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FINAL PLAN OF ACTION UNDERGROUND STORAGE TANK N-12 MILLINGTON SUPPACT TN
12/18/1997
ENSAFE/ALLEN & HOSHALL

(9)

FINAL PLAN OF ACTION
UNDERGROUND STORAGE TANK N-12
FACILITY ID #0-791696
NAVAL SUPPORT ACTIVITY MEMPHIS
MILLINGTON, TENNESSEE

SOUTHNAVFACENGCOM
Contract Number: N62467-89-D-0318

CTO-136

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

EnSafe Inc.
5724 Summer Trees Drive
Memphis, Tennessee 38134
(901) 372-7962

The Contractor, EnSafe Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0318 are complete, accurate, and comply with all requirements of the contract.

Date: December 18, 1997
Signature: Allison F Dennen
Name: Allison Dennen
Title: Task Order Manager

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List of Abbreviations

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

ACGIH	American Conference of Governmental Industrial Hygienists
AQTESOLV	Aquifer Test Solver
BCT	BRAC Cleanup Team
bgs	Below Ground Surface
BPA	Blanket Purchase Agreement
BRAC	Base Closure and Realignment Act
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
CHASP	Comprehensive Health and Safety Plan
cm	Centimeter
COC	Chain of Custody
CTO	Contract Task Order
DQO	Data Quality Objective
EAG	Environmental Assessment Guidelines
EIC	Engineer-in-Charge
EnSafe	EnSafe Inc.
FID	Flameionization Detector
f_{oc}	Fractional Organic Carbon
gal	gallon
GPS	Global Positioning System
HAZWOPER	Hazardous Waste Operations and Emergency Response
ID	Inside Diameter
IDW	Investigation-derived Waste
ISCR	Initial Site Characterization Report
lbs	Pounds
LEL	Lower Explosive Limit
LQAC	Laboratory Quality Assurance Coordinator
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSDS	Material Safety Data Sheet

List of Abbreviations (continued)

