.
- PA and lateral chest X-ray.
- A multi-chemistry panel including tests of kidney and liver function.
- Red blood cell cholinesterase.
- Audiogram.

The history, physiological parameters, X-ray, screening tests and laboratory studies will be done before the physical examination. After the physical examination, the medical examiner will review the results of the examination and special studies with each employee and facilitate referral for further evaluation of abnormalities detected during this examination. The Health and Safety Officer will provide each employee with a written summary and detailed results of the

examination along with treatment of any job restrictions. Additional medical testing procedures (e.g. ophthalmology/optometric assessment, specialized audiometric testing, etc.) may be required at the discretion of E/A&H's attending physician.

Periodic and Exit Examinations

An examination and updated occupational history will be repeated annually and include:

- Updated occupational and medical history
- Physical examination, stressing examination of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems
- Pulmonary function testing including FVC, FEVI and FEV 25-75
- Multi-chemistry panel including tests of kidney and liver function
- Urinalysis

The company doctor will review the results of annual examination and exposure data, and request further tests or issue medical clearances as appropriate.

An examination will also be administered when an employee leaves the company. The company doctor will be consulted for the contents of the exam, except when the employee has had an exam within 6 months or when there has been no site work since the last examination.

Return-to-Work Examinations

After any job-related injury or illness, a medical examination is required to determine fitness for duty or to identify any job restrictions. The medical examiner will review the results of this back-to-work examination with Company doctor before to releasing the employee for work. A similar examination will be performed if an employee has missed at least 3 days of work due to a non-job-related injury requiring medical attention.

Confidentiality

Medical records will be maintained in a confidential manner so that only authorized persons will have access to the records. The authorized personnel will include medical staff of the joint venture or contract medical personnel, the individual, the individual's personal physician or the individual's designated representative. Upon request, the individual may obtain a copy of the medical file, which will be provided within 15 days of the receipt of the written request. Information used for research, testing, statistical, or epidemiologic purposes will have all identifying data removed, including the identity of the individual. Any medical information or findings obtained which do not affect the individual's job performance will not be made available to E/A&H to maintain the patient-physician confidentiality. Upon death, retirement, resignation, or other termination of services, the records will be retained by E/A&H or contracting physician.

3.7 Decontamination

A decontamination zone will be established and will include one area for sampling equipment and one area for personnel decontamination (if necessary).

3.7.1 Personnel Decontamination

The decontamination procedures, based on Level D protection, will consist of:

- Brushing heavily soiled boots and rinsing outer gloves and boots with soap and water.
- Removing outer gloves and depositing them in a plastic lined container.
- Hard hats and eye protection should also be washed thoroughly at the end of each work day with a soap and water solution.
- All field personnel are to be instructed to shower as soon as possible after leaving the site.

Decontamination procedures will be conducted at the lunch break and at the end of each work day.

If higher levels of personal protection equipment are needed, adjustments will be made to these procedures and an amendment will be made to this health and safety plan.

3.7.2 Closure of the Personnel Decontamination Station

Used decontamination and rinse solutions (soap and water solutions) from sampling tool decontamination will be containerized in drums with purge and development water for future chemical analysis. Reusable clothing will be dried and prepared for future use. All washtubs, pails, buckets, etc. will be washed, rinsed and dried at the end of each workday.

All contaminated soils produced during decontamination activities will be containerized in drums along with drill cuttings and other soil waste produced during site activities. These soils will be subsequently disposed of in accordance with TDEC guidelines for UST-contaminated soil disposal (if applicable).

3.8 Authorized Personnel

Personnel anticipated to be onsite at various times during site activities include:

- EnSafe/Allen & Hoshall Task Order Manager — Mr. Lawson Anderson
- EnSafe/Allen & Hoshall Field Project Manager — To Be Determined
- EnSafe/Allen & Hoshall Field Geologist — To Be Determined
- EnSafe/Allen & Hoshall Site Health & Safety Officer — Mr. Rick Barlow
- EnSafe/Allen & Hoshall Representatives — To Be Determined
- SOUTHDIV, Engineer-in-Charge — Mr. John Karlyk
- NAS Memphis, Site Contact — Mike Kempf
- Drilling Subcontractor — To Be Determined

3.8.1 Responsibilities of EnSafe/Allen & Hoshall Field Project Manager

The Project Manager will direct the site investigation and operation. The Project Manager has the primary responsibility for assuring that all personnel are aware of:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on the site
- Use of personal protection equipment and assuring that the equipment is available
- Work practices by which the employee can minimize risks from hazards
- Safe use of engineering controls and equipment on the site
- Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards
- Site control measures, decontamination procedures, site standard operating procedures and the contingency plan and responses to emergencies including the necessary PPE.

The Project Manager is also responsible for assuring that all employees have received at least 40 hours of health and safety instruction, off the site, and actual field experience under the direct supervision of a trained experienced supervisor. Workers who may be exposed to unique or special hazards shall be provided additional training.

The Project Manager also monitors the performance of personnel to ensure that mandatory health and safety procedures are being performed and corrects any performances that do not comply with the Health and Safety Plan. (Copies of health and safety training certificates must be available for review by the E/A&H Project Manager and Site Safety Officer.)

Additional responsibilities extend to ensuring that all field personnel employed on the site are covered by a medical surveillance program as required by 29 CFR 1910.120(f):

- Consulting with the Health and Safety Officer and/or other personnel

- Preparation and submittal of any and all project reports— includes progress, accident, incident, contractual, etc.

- Monitoring personnel decontamination to ensure that all personnel are complying with the established decontamination procedures.

3.8.2 Responsibilities of EnSafe/Allen & Hoshall Site Health and Safety Officer

The E/A&H Health and Safety Officer has the primary responsibility for:

- Assuring that a copy of the Health and Safety Plan is maintained onsite during all field activities.

- Advising the Field Project Manager on all health and safety related matters involved at the site.

- Directing and ensuring that the safety program is being correctly followed in the field, including the proper use of personal protective and site monitoring equipment.

- Ensuring that the field personnel observe the appropriate work zones and decontamination procedures.

- Reporting any safety violations to the Project Manager.

- Conducting safety briefings during field activities.

The Site Health and Safety Officer will be a person trained in safety and industrial hygiene. After the project begins and the Site Health and Safety Officer has had time to evaluate actual hazardous site conditions, he/she may determine that a member of the project team may assume the duties of the Site Health and Safety Officer.

The person responsible for daily health and safety will be trained to use the air monitoring equipment, interpret the data collected with the instruments, and be familiar with symptoms of

heat stress and cold exposure and the location and use of safety equipment onsite. He will also be familiar with this health and safety plan.

The following criteria outline when the Site Health and Safety Officer will be replaced: (1) termination of employment, (2) sickness, (3) end of shift, (4) injury, or (5) death. It should be noted that under site work schedules only one shift will be working. As a result, the Site Health and Safety Officer will be responsible for the day shift. If circumstances arise that require work during other periods, an alternate Site Health and Safety Officer will be designated.

3.8.3 Responsibilities of Onsite Field Personnel

All onsite field personnel will be responsible for the following:

- All personnel going onsite must be thoroughly briefed on anticipated hazards and trained on equipment to be worn, safety procedures to be followed, emergency procedures and communications.

- Required respiratory protective devices and clothing must be worn by all personnel going into areas designated for wearing protective equipment.

- Personnel must be fit-tested before using respirators.

- No facial hair which intrudes on the sealing surface of the respirator is allowed on personnel.

- Personnel on site must use the buddy system when wearing respiratory protective equipment. As a minimum, a third person, suitably equipped as a safety backup, is required during initial entries.

- Visual contact must be maintained between pairs onsite and site safety personnel. Field personnel should remain close together to assist each other during emergencies.

- All field personnel should make use of their senses to alert themselves to potentially dangerous situations which they should avoid, e.g., presence of strong and irritating or nauseating odors.

- Personnel should practice unfamiliar operations prior to doing the actual procedure in the field.

- Field personnel shall be familiar with the physical characteristics of the site, including:
  - wind direction in relation to contamination zones
  - accessibility to associates, equipment and vehicles
  - communications
  - operation zones
  - site access
  - nearest water sources

- The number of personnel and equipment in the contaminated area must be kept to a minimum, consistent with effective site operations.

- Procedures for leaving a contaminated area must be planned and implemented before going onsite in accordance with the Site Health and Safety Plan.

- All visitors to the job site must comply with the Health and Safety Plan procedures. Personal protection equipment may be modified for visitors depending on the situation. Modifications must be approved by the Site Health and Safety Officer.

3.9 Emergency Information

All hazardous waste site activities present a potential risk to onsite personnel. During routine operations, risk is minimized by establishing good work practices, staying alert and using proper personal protective equipment. Unpredictable events such as physical injury, chemical exposure or fire may occur and must be anticipated.

If any situation or unplanned occurrence requires outside or support service, Mike Kempf, NAS Memphis site contact, will be informed and the appropriate contact from the following list will be made:

Contact	Agency or Organization	Telephone
Mike Kempf	NAS Memphis	(901) 873-5462
John Karlyk	SOUTHDIV EIC	(803) 743-0624
Law Enforcement	NAS Memphis Security	911
Fire Department	NAS Memphis Security	911
Hospital Emergency	Naval Hospital	(901) 873-5801
	Methodist North	(901) 372-5211
Poison Center	Southern Poison Control Center	(901) 528-6048
	CHEMTREC	(800) 424-9300
Lawson Anderson	EnSafe/Allen & Hoshall	(901) 372-7962

John Karlyk, SOUTHDIV Engineer-in-Charge will be contacted after appropriate emergency measures have been initiated onsite.

Site Resources

Telephones for emergency use are located in Building S-50 adjacent to the work area. First aid equipment, restroom facilities and water supplies at the work sites will be pre-arranged with NAS Memphis personnel prior to the commencement of field activities.

3.10 Emergency Procedures

An emergency can be defined as:

- Any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while on site; or

- A condition is discovered that suggests the existence of a situation more hazardous than anticipated.

The following procedures should be followed in anticipation of any emergency:

- Site work area entrance and exit routes will be planned and emergency escape routes delineated by the Site Safety Officer.

- If any member of the field team experiences any effects or symptoms of exposure while on the scene, the entire field crew will immediately halt work and act according to the instructions provided by the Site Safety Officer.

- For applicable site activities, wind indicators visible to all onsite personnel will be provided by the Site Safety Officer to indicate possible routes for upwind escape.

- The discovery of any conditions that would suggest the existence of a situation more hazardous than anticipated will result in the suspension of work until the Safety Officer has evaluated the situation and provided the appropriate instructions to the field team.

- If an accident occurs, the Project Manager is to complete an accident report form for submittal to the managing principal-in-charge of the project.

- If a member of the field crew suffers a personal injury, the Site Health and Safety Officer will call 911 (serious injury) to alert appropriate emergency response agencies or

administer on-site first aid (minor injury) as the situation dictates. An Accident Report Form will be completed for any such incident.

- If a member of the field crew suffers a chemical exposure, the affected areas should be flushed immediately with copious amounts of clean water, and if the situation dictates, the Site Health and Safety Officer should alert appropriate emergency response agencies, or personally ensure that the exposed individual is transported to the nearest medical treatment facility for prompt treatment. An Accident Report Form will be completed for any such incident.

Additional information on appropriate chemical exposure treatment methods is provided in MSDSs in Appendix D. Directions to the nearest emergency medical facility capable of providing general emergency medical assistance and treating chemical burns are provided in Appendix F.

3.11 Forms

The following forms will be used in implementing this Health and Safety Plan:

Plan Acceptance Form
Plan Feedback Form
Exposure History Form

The Plan Acceptance Form will be filled out by all employees working on the site prior to commencement of site activities. The Plan Feedback Form will be filled out by the Site Safety Officer and any other onsite employee who wishes to fill one out. The Exposure History Form will be completed by both the Field Project Manager and the individual(s) for whom the form is intended. Examples of each form are provided in Appendix G.

All completed forms must be returned to the Task Order Manager at EnSafe/Allen & Hoshall, Memphis, Tennessee.

APPENDIX A

ANALYTICAL METHODS

Sample Container, Preservatives, & Holding Times

Analytical Method	Sample Matrix	Sample Container	Preservative	Holding Time
DRO-TPH Modified EPA Method 8015/TN DRO	Water	1 Liter glass	pH<2; 1:1 HCl; Chill: 4°C	7 Days to Extraction
	Soil	125 ml glass	Chill: 4°C	7 Days to Extraction
Total Iron EPA 6010	Water	1 liter HDPE	pH<2; 1:1 HCl; Chill: 4°C	6 months
Total Manganese EPA 6010	Water	1 liter HDPE	pH<2; HNO_3; Chill: 4°C	6 months
Turbidity EPA 180.1	Water	500 ml HDPE	Chill: 4°C	48 hrs.
TOC EPA 9060	Soil	125 ml glass	Chill: 4°C	28 days
Microbial Plate Count EPA 9215 (Standard Method)	Water	4 oz.glass (sterile)	Chill: 4°C	14 days
	Soil	125 ml glass (sterile)	Chill: 4°C	14 days
Nitrate-Nitrite EPA 353.1	Water*	500 ml HDPE	pH<2; H_2SO_4; Chill: 4°C	28 days
	Soil	250 ml glass	Chill: 4°C	28 days
Phosphorus EPA 365.3	Water*	500 ml HDPE	pH<2; 50% H_2SO_4; Chill: 4°C	28 days
	Soil	250 ml glass	Chill: 4°C	28 days
Total Suspended Solids EPA 160.2	Water	500 ml HDPE	Chill: 4°C	7 days
Alkalinity EPA 310.1	Water	500 ml HDPE	Chill: 4°C	14 days
TCLP Lead	Water	500 ml HDPE	Chill: 4°C	14 days
	Soil	125 ml glass	Chill: 4°C	14 days
TCLP TPH	Water	1 Liter glass - DRO	Chill: 4°C	14 days
	Soil	125 ml glass	Chill: 4°C	14 days
TCLP Benzene	Water	40 ml VOA	Chill: 4°C	14 days
	Soil	60 ml VOA	Chill: 4°C	14 days

* - Analyses for these two parameters can be run from the same container.

APPENDIX B

DATA VALIDATION AND CLASSIFICATION CHECKLISTS

FIELD DATA VALIDATION CHECKLIST

Project Name: _____
Project Number: _____
Sample Identification: _____
Sampling Team: _____
Analyzing Laboratory: _____
Analyses Performed: _____
Sample Matrix: _____
QA Reporting Level: _____

REPORTING REQUIREMENTS

FIELD DATA PACKAGE DOCUMENTATION	YES	NO	NOT REQUIRED
1. Field (water and soil sample logs completed properly and signed			
2. Sampling dates noted			
3. Sampling team indicated			
4. Sample identification traceable to location collected			
5. Sample location provided			
6. Sample depth for soils indicated			
7. Collection technique (bailer, pump etc.)			
8. Field preparation techniques and sample type indicated (grab, composite)			
9. Sample container type described			
10. Sample container type proper for analysis			
11. Preservation methods indicated			
12. Chain-of-custody form completed			
13. Proper analytical methods requested			
14. Proper number and type of field QC samples were collected (blanks, replicates, splits, etc.)			
15. Field equipment was properly calibrated before use and results documented.			

COMMENTS: _____
_____

FIELD DOCUMENTATION IS COMPLETE: _____
QA Officer

ANALYTICAL DATA VALIDATION CHECKLIST

Project Name: _____
Project Number: _____
Sample Identification: _____
Sampling Team: _____
Analyzing Laboratory: _____
Analyses Performed: _____
Sample Matrix: _____
QA Reporting Level: _____

REPORTING REQUIREMENTS
ANALYTICAL DATA PACKAGE DOCUMENTATION
LEVEL A (QUALITATIVE)

Section I: General Information	YES	NO	NOT REQUIRED
1. Sample results complete			
2. Proper parameters analyzed			
3. Method of analysis reported			
4. Detection limits of analysis reported			
5. Master tracking list provided			
6. Sample collection date provided			
7. Sample received date provided			
8. Sample preparation/extraction date provided			
9. Sample analysis date provided			
10. Copy of Chain-of-Custody form signed by the lab sample custodian			
11. A narrative summary of QA or sample problems is provided			

COMMENTS: _____
_____
_____
_____
_____

Section II: Inorganic Analyses	YES	NO	NOT REQUIRED
1. Results of ICVS and CCVS, %R, expected values			
2. Results of Digested LCS (may be called QC Check sample), %R and expected value			
3. Results of undigested QC Check sample, %R, Source (Lot No. and manufacturer)			
4. Results of method blanks			
5. Results of interference check sample (ICS) and expected value (ICP only)			
6. Results of a dilution check sample and expected value (ICP only)			
7. Results of laboratory duplicate analysis and %RSD or RPD and control			
8. Results of Matrix spike (digested spike) analysis, amount spiked, %R and control limits			
9. Results of analytical (post-digested) spike analysis, amount spiked, %R, and control limits (furnace AAS only)			

COMMENTS: _____

Documentation

Section III: Organic Analyses	YES	NO	NOT REQUIRED
A. GAS CHROMATOGRAPHY (NO MASS SPEC)			
1. Results of water blanks (VOA), Extraction blanks, and/or trip blanks			
2. Results of latest independent QC check samples, expected value %R and source (Lot No. and manufacturer			
3. Results of analysis of reagent water spike, expected value %R, control limits			
4. Results of reagent water spike duplicate, expected value, %R, RPD and control limits			
5. Results of matrix spikes, amount spiked, %R and control limit			
6. Results of matrix spike duplicates, amount spiked, %R, RPD or $RSD and control limit			
7. Results of laboratory duplicates (if performed), RPD or %RSD and control limit			
8. Results of surrogate spikes, %R, control limits			

COMMENTS: _____

Documentation

B.	GAS CHROMATOGRAPHY/MASS SPECTROMETER	YES	NO	NOT REQUIRED
1.	Verification statement acknowledging tuning with BFB or DFTPP that indicates compliance with acceptance criteria			
2.	Results of continuing calibration standards (SPCC and CCC), expected value			
3.	Results of water blanks, extraction (method) blanks, and trip blanks.			
4.	Results of analysis of reagent water spike, expected value, %R, control limits			
5.	Results of reagent water spike duplicate, expected value, %R, RPD, and control limits			
6.	Results of matrix spikes analysis, amount spiked, %R, and control limits			
7.	Results of matrix spike duplicate analysis amount spiked, %R, RPD or %RSD and control limits			
8.	Results of surrogate spike analysis, %R, control limits			
9.	Results of latest Independent QC check samples (EPA or NBS traceable) analyzed expected value, and source (Lot No. and manufacturer)			
10.	Results of blank spike analysis for matrix spike or matrix spike duplicate parameters not meeting recovery requirements			