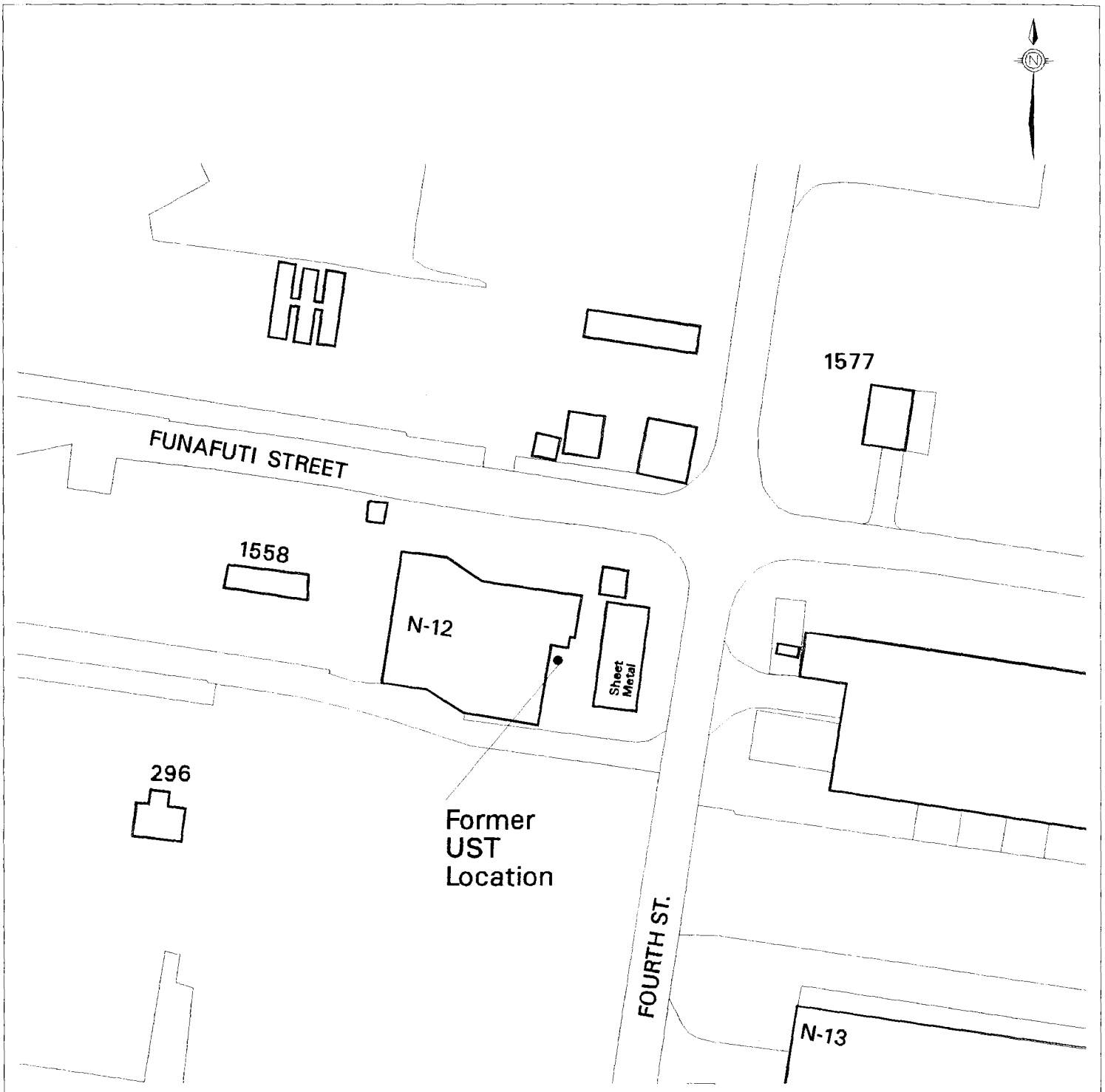
msl	Mean Sea Level
MTBE	Methyl-tertiary-butyl-ether
NIOSH	National Institute for Occupational Safety and Health
NSAMEM	Naval Support Activity Memphis
OD	Outside Diameter
OVD	Organic Vapor Detector
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Officer
PID	Photoionization Detector
POA	Plan of Action
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
ppm	Part per million
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
REL	Recommended Exposure Limit
RPD	Relative Percent Difference
sec	Second
SHSO	Site Health and Safety Officer
SO	Service Order
SOP	Standard Operating Procedure
SOUTHNAVFACENGCOM	Southern Division, Naval Facilities Engineering Command
SOW	Statement of Work
SSHSP	Site-Specific Health and Safety Plan
TCLP	Toxicity Characteristic Leaching Procedure
TDEC	Tennessee Department of Environment and Conservation
TGD	Technical Guidance Document
TLV	Threshold Limit Value
TPH-DRO	Total Petroleum Hydrocarbon-Diesel Range Organics
TPH-GRO	Total Petroleum Hydrocarbon-Gasoline Range Organics

List of Abbreviations (continued)

USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound

1.0 INTRODUCTION

At the request of the Department of the Navy, Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), EnSafe Inc. (EnSafe) has prepared the following plan of action (POA) to determine the nature and extent of contamination at the underground storage tank (UST) N-12 (Facility ID #0-791696) at Naval Support Activity Memphis (NSA Memphis [Figure 1-1]). The tank removed in September 1996 was a 7.5 gallon (gal) UST which had stored diesel. Tank N-12 was east of Building N-12 and had a broken fill pipe. Two soil samples collected at the time of removal indicated that there was contamination (see Section 2.0).



SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

Plan of Action
UST N-12
NSA Memphis

FIGURE 1-1
Vicinity Map

2.0 SITE HISTORY AND PREVIOUS INVESTIGATIONS

Information provided by the Navy indicates that the steel tank was installed in 1945. It was removed in August 1996 by Omega Environmental Services, at which time a closure report was submitted (Appendix A). During the N-12 tank removal in 1996, two soil samples were collected from the bottom of the tank pit approximately 6 to 7 feet below ground surface (bgs) to determine if any contamination was present. Sample 12S was taken from the south end of the tank pit and Sample 12N was taken from the north end of the tank pit. The samples were analyzed using method SW-846 8020 for benzene and method SW-846 8015 for total petroleum hydrocarbons-gasoline range organics (TPH-GRO) with the following results, reported in parts per million (ppm):