COMMENTS: _____

_____

QUANTITATIVE STATISTICAL SIGNIFICANCE
LEVEL B (QUANTITATIVE)

DATA EVALUATION	PASS	FAIL	NOT APP
1. Samples were properly collected			
2. Samples were properly preserved			
3. Field measurements of pH and specific conductance are consistent with historical data			
4. Samples were analyzed by the proper methods			
5. Sample extracted within holding time			
6. Sample analyzed within holding time			
7. Required detection limits were employed by the laboratory			
8. Results of Sampler rinsate blanks were contaminant free or less than five times the detection limit			
9. Sampler rinsate blanks were not contaminant free and field blanks were analyzed properly			
10. Field blanks were contaminant free			
11. Field blanks were not contaminant free and trip blanks were properly analyzed			
12. Trip blanks were contaminant free			
13. Trip blanks were not contaminant free			
14. Laboratory blanks (method blanks, extraction blanks, water blanks) are contaminant free			
15. Blanks summary (conclusions reached): _____			

QUANTITATIVE STATISTICAL SIGNIFICANCE (Continued)
LEVEL B (QUANTITATIVE)

DATA EVALUATION	PASS	FAIL	NOT APP
16. RPD of field replicates is less than 25% for water matrices and less than 40% for soil matrices or the difference can be explained			

COMMENTS: _____

INORGANIC ANALYSES	PASS	FAIL	NA
1. ICVS and CCVD %R within control limits			
2. LCS %R within control limits			
3. QC Check Sample %R within control limits and source given			
4. Laboratory blanks acceptable			
5. Interference Check sample within control limits (ICP only)			
6. Dilution Check sample within control limits (ICP only)			
7. RPD for laboratory duplicate within allowable limits			
8. Matrix spike %R within control limits			
9. Analytical post digested spike within control limits (furnace AAS only)			

COMMENTS: _____

_____

_____

_____

_____

ORGANIC ANALYSES	PASS	FAIL	NA
1. Laboratory blanks are acceptable			
2. QC check samples %R were within control limits and source given			
3. GC/MS properly tuned with BFB or DFTPP			
4. GC/MS continuing calibration (SPCC and CCC) standards within acceptable control limits			
5. Matrix spikes or reagent water spikes %R within control limits			
6. Matrix spike duplicates %R within control limits			
7. RPD of matrix spike duplicate or reagent water spike duplicate was within control limits			
8. Surrogate spikes within control limits			
9. Laboratory duplicates have acceptable RPD			

COMMENTS: _____

DATA VALIDATION QUALIFIER CODES
FOR ORGANIC ANALYSES

The analytical data validation
level is (check one):

EXPLANATION: _____

_____

_____

_____

_____

_____

FINAL CONCLUSION: _____

VALIDATION PERFORMED BY: _____

REPORTING QUALIFIERS:

U code: Indicates that compound was analyzed for but not detected. Report the minimum detection limit for the sample with the U (e.g., I0U) based on necessary concentration/dilution actions. (This is not necessarily the instrument detection limit.) The footnote should read: U-Compound was analyzed for but not detected. The number is the minimum attainable detection limit for the sample.

J code: Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed or when the mass spectral data indicates the presence of a compound the meets the identification criteria but the result is less than the specified detection limit but greater than zero (e.g., 10J)>

C code: This flag applies to pesticide parameters where the identification has been confirmed by GC/MS. Single component pesticides > 19 bg.yk in the final extract should be confirmed by GC/MS.

B code: This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probably blank contamination and warns the data user to take appropriate action.

E code: Indicates a value estimated or not reported due to the presence of interference. Explanatory note included on cover page.

R code: Indicates spike sample recovery is not within control limits.

s code: Indicates value determined by Method of Standard Addition.

REPORTING QUALIFIERS: (Continued)

* code: Indicated duplicate analysis is not within control limits.

+ code: Indicates the correlation coefficient for method of standard addition is less than 0.995.

Other: Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the data summary report.

DATA CLASSIFICATION SUMMARY CHECKLIST
Class A Criteria
Matrix: Ground Water

To be classified for Class A use, the data must meet the following criteria:

Criteria	Evaluation Result
1. Sampling dates were recorded;	
2. Signatures of Sampling Team on each water sample log or soil sample log;	
3. Sampling locations were clearly designated and described;	
4. Sampling depth increment for soils was recorded;	
5. Sample collection technique was described on water sample log or soil sample log;	
6. Field preparation techniques were clearly described where applicable;	
7. Sample preservation techniques were clearly described, consistent, and adequate for the parameters to be analyzed and the sample matrix;	
8. Shipping bill of lading or constant surveillance documentation is available;	
9. The laboratory sample preparation or extraction date is recorded and available;	
10. The laboratory sample analysis date is recorded and available;	

Class A Criteria (continued)

Criteria	Evaluation Result
11. The laboratory sample preparation technique is recorded and available either in the laboratory report or in the laboratories approved SOP;	
12. The methods of analysis are listed in the laboratory reports and are consistent with the methods specified in the QAPP and laboratory contract;	
13. The laboratory analytical detection limits or limits of quantitation (LCQ) are given in lab reports and are adequate for project objectives;	
14. Field records include: • Soil/sediment log sheets • Water sampling log sheets • QC field checklist • Field instrument calibration logs • Master bound log book with sequentially numbered pages • Daily log book • Chain-of-custody forms	
15. All applicable records described above were properly created and are on file;	
16. Samples passed laboratory data validation without any R flags (samples with J flags may be accepted at this level).	

Remarks:

Conclusion:

DATA CLASSIFICATION SUMMARY CHECKLIST
Class B Criteria
Matrix: Ground Water

To be classified for Class B use, the data must meet the following criteria:

Criteria	Evaluation Result
A. Data Validation Result	
1. Samples of this matrix have not been flagged J or R during data validation;	
2. All samples of this matrix have been classified as Level A data;	
B. Quantitative Statistical Significance	
1. Laboratory and field instruments were properly standardized (calibrated) employing proper methods and records are available;	
2. Sample bottle preparation was proper and appropriate for the parameters measured and the sample matrix;	
3. All laboratory procedures were referenced to approved EPA methods and were contained in an approved SOP manual;	
4. Analytical QC data was available to demonstrate proper instrument calibration;	
5. Laboratory QC check sample standards are EPA and NBS traceable and were used at least once each three months;	
6. Laboratory reagent (method) blanks were analyzed at frequency of at least 1 per 20 samples;	
7. Laboratory duplicates were analyzed at a frequency of at least 1 per 20 samples;	

Class B Criteria (continued)

Criteria	Evaluation Result
8. Laboratory matrix spikes and matrix spike duplicates were analyzed at a frequency of at least 1 per 20 samples;	
9. Field replicates if required were analyzed at a frequency of at least 1 per 10 samples;	
10. Field blanks were submitted at a frequency of at least 1 per 20 samples;	
11. One trip blank was submitted for VOCs analysis with each cooler;	
12. Field split samples if required were analyzed at a frequency of at least 1 per 20 samples per matrix;	
13. Appropriate and sufficient QC data with acceptance criteria were presented to allow data validation by the project QA officer;	
14. If required for the project, the laboratories used were approved by the EPA for participation in the Contract Laboratory Program (CLP);	
15. The laboratories participated in round-robin testing program by WPA or other accrediting agency;	
16. Quality control limits were consistent with or exceed the limits established by the EPA for all methods of analysis or the EPA CLP;	
17. All samples submitted were analyzed for the requested parameters.	

Class B Criteria (continued)

Criteria	Evaluation Result
C. Custody and Document Control	
1. Field custody of all samples was noted in a bound field log book;	
2. Transfer of custody documentation (chain-of-custody form) signed by field and laboratory sample custodians is available and properly completed;	
3. Laboratory custody is documented by a designated lab sample custodian in a master log and a secured sample storage area;	
4. Sample identification and assigned laboratory tracking numbers are traceable through the entire monitoring system;	
5. Field notebooks, log sheets, log books, checklists, reports, data validations, and custody documents are stored in a secure repository or under the control of a document custodian;	
6. All records, forms log books, etc., are filled out completely in indelible ink without alterations except as initialed;	
7. All sample log sheets have been signed by the sample collector;	
8. Field log book sheets signed by the field sample custodian.	
D. Sample Representativeness	
1. Compatibility exists between field and laboratory measurements or incompatibilities have been suitably explained;	

Class B Criteria (continued)

Criteria	Evaluation Result
2. Laboratory analysis and/or sample preparation or extraction were within allowable holding times established for the sample preservation and methods used;	
3. Sample storage was maintained within suitable temperature, light and moisture conditions to guarantee sample integrity;	
4. Proper sample containers were used for the parameters analyzed;	
5. Proper sample collection equipment was used such that the equipment would neither contribute nor remove any substance to or from the sample;	
6. The sample site selection criteria are consistent with the objectives of the investigation and will provide the required data.	

Remarks:

Conclusion:

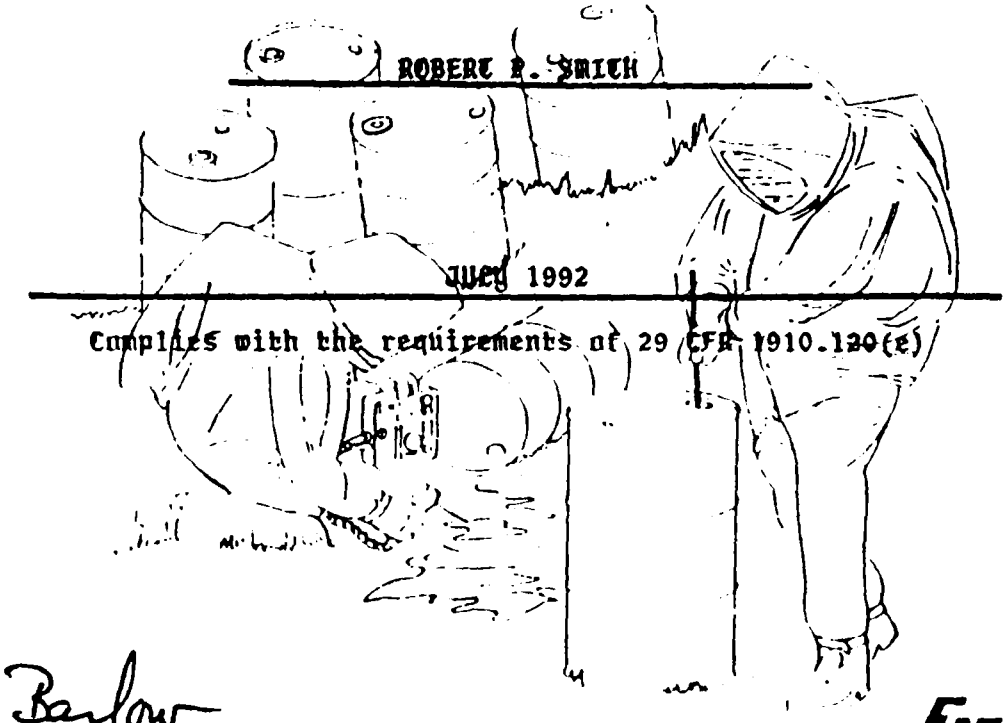
APPENDIX C

HEALTH AND SAFETY CERTIFICATES

CERTIFICATE OF ATTENDANCE

HAZARDOUS WASTE FIELD INVESTIGATION HEALTH AND SAFETY TRAINING

8 HOUR REFRESHER TRAINING



ROBERT P. SMITH

JULY 1992

Complies with the requirements of 29 CFR 1910.120(e)

Richard Barlow

Instructor - Richard Barlow

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ENVIRONMENTAL TRAINING DIVISION

presents this

CERTIFICATE OF COMPLETION

to

LAWSON M. ANDERSON

for 8 *hours of successful participation in*

HAZARDOUS WASTE SITE OPERATIONS REFRESHER

this 25th *day of* SEPTEMBER 19 92

this course is part of a series in

HAZARDOUS WASTE MANAGEMENT TRAINING

Ralph E. Kaiser
Course Instructor

K Orr 20
Director of Training

GSS SAFETY SERVICES OF TENNESSEE, INC.

ENVIRONMENTAL TRAINING DIVISION

presents this

CERTIFICATE OF COMPLETION

to

BARTON T. DOUGLAS

for 8 *hours of successful participation in*

HAZARDOUS WASTE SITE OPERATIONS REFRESHER

this 25th *day of* SEPTEMBER 19 92

this course is part of a series in

HAZERDOUS WASTE MANAGEMENT TRAINING

Ralph E. Kaune
Course Instructor

K.W. 20
Director of Training

APPENDIX D

MATERIAL SAFETY DATA SHEETS

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 421 LAST UPDATE OF THIS RECORD: 12/03/92

NAME: XYLENE

SYNONYMS: XYLENE (XYLOL); XYLOL; METHYL TOLUENE; BENZENE, DIMETHYL-; DIMETHYLBENZENE; NCI-C55232; VIOLET 3; XYLOL (DOT); SOCAL AQUATIC SOLVENT 3501

CAS: 1330-20-7 RTECS: ZE2100000

FORMULA: C8H10 MOL WT: 106.18

WLN: 1R X1

CHEMICAL CLASS:Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless liquid with aromatic odor

BOILING POINT:	412 K	138.8 C	281.9 F
MELTING POINT:	247 K	-26.2 C	-15.1 F
FLASH POINT:	300.35-305.35	27.2-32.2 C	80.9-89.9 F

AUTO IGNITION: NA

VAPOR PRESSURE: 6.7 mm @ 21 C

'JEL: 7 %

EL: 1 %

IIZATION POTENTIAL (eV): 8.56

..POR DENSITY: 3.7 (air=1)

EVAPORATION RATE: 0.77(n-BUTYL ACETATE=1)

SPECIFIC GRAVITY: 0.861 20C

DENSITY: 0.861 g/cc or 8.0073 lb/gal

WATER SOLUBILITY: VERY SL SOL

INCOMPATIBILITIES: strong oxidizers

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: No data

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): 0.05

ODOR DESCRIPTION: LIKE BENZENE; CHARACTERISTIC AROMATIC
Source:CHRIS

100 % ODOR DETECTION: 0.4-20 ppm

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID

DOT guide: 27

dent fication number: UN1307

T sh pping name: XYLENES

Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909350, 4909351

CLEAN WATER ACT Sect.307:No
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 10 mg/L»(07/30/92)
Maximum Contaminant Level Goals (MCLG): 10 mg/L»(07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U239,D001
CERCLA REF: Not listed
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Not given
Mailability: Nonmailable
Max per parcel: 0

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: Unknown

LONG TERM TOXICITY: unknown

ARGET ORGANS: CNS, eyes, gi tract, blood, liver, kidneys, skin

MPTOMS: DIZZ, EXCITEMENT, DROW, INCO, STAGGERING GAIT, IRRIT EYES, NOSE, THROAT, CORNEAL VACUOLIZATION, ANOREXIA, NAU, VOMIT, ABDOM PAIN; DERM Source: CHRIS

CONC IDLH: 1000ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
434 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN) 868 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: TLV = 100ppm(435 mg/M3)
ACGIH STEL: STEL = 150 ppm(655 mg/M3)

OSHA PEL: Transitional Limits:
PEL = 100 ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 150 ppm(655 mg/M3)

MAK INFORMATION: 100 ppm
440 mG/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 2xMAK for 30 minutes, 4 times per shift of 8 hours.

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-man LCLo:10000 ppm/6H BMJOAE 3,442,70

LD50 value: orl-rat LD50:4300 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:4300 mg/kg
ihl-rat LC50:5000 ppm/4H
ipr-rat LD50:2459 mg/kg
scu-rat LD50:1700 mg/kg
ipr-mus LD50:1548 mg/kg

ivn-rbt LDLo:129 mg/kg
ihl-gpg LCLo:450 ppm
ipr-gpg LDLo:2000 mg/kg
ipr-mam LDLo:2 gm/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
ihl-rat TCLo:250 mg/m3/24H (7-15D preg) ATSUDG 8,425,85
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:50 mg/m3/6H (1-21D preg) JHEMA2 27,337,83
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)

ihl-rat TCLo:50 mg/m3/6H (1-21D preg) JHEMA2 27,337,83
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Other developmental abnormalities
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-rat TCLo:600 mg/m3/24H (7-15D preg) PCBRD2 163B,295,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:20600 ug/kg (6-15D preg) JTEHD6 9,97,82
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:31 mg/kg (6-15D preg) JTEHD6 9,97,82
EFFECTS ON FERTILITY
Post-implantation mortality

ihl-mus TCLo:4000 ppm/6H (6-12D preg) TJADAB 28,22A,83
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)
EFFECTS ON NEWBORN

Physical

ihl-mus TCLo:2000 ppm/6H (6-12D preg) TJADAB 28,22A,83
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-mus TCLo:1 gm/m3/12H (6-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rbt TCLo:500 mg/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammabilit

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (XYLENE)
1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection. EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap wash promptly
INHALATION: art resp
INGESTION: no vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: XYLENES
DOT ID NUMBER: UN1307

ERG90 GUIDE 27

* POTENTIAL HAZARDS *

FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.

*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.

Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 398 LAST UPDATE OF THIS RECORD: 12/03/92
NAME: TOLUENE
SYNONYMS: TOLUOL; PHENYL METHANE; METHYL BENZENE; BENZENE, METHYL-
CAS: 108-88-3 RTECS: XS5250000
FORMULA: C7H8 MOL WT: 92
WLN: 1R
CHEMICAL CLASS:Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless watery liquid with a pleasant odor

BOILING POINT:	383.6 K	110.4 C	230.8 F
MELTING POINT:	178.00 K	-95.2 C	-139.3 F
FLASH POINT:	277.6 K	4.4 C	40 F
AUTO IGNITION:	809 K	535.8 C	996.5 F
CRITICAL TEMP:	591.8 K	318.65 C	605.57 F
CRITICAL PRESS:	4.108 kN/M2	40.5 atm	595 psia
HEAT OF VAP:	155 Btu/lb	86.08 cal/g	3.601x E5 J/kg
HEAT OF COMB:	-17430 Btu/lb	-9690 cal/g	-405x E5 J/kg

VAPOR PRESSURE: 36.7 mm @ 30 C
L: 7.1 %
LEL: 1.3 %
IONIZATION POTENTIAL (eV): 8.82
VAPOR DENSITY: 3.14 (air=1)
EVAPORATION RATE: 2.00(n-BUTYL ACETATE=1)
SPECIFIC GRAVITY: 0.867 @ 20 C
DENSITY: 0.867
WATER SOLUBILITY: 0.05%
INCOMPATIBILITIES: strong ox

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: No data
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors
ODOR DETECTED AT (ppm): 40 PPM
ODOR DESCRIPTION: STRONG, PLEASANT Source:NYDH
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27
Identification number: UN1294

DOT shipping name: Toluene
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909305

CLEAN WATER ACT Sect.307: Yes
CLEAN WATER ACT Sect.311: Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 1 mg/L» (07/30/92)
Maximum Contaminant Level Goals (MCLG): 1 mg/L» (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U220,D001
CERCLA REF: Not listed
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.