	Benzene	**TPH**
Sample 12S	0.027	2,700
Sample 12N	1.9	8,900

3.0 SOIL INVESTIGATION PROCEDURES

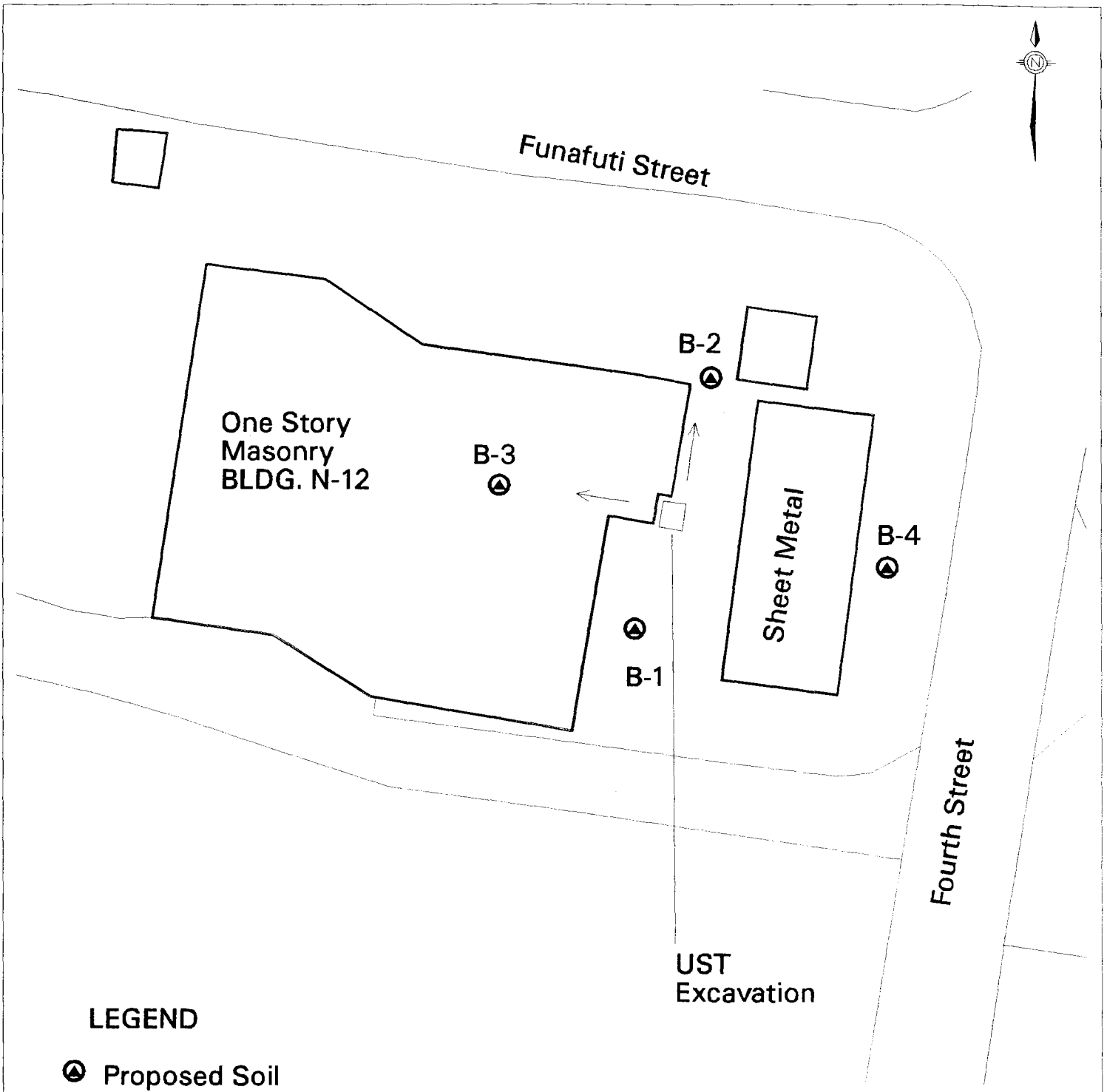
The N-12 tank site will be assessed using conventional drilling and sampling techniques. Before completing any soil borings or monitoring wells, all utilities, lines, and storage tanks will be identified to prevent damage. Potential soil contamination will be evaluated using soil borings, continuous soil sampling, field screening, and laboratory analyses of selected samples. In addition, groundwater samples will be collected from at least four monitoring wells to be installed as a part of this assessment. To allow for delineation of groundwater contamination, three additional monitoring wells may be required.