Fire hazard: flammable.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Flammable liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 QT METAL; 1 PT OTHER

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: INHALATION: 100 ppm exposure can cause dizziness, drowsiness and hallucinations. 100-200 ppm can cause depression. 200-500 ppm can cause headaches, nausea, loss of appetite, loss of energy, loss of coordination and coma. in addition to the above, death has resulted from exposure to 10,000 ppm for an unknown time. SKIN: can cause dryness and irritation. absorption may cause or increase the severity of symptoms listed above. Eyes: can cause irritation at 300 ppm. INGESTION: can cause a burning sensation in the mouth and stomach, upper abdominal pain, cough, hoarseness, headache, nausea, loss of appetite, loss of energy, loss of coordination and coma.(NYDH)

LONG TERM TOXICITY: levels below 200 ppm may produce headache, tiredness and nausea. from 200 to 750 ppm symptoms may include insomnia, irritability, dizziness, some loss of memory, loss of appetite, a feeling of drunkeness and disturbed menstruation. levels up to 1,500 ppm may cause heart palpitations and loss of coordination. blood effects and anemia have been reported but are probably due to contamination by benzene. most of these effects area believed to go away when exposure stops.(NYDH)

TARGET ORGANS: CNS, liver, kidneys, skin, eyes

SYMPTOMS: Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration. Source: CHRIS

CONC IDLH: 2000ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure 375 mg/M3 Time weighted averages for 8-hour exposure 200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN) 750 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: TLV = 50ppm(188 mg/M3) Skin
ACGIH STEL: Not listed

OSHA PEL: Transitional Limits:
PEL = 200 PPM; CEILING = 300 PPM; MAXIMUM PEAK ABOVE CEIL
Final Rule Limits:
TWA = 100 ppm (375 mg/M3)
STEL = 150 ppm(560 mg/M3)

PEAK INFORMATION: 100 ppm
380 mG/M3

Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 5xMAK for 30 minutes, 2 times per shift of 8 hours.
Risk of damage to the developing embryo or fetus must be considered probable. Damage cannot be excluded even when the MAK values are adhered to.

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:

IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-hmn TCLo:200 ppm JAMAAP 123,1106,43
BRAIN AND COVERINGS
Recordings from specific areas of CNS
BEHAVIORAL
Antipsychotic
BLOOD
Changes in bone marrow not included above

D50 value: orl-rat LD50:636 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:636 mg/kg
ihl-rat LC50:>26700 ppm/1H
ipr-rat LD50:1332 mg/kg
ivn-rat LD50:1960 mg/kg
unr-rat LD50:6900 mg/kg
ihl-mus LC50:400 ppm/24H
ipr-mus LD50:59 mg/kg
scu-mus LD50:2250 mg/kg
unr-mus LD50:2000 mg/kg
ihl-rbt LCLo:55000 ppm/40M
skn-rbt LD50:12124 mg/kg
ivn-rbt LDLo:130 mg/kg
ihl-gpg LCLo:1600 ppm
ipr-gpg LD50:500 mg/kg
scu-frg LDLo:920 mg/kg
ipr-mam LDLo:1750 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

EPRODUCTIVE TOXICITY DATA (1992 RTECS)

ihl-rat TCLo:1500 mg/m3/24H (1-8D preg) TXCYAC 11,55,78
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:1000 mg/m3/24H (7-14D preg) FMORAO 28,286,80
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:100 ppm (51W male) SAIGBL 13,501,71
PATERNAL EFFECTS
Testes,epididymis,sperm duct

orl-mus TDLo:9 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:15 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:30 gm/kg (6-15D preg) TJADAB 19,41A,79
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)

ihl-mus TCLo:500 mg/m3/24H (6-13D preg) TXCYAC 11,55,78
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-mus TCLo:1000 ppm/6H (2-17D preg) TJEMDR 7,265,82
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:400 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system
EFFECTS ON NEWBORN

ihl-mus TCLo:200 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Urogenital system

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

WEAR APPROPRIATE EQUIPMENT TO PREVENT:

Repeated or prolonged skin contact.

WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes wet.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammabilit

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (TOLUENE)
1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.
2000 ppm: Any supplied-air respirator operated in a continuous flow mode. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece. / Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap wash promptly
INHALATION: art resp
INGESTION: no vomit

FIRST AID SOURCE: CHRIS Manual 1991
INHALATION: remove to fresh air, give artificial respiration and oxygen if needed; call a doctor.
INGESTION: do NOT induce vomiting; call a doctor.
EYES: flush with water for at least 15 min.
SKIN: wipe off, wash with soap and water.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not

breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

FIRE EXTINGUISHMENT: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires. Note: Water may be ineffective CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Toluene
DOT ID NUMBER: UN1294

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* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structura firefighters' protective clothing will provide limited protection.
Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.
SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area.

Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 59 LAST UPDATE OF THIS RECORD: 12/03/92
NAME: BENZENE
SYNONYMS: BENZOL; COAL TAR NAPHTHA; CYCLOHEXATRIENE; PHENYL HYDRIDE; PHENE; COAL NAPHTHA; PYROBENZOL
CAS: 71-43-2 RTECS: CY1400000
FORMULA: C6H6 MOL WT: 78.11
WLN: RH
CHEMICAL CLASS: Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless to pale yellow watery liquid with a gasoline-like odor

BOILING POINT:	353.15 K	80 C	176 F
MELTING POINT:	278.71 K	5.5 C	42 F
FLASH POINT:	262 K	-11.2 C	11.9 F
AUTO IGNITION:	864.8 K	591.6 C	1096.9 F
CRITICAL TEMP:	562.1 K	288.95 C	552.11 F
CRITICAL PRESS:	4.89 kN/M2	48.2 atm	708 psia
HEAT OF VAP:	169 Btu/lb	93.85 cal/g	3.927x E5 J/kg
HEAT OF COMB:	-17460 Btu/lb	-9707 cal/g	-406x E5 J/kg

VAPOR PRESSURE: 75 mm @ 20 C
UEL: 7.1 %
LEL: 1.3 %
IONIZATION POTENTIAL (eV): 9.25
VAPOR DENSITY: 2.77 (air=1)
EVAPORATION RATE: 3.50(n-BUTYL ACETATE=1)
SPECIFIC GRAVITY: 0.86-0.88 20 C
DENSITY: 0.8794 @ 20 C
WATER SOLUBILITY: 0.06%
INCOMPATIBILITIES: strong ox,chlorine,bromine with iron

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: OXIDIZING MATERIALS(Br2, F2, CL2, CrO3, NaClO4, O2, O3), PERCHLORATES (AlCl3 +NaClO4), (H2SO4 & PERMANGANATES), K2O2, (AgClO4 & ACETIC ACID), Na2O2 Source: SAX
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: VAPOR IS HEAVIER THAN AIR AND MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.
ODOR DETECTED AT (ppm): 4.68 ppm
ODOR DESCRIPTION: odor; characteristic odor Source:CHRIS

00 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27
Identification number: UN1114
DOT shipping name: Benzene
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T8
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions: 40

STCC NUMBER: 4908110

CLEAN WATER ACT Sect.307: Yes
CLEAN WATER ACT Sect.311: Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.005 mg/L»(01/09/89)
Maximum Contaminant Level Goals (MCLG): 0 mg/L»(01/09/89)
LEAN AIR ACT: CAA '90 Listed and CAA '77 Sect 109
A WASTE NUMBER: U019,D018,D001
ERCLA REF: Y
RQ DESIGNATION: A 10 pounds (4.54 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: carcinogen
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 0.1 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Not given
Mailability: Nonmailable
Max per parcel: 0

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.

SPECIAL : Unspecified

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: INHALATION: benzene may produce both nerve and blood effects. irritation of the nose, throat and lungs may occur (3,000 ppm may be tolerated for only 30 to 60 minutes). lung congestion may occur. nerve effects may include an exaggerated feeling of well-being, excitement, headache, dizziness and slurred speech. at high levels, slowed breathing and death may result. death has occurred at 20,000 ppm for 5 to 10 minutes, or 7,500 ppm for 30 minutes. SKIN: irritation may occur, with redness and blistering if not promptly removed. benzene is poorly absorbed. whole body exposure for 30 minutes has been reported with no health effects. Eyes: may cause severe irritation. INGESTION: may cause irritation of mouth, throat and stomach. symptoms are similar to those listed under inhalation. one tablespoon may cause collapse, bronchitis, pneumonia and death.(NYDH)

LONG TERM TOXICITY: may cause loss of appetite, nausea, weight loss, fatigue, muscle weakness, headache, dizziness, nervousness and irritability. mild anemia has been reported from exposures of 25 ppm for several years and 100 ppm for 3 months. at levels between 100 and 200 ppm for periods of 6 months, or more, severe irreversible blood changes and damage to liver and heart may occur. temporary partial paralysis has been reported.(NYDH)

TARGET ORGANS: blood, CNS, skin, bone marrow, eyes, resp sys

SYMPTOMS: Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death. Source: CHRIS

CONC IDLH: 3000ppm

NIOSH REL: Potential occupational carcinogen 0.1 ppm Time weighted averages for 8-hour exposure 0.32 mg/M3 Time weighted averages for 8-hour exposure 1 ppm Ceiling exposures which shall at no time be exceeded 3.2 mg/M3 Ceiling exposures which shall at no time be exceeded

ACGIH TLV: TLV = 10ppm Suspected human carcinogen (A2)
ACGIH STEL: Suspected human carcinogen (A2)

OSHA PEL: Final Rule Limits:
TWA = 1 ppm
STEL = 5 ppm
CONSULT 29CFR 1910.1028

MAK INFORMATION: Danger of cutaneous absorption
Carcinogenic working material without MAK
Capable of inducing malignant tumors as shown by experience with humans.

CARCINOGEN?: Y STATUS: See below
REFERENCES:

HUMAN SUSPECTED IARC** 7,203,74
HUMAN SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 29,93,82
HUMAN POSITIVE IARC** 29,93,82
ANIMAL INDEFINITE IARC** 7,203,74

CARCINOGEN LISTS:

IARC: Carcinogen as defined by IARC as carcinogenic to humans, with sufficient epidemiological evidence.
MAK: Capable of inducing malignant tumors as shown by experience in humans.
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as known to be carcinogenic, with evidence from human studies.
ACGIH: Carcinogen defined by ACGIH TLV Committee as a suspected carcinogen, based on either limited epidemological evidence or demonstration of carcinogenicity in experimental animals.
OSHA: Cancer hazard

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

* ihl-hmn LCLo:2 pph/5M TABIA2 3,231,33

* orl-man LDLo:50 mg/kg YAKUD5 22,883,80

* ihl-hmn LCLo:2000 ppm/5M YAKUD5 22,883,80

ihl-man TCLo:150 ppm/1Y-I BLUTA9 28,293,74
BLOOD
Other changes
NUTRITIONAL AND GROSS METABOLIC
Changes in:
Body temperature increase

ihl-hmn TCLo:100 ppm INMEAF 17,199,48
BEHAVIORAL
Somnolence(general depressed activity)
GASTROINTESTINAL
Nausea or vomiting
SKIN AND APPENDAGES

Skin - after systemic exposure
Dermatitis,other

ihl-hmn LCLo:65 mg/m3/5Y ARGEAR 44,145,74
BLOOD
Other changes

LD50 value: orl-rat LD50:930 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:930 mg/kg
ihl-rat LC50:10000 ppm/7H
ipr-rat LD50:2890 ug/kg
orl-mus LD50:4700 mg/kg
ihl-mus LC50:9980 ppm
ipr-mus LD50:340 mg/kg
orl-dog LDLo:2 gm/kg
ihl-dog LCLo:146000 mg/m3
ihl-cat LCLo:170000 mg/m3
ihl-rbt LCLo:45000 ppm/30M
ivn-rbt LDLo:88 mg/kg
ipr-gpg LDLo:527 mg/kg
scu-frg LDLo:1400 mg/kg
ihl-mam LCLo:20000 ppm/5M
ipr-mam LDLo:1500 mg/kg

'RRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
ihl-rat TCLo:670 mg/m3/24H (15D pre/1-22D preg) HYSAAV 33(1-3),327,68
EFFECTS ON FERTILITY
Female fertility index

ihl-rat TCLo:56600 ug/m3/24H (1-22D preg) HYSAAV 33(7-9),112,68
EFFECTS ON NEWBORN

ihl-rat TCLo:50 ppm/24H (7-14D preg) JHEMA2 24,363,80
EFFECTS ON EMBRYO OR FETUS
Extra embryonic features(e.g.,placenta,umbilical cord)
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rat TCLo:150 ppm/24H (7-14D preg) JHEMA2 24,363,80
EFFECTS ON FERTILITY
Post-implantation mortality
SPECIFIC DEVELOPMENTAL ABNORMALITIES

Musculoskeletal system

orl-mus TDLo:9 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:12 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON FERTILITY
Post-implantation mortality

orl-mus TDLo:6500 mg/kg (8-12D preg) TCMUD8 6,361,86
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-mus TCLo:500 ppm/7H (6-15D preg) AIHAAP 40,993,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:500 mg/m3/12H (6-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:5 ppm (6-15D preg) TXCYAC 42,171,86
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ihl-mus TCLo:20 ppm/6H (6-15D preg) FAATDF 10,224,88
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ipr-mus TDLo:5 mg/kg (1D male) TPKVAL 15,30,79
EFFECTS ON FERTILITY
Pre-implantation mortility
EFFECTS ON EMBRYO OR FETUS
Fetal death

scu-mus TDLo:1100 mg/kg (12D preg) TOXID9 1,125,81
EFFECTS ON EMBRYO OR FETUS
Other effects on embryo or fetus

scu-mus TDLo:7030 mg/kg (12-13D preg) SEIJBO 15,47,75
EFFECTS ON EMBRYO OR FETUS
Extra embryonic features(e.g.,placenta,umbilical cord)
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ivn-mus TDLo:13200 ug/kg (13-16D preg) ICHUDW 4(6),24,82
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)

par-mus TDLo:4 gm/kg (12D preg) NEZAAQ 25,438,70
EFFECTS ON NEWBORN
Weaning or lactation index(#alive at weaning per # alive at day 4)

ihl-rbt TCLo:1 gm/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON FERTILITY
Abortion
EFFECTS ON EMBRYO OR FETUS
Fetal death

NO SIGNIFICANT
RISK LEVEL(Ca P65): 20 micrograms/day

---------- PROTECTION AND FIRST AID ----------

ROTECTION SUGGESTED
OM THE CHRIS MANUAL:
ydrocarbon vapor canister, supplied air or hose mask; hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face splash shield; hydrocarbon-insoluble apron such as neoprene.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly wash with soap when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammabili

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (BENZENE)
Less than or equal to 10 ppm: Half-mask air-purifying respirator with organic vapor cartridge.
ess than or equal to 50 ppm: Full facepiece respirator with organic apor cartridges. / Full facepiece gas mask with chin style canister.

Less than or equal to 100 ppm: Full facepiece powered air-purifying respirator with organic vapor canister.
Less than or equal to 1000 ppm: Supplied air respirator with full facepiece in positive-pressure mode.
Greater than 1000 ppm or Unknown concentration: (1) Self-contained breathing apparatus with full face-piece in positive pressure mode. (2) Full facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.
Escape : (1) Any organic vapor gas mask; or (2) Any self-contained breathing apparatus with full facepiece.
Firefighting : Any full facepiece self-contained breathing apparatus operated in positive pressure mode.

FIRST AID SOURCE: NIOSHP
EYE: irr immed
SKIN: soap wash promptly
INHALATION: art resp
INGESTION: no vomit

FIRST AID SOURCE: CHRIS Manual 1991
SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin.
EYES: flush with plenty of water until irritation subsides.
INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

FIRE EXTINGUISHMENT: Dry chemical, foam, or carbon dioxide. Note: Water may be ineffective CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Benzene
DOT ID NUMBER: UN1114

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* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS

May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structura firefighters' protective clothing will provide limited protection.
Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

*FIRE

Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

APPENDIX E

DRILLING SAFETY GUIDE

Drilling Safety Guide

Drilling Safety Guide

EnSafe is concerned about employee safety while working on or around drill rigs as well as when traveling to and from a drilling site, moving the drill rig and tools from location to location on a site, and during maintenance of the drill rig. Every drill crew will have a designated safety supervisor. The safety supervisor will have the responsibility for ensuring that all drilling operations are conducted in a safe manner. All personnel working on, with, or around a drill rig will be under the jurisdiction of the rig safety supervisor.

Drill Rig Safety Supervisor

The safety supervisor for the drill crew will be the drill rig operator. However, the EnSafe safety officer still maintains the overall safety responsibility for the site. The drill crew safety supervisor is a direct representative of the site health and safety supervisor and will report any safety problems directly to the site health and safety officer. The drill rig safety supervisor will:

- Be the leader in using proper personal protective equipment. He/she will set an example for other personnel to follow.
- Enforce the requirements of the health and safety plan and take appropriate actions when other personal are not following the requirements of the health and safety plan.
- Ensure that all drill rig and associated drill rig equipment is properly maintained.
- Ensure that all drill rig operating personnel are thoroughly familiar with the drill operations.
- Enspect the drill rig and associated drill rig equipment for damage before starting drilling operations. Check for structural damage, loose bolts or nuts, correct tension in chains and cables, loose or missing guards or protective covers, fluid leaks, damaged hoses and/or damaged pressure gauges and pressure relief valves.
- Test all emergency and warning devices such as emergency shut-down switches at least daily (prior to starting drilling operations). Drilling will not be permitted until all emergency and warning devices are functioning.
- Conduct a safety briefing daily before starting drilling operations. Any new employee will receive a copy of the drilling operations safety manual, and the drill rig manufacturer's operating and maintenance manual.
- Ensure that each employee reads and understands the drill rig manufacturer's operating and maintenance manual.
- Observe the mental, emotional, and physical capabilities of each worker.
- Ensure that each drill rig has a first aid kit and fire extinguisher.
- Maintain a list of emergency contact telephone numbers. This list will be posted in a prominent location and each drill rig employee will be informed of the list's location.

Drill Rig Personnel Protective Equipment

For most geotechnical, mineral, and/or groundwater drilling, drill rig personal protective equipment will include the following:

- Hard hat
- Safety shoes with steel toe and steel shank (or equivalent)
- Gloves
- Safety glasses with side shields
- Close-fitting but comfortable clothes
- Hearing protection

It is important that clothing does not have loose ends, straps, drawstrings or belts, or other unfastened parts that might become caught in or on a rotating or translating part of the drill rig.

Rings, necklaces, or other jewelry will not be worn during drilling operations.

Additional protective equipment may be required by the Site-Specific Health and Safety Plan.

Drill Rig Housekeeping

The following housekeeping measures must be taken for all drilling operations.

- Suitable storage locations will be provided for all tools, materials, and supplies. The storage should be conveniently located and will provide for safe handling of all supplies.
- Drill tools, supplies, and materials will not be transported on the drill rig unless the drill rig is designed and equipped to carry drill tools, supplies, and materials.
- Pipe, drill rods, casing, augers, and similar drilling tools when stored will be stacked in a manner that will prevent spreading, rolling, or sliding.
- Penetration or other driving hammers will be secured to prevent movement when not in use.
- Work areas, platforms, walkways, scaffolding, and other access ways will be kept free of materials, debris and obstructions and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.
- Never store gasoline in a nonapproved container. Red, nonsparking, vented containers marked with the word gasoline will be used. The fill spout will have a flame arrester.
- Prior to drilling, adequate site clearing and leveling will be performed to accommodate the drill rig and supplies and to provide a safe working area. Drilling will not be started when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

Maintenance Safety

Well maintained drilling equipment makes drilling operations safer. When performing equipment/tool maintenance, the follow safety precautions will be followed:

- Safety glasses will be worn when maintenance is performed on drill rigs or drilling tools.
- Shut down the drill rig engine to make repairs or adjustments to the rig or to lubricate fittings (except to make repairs or adjustments that can only be made while the engine is running).
- Always block the wheels or lower the leveling jacks or both. Set the hand brake before working under a drill rig.
- Release all pressure on hydraulic systems, the drilling fluid system, and the air operating system of the drill rig prior to performing maintenance.
- Use extreme caution when opening drain plugs and radiator caps and other pressurized plugs and caps.
- Allow time for the engine and exhaust to cool before performing maintenance on these systems.
- Never weld or cut on or near the fuel tank.
- Do not use gasoline or other volatile or flammable liquids as a cleaning agent.
- Follow the manufacturer's recommendations for quantity and type of lubricants, hydraulic fluids and coolants.
- Replace all caps, filler plugs, protective guards or panels, and high pressure hose clamps and chains or cables that have been removed during maintenance.
- Perform a safety inspection prior to starting drilling equipment after maintenance is performed.

Safe Use of Hand Tools

There are a large number of hand tools that can be used on or around a drill rig. The most important rule of hand tools is to use a tool for its intended purpose. The following are a few general and specific safety rules to follow when using hand tools.

- When using a hammer, wear safety glasses and require all others around you to wear safety glasses.
- When using a chisel, wear safety glasses and require all others around you to wear safety glasses.
- Keep all tools cleaned and stored in an orderly manner.
- Use wrenches on nuts, not pliers.
- Use screwdrivers with blades that fit the screw slot.
- When using a wrench on a tight nut, use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands when possible and with both feet firmly placed. Do not push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-

off device. Always assume that you may lose your footing. To avoid serious injury if you fall, remove sharp objects from the area near you.

- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches will be wire brushed frequently to prevent accumulation of dirt and grease which cause wrenches to slip.
- Never use pipe wrenches in place of a rod holding device.
- Replace hock and heel jaws when visibly worn.
- When breaking tool joints on the ground or on a drilling platform, position hands so that fingers will not be smashed between the wrench handle and the ground or the platform if the wrench were to slip or the joint suddenly to let go.

Safety During Drilling Operations

- Do not drive a drill rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast, look up to check for overhead obstructions.
- Before raising the mast, all drill rig personnel (except the person raising the mast) and visitors will be cleared from the area immediately to the rear and sides of the mast. All drill rig personnel and visitors will be informed that the mast is being raised prior to raising the mast.
- All drill rig personnel and visitors will be instructed to stand clear of the drill rig immediately prior to and during starting of the engine.
- All gear boxes will be in the neutral position, all hoist levers will be disengaged, all hydraulic levers will be in the nonactuating positions, and the cathead rope will not be on the cathead before starting the drill rig engine.
- The drill rig must be leveled and stabilized with leveling jacks and/or solid cribbing before the mast is raised. The drill rig will be leveled if settling occurs after initial setup.
- The mast will be lowered only when the leveling jacks are down. The leveling jacks must be in the down position until the mast is completely lowered.
- Secure and/or lock the mast according to the drill rig manufacturer's recommendations before starting drilling operations.
- The drill rig must only be operated from the control position. If the operator must leave the control position, the rotary drive and the feed control must be placed in the neutral position. The drill engine will be shut down when the operator leaves the vicinity of the drill rig.
- Throwing or dropping of tools is not permitted. All tools will be carefully passed by hand between personnel or a hoist line will be used.
- When drilling within an enclosed area, ensure that fumes are exhausted out of the area. Exhaust fumes can be toxic and may not be detected by smell.
- Clean mud and grease from boots before mounting the drill platform. Use hand holds and railings. Watch for slippery ground when dismounting from the drill platform.
- Do not touch any metal parts of the drill rig with exposed flesh during freezing weather. Freezing of moist skin to metal can occur almost instantaneously.
- All unattended boreholes must be covered or otherwise protected to prevent drill rig personnel, site visitors, or animals from stepping or falling into the hole.

- Do not attempt to use one or both hands to carry tools when climbing ladders.

Working on Derrick Platforms

- When working on a derrick platform, us a safety belt and a lifeline. The safety belt will be at least 4 inches wide and will fit snugly but comfortably. The lifeline, will be less than 6 feet long and attached to the derrick.
- The safety belt and lifeline will be strong enough to withstand the dynamic force of a 250-pound weight falling 6 feet.
- A safety climbing device will be used when climbing to a derrick platform that is higher than 20 feet.
- The lifeline will be fastened to the derrick just above the derrick platform to a structural member that is not attached to the platform or to other lines or cables supporting the platform.
- Tools will be securely attached to the platform with safety lines. Do not attach a tool to a line attached to the wrist or other body part.
- When working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.
- Derrick platforms over 4 feet above the ground will have toe boards and safety railings.

Working on the Ground

- Workers on the ground must avoid going under elevated platforms.
- Terminate drilling operations and, if possible, lower the mast during an electrical storm.
- Overhead and buried utilities must be located and marked on all boring location plans and boring assignment sheets.
- When there are overhead electrical power lines at or near a drilling site or project, consider all wire to be charged and dangerous.
- Watch for sagging power lines before entering a site. Do not lift power lines to gain entry. Call the utility to have them lift the power lines or to deenergize the power.
- Operations adjacent to overhead lines are prohibited unless one of the following conditions is satisfied:
  - — Power has been shut off and positive means taken to prevent the lines from being energized.
  - — Equipment, or any part, does not have the capability of coming within the following minimum clearance from energized overhead lines, or the equipment has been positioned and blocked to assure no part, including cables, can come within the minimum clearances listed in the adjacent table.

Power lines nominal system kv	Minimum required clearance
0-50	10 feet
51-100	12 feet
101-200	15 feet
201-300	20 feet
301-500	25 feet
501-750	35 feet
751-1000	45 feet

- While in transit with boom lowered and no load, the equipment clearance will be a minimum of 4 feet for voltages less than 50kv, 10 feet for voltages 51kv to 345kv, and 16 feet for voltages over 345kv.
- Before working near transmitter towers where an electrical charge can be induced in the equipment or materials being handled, the transmitter will be de-energized. The following precautions will be taken to dissipate induced voltages:
  - The equipment will be provided with an electrical ground to the upper rotating structure supporting the boom.
  - Ground jumper cables will be attached to materials being handled by boom equipment when electrical charge may be induced while working near energized transmitters. Crews will be provided nonconductive poles having large alligator clips or other similar protection to attach the ground cable to the load. Insulating gloves will be used.
- Continue to watch overhead power lines. Both hoist lines and overhead power lines can be moved toward each other by the wind.
- If there are any questions concerning drill rig operations on a site in the vicinity of overhead power lines, call the power company. The power company will provide expert advice as a public service.
- Look for warning signs indicating underground utilities. Underground utilities may be located a considerable distance away from the warning sign. Call the utility and jointly determine the precise location of all underground utility lines, mark and flag the locations, and determine the specific precautions to be taken to ensure safe drilling operations.

Wire Rope Safety

- All wire ropes and fittings will be visually inspected at least once a week for abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reeving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting hardware.
- Wire ropes must be replaced when inspection indicates excessive damage. The *Wire Rope User's Manual* may be used as a guide for determining excessive damage.
- Wire ropes that have not been used for a period of a month or more will be thoroughly inspected before being returned to service.
- All manufactured and end fittings and connections must be installed according to the manufacturer's specifications.
- Swivel bearings on ball-bearing type hoisting swivels must be inspected and lubricated daily to ensure that the swivel rotates freely under load.
- Do not drill through or rotate drill through a slipping device, do not hoist more that 10 feet of the drill rod column above the top of the last (mast), do not hoist a rod column with loose tool joints, and do not make up, tighten, or loosen tool hoists while the rod column is being supported by a rod slipping device.

- Do not attempt to brake the fall of a drill rod column with your hands or by increasing tension on the rod slipping device.
- Wire ropes must be properly matched with each sheave. The sheave will pinch wire rope that is too large. Wire rope that is too small will groove the sheave. Once a sheave is grooved, it will severely pinch and damage larger sized wire rope.
- Use tool handling hoists only for vertical lifting of tools. Do not use tool handling hoists to pull on objects away from the drill rig.
- All hoisting hooks will be equipped with safety latches.
- When tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull for the hoist line or the feed mechanism of the drill.
- Minimize shock loading of a wire rope; apply loads smoothly and steadily.
- Avoid sudden loading in cold weather.
- Never use frozen ropes.
- Protect wire rope from sharp corners or edges.
- Replace faulty guides and rollers.
- Replace worn sheaves or worn sheave bearings.
- Know the safe working load of the equipment and tackle. Never exceed safe working limits.
- Periodically inspect clutches and brakes of hoists.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope onto hoist drums with your hands.
- After installation of a new wire rope, the first lift must be a light load to allow the wire rope to adjust.
- Never leave a load suspended when the hoist is unattended.
- Never use a hoist line to ride up the mast.

Cathead and Rope Hoist Safety

- Keep the cathead clean and free of rust and oil and/or grease. The cathead must be cleaned with a wire brush when it becomes rusty.
- Check the cathead for rope-wear grooves. If a rope groove forms that is deeper than 1/8-inch, the cathead must be replaced.
- Always start work with a clean, dry, sound rope. A wet or oily rope may grab the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast. If the rope grabs the cathead or otherwise becomes tangled in the drum, release the rope and sound the alarm for all personnel to clear the area rapidly.
- The rope must not be permitted to contact chemicals.
- Never wrap the rope from a cathead around a hand, wrist, arm, foot, ankle, leg, or any other body part.
- Attach the hammer to the ropeusing a knot that will not slip, such as a bowline.

- A minimum of 18 inches must be maintained between the operating hand and the cathead drum when driving samplers, casing , or other tools. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground. Loosen grip on the rope as the hammer falls. Maintaining a tight grip on the rope increases the chances of being pulled into the cathead.
- Do not use a rope that is longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.
- Do not leave a cathead unattended with the rope wrapped on the drum.
- Position all other hoist lines to prevent contact with the operating cathead rope.
- The cathead operator must be on a level surface with good, firm footing conditions.

Auger Safety

- The drill rig must be level, the clutch or hydraulic rotation control disengaged, the transmission in low gear and the engine running at low RPM when starting an auger boring.
- Seat the auger head below the ground surface with an adequate amount of downward pressure prior to rotation.
- Observe the auger head while slowly engaging the clutch or rotation control and start rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply downward pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below the surface.
- Follow manufacturer's recommended methods for securing the auger to the power coupling.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never place feet under the auger section that is being hoisted.
- Stay clear of rotating augers and other rotating components of the drill rig.
- Never reach behind or around a rotating auger.
- Use a long-handle shovel to move auger cuttings away from the auger.
- Augers will be cleaned only when the drill rig is in neutral and the augers have stopped rotating.

Rotary and Core Drilling Safety

- Water swivels and hoist plugs must be lubricated and checked for frozen bearings before use.
- Drill rod chuck jaws must be checked periodically and replaced as necessary.
- The weight of the drill rod string and other expected hoist loads must not exceed the hoist and sheave capacities.
- Only the operator of the drill rig will brake or set a manual chuck to ensure that rotation of the chuck will not occur prior to removing the wrench from the chuck.

- The drill rod chuck jaws will not be used to brake drill rods during lowering into the hole.
- Drill rods will not be held or lowered into the hole with pipe wrenches.
- Do not attempt to grab falling drill rods with hands or wrenches.
- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction must be relieved or bled down prior to breaking the first tool joint.
- Use a rubber or other suitable rod wiper to clean rods during removal from the hole. Do not use hands to clean drilling fluids from the drill rods.
- Do not lean unsecured drill rods against the mast.

APPENDIX F

DIRECTIONS TO MEDICAL FACILITY

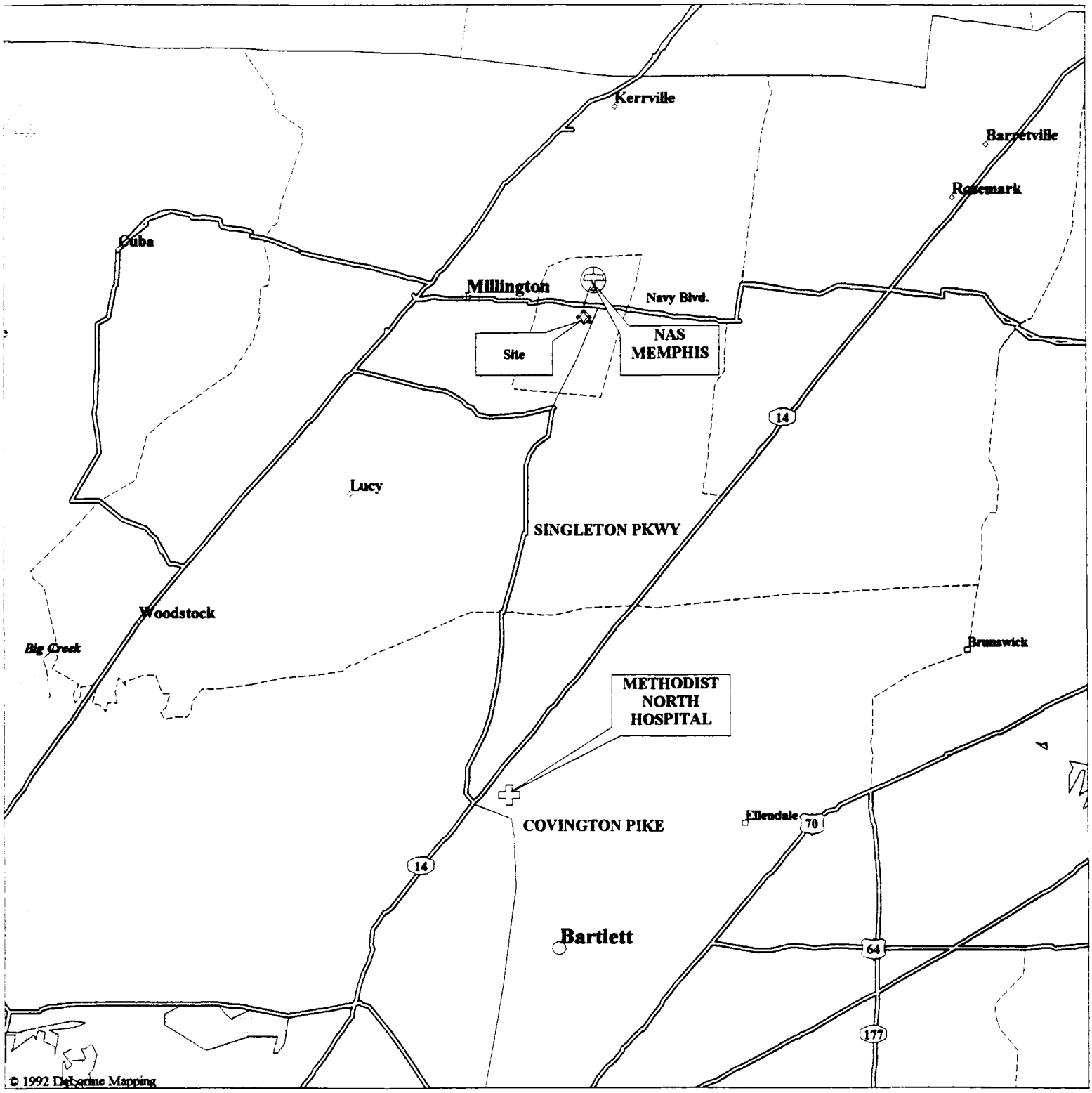
DIRECTIONS TO THE NEAREST MEDICAL FACILITY

HOSPITAL

METHODIST NORTH HOSPITAL
3960 COVINGTON PIKE
MEMPHIS, TENNESSEE
EMERGENCY NUMBER: (901) 372-5211

Directions to Methodist North Hospital from Building S-50:

1. From the Site drive south on 6th Avenue to "E" Street.
2. Turn left on "E" Street and proceed to 7th Avenue.
3. Turn right on 7th Avenue.
4. Remain on 7th Avenue and exit through the South Gate (Singleton Parkway).
5. Continue on Singleton Parkway through the stop signs.
6. Singleton Parkway and Covington Pike will intersect at a red light (about 5 miles).
7. You will see the entrance to the emergency room about 700 feet past this light on the left.



LEGEND

- State route
- Marker
- City
- Small town
- Large town
- S. route
- Boundary
- Interstate highway
- State highway
- U.S. highway
- Open water

Scale 1:125,000 (at center)

2 Miles

2 KM

Mag 12.00
Thu Apr 22 13:15:40 1993

EMPLOYEE EXPOSURE HISTORY FORM

EMPLOYEE: _____

JOB NAME: _____

DATE(S) FROM/TO: _____

HOURS ON SITE: _____

CONTAMINANTS (SUSPECTED/REPORTED):

_____

_____

_____

_____

_____

_____

_____

_____

_____

(SEE ATTACHED LABORATORY ANALYSIS)

PLAN FEEDBACK FORM

Problems with plan requirements

Unexpected situations encountered:

Recommendations for revisions:

APPENDIX G

HEALTH AND SAFETY FORMS

PLAN ACCEPTANCE FORM

PROJECT HEALTH AND SAFETY PLAN

INSTRUCTIONS: This form is to be completed by each person working on the project work site and returned to EnSafe/Allen & Hoshall, Memphis, Tennessee.

Job No: 2151-068

Contract No: N62467-89-D-0318

Project: NAS MEMPHIS (BLDG S-50 UST)

I represent that I have read and understand the contents of the above plan and agree to perform my work in accordance with it.

_____

Signed

_____

Print Name

_____

Company

_____

Date