3.1 Number and Location of Soil Borings

During the investigation, soil samples will be collected and analyzed from four boring locations (see Figure 3-1). The first boring (B-1/MW-1) is to be placed in the release's upgradient direction. The second and third borings (B-2/MW-2, B-3/MW-3) are to be placed in its downgradient direction while the fourth boring (B-4/MW-4) is to be placed as close as possible to the release's location. If the specific location of the release cannot be ascertained, this boring is to be located where the site-specific data suggest the highest concentrations of contamination are present. Boring locations shown on Figure 3-1 are approximate, and may be revised in the field due to interferences or site conditions.

3.2 Boring Methods

All soil borings will be advanced using hollow-stem augers at either a 3.25-inch or a 4.25-inch inside diameter (ID). A hand auger or power auger would only be used if conditions such as the presence of utility lines, product lines, tanks or buried structures, or areas inaccessible to a drill rig do not permit the use of the drill rig.



LEGEND

- Proposed Soil Boring/Monitoring Well Locations
- ← Assumed Groundwater Flow Direction

0 40 feet

Plan of Action
UST N-12
NSA Memphis

FIGURE 3-1
Site Map

3.3 Procedures for Sample Collection

3.3.1 Equipment and Collection

Soil samples will be collected continuously from each boring using decontaminated 2-inch outside diameter (OD) split-spoon samplers or a continuous sampler at least 2 feet long.

Auger cuttings generated from the soil borings will be containerized in 55-gallon steel drums and segregated by soil boring. Before containment, samples of the cuttings will be collected using a decontaminated or dedicated stainless steel spoon or putty knife following procedures outlined in *TDEC TGD-005*, August 1996.

3.3.2 Procedure for Selection of Soil Samples

Petroleum Samples

Each split-spoon or continuous sample will be split in half lengthwise with a decontaminated or dedicated stainless steel spoon or putty knife. One half of the sample will be immediately placed in a laboratory-prepared jar in a manner that eliminates headspace. The jar is to be properly labeled and stored at 4°C until it is delivered to the TDEC-approved laboratory. A chain-of-custody form will be completed for each soil sample collected and signed by the person collecting the sample and the laboratory receiving the sample. Sample security will be maintained during all phases of transport.

The remaining half will be visually logged and placed in a clean, air-tight container such as a sealable plastic bag to allow some air-space for headspace screening. After this screening sample has been properly labeled, it will be allowed to volatilize for at least of 15 minutes at a minimum temperature of 68° Fahrenheit. All samples will be allowed to volatilize for an approximately equal period of time before screening. After volatilization has occurred, the headspace will be screened using either a flame ionization or photoionization organic vapor detector (OVD).

Samples will be selected for laboratory analysis based on field screening results and visual and/or olfactory detection. Table 3-1 below summarizes the minimum number of samples which will be analyzed from each boring depending upon the results of both field screening and visual/olfactory detection.

Table 3-1
Procedure for Selection of Soil Samples for Laboratory Analyses

Sample Condition	Number of Samples To Be Analyzed	Samples To Be Analyzed
No indication of contamination from either organic vapor detector (OVD) field screening or olfactory/visual detection	1	1) The sample collected immediately above the water table or the bottom of the boring, whichever occurs first
No indication of contamination from OVD field screening, but there is visual and/or olfactory observation of contamination	2	1) The sample which appears to have the highest concentration of contamination based on visual/olfactory detection 2) The sample collected immediately above the water table or the bottom of the boring, whichever occurs first
OVD readings indicate contamination in the soil	3*	1) The sample in which the OVD indicates the highest level of concentration 2) The deepest sample which the OVD indicates is contaminated 3) The sample collected immediately above the water table or the bottom of the boring, whichever occurs first

Note:
* = If one soil sample meets more than one of the above-listed criteria, the sample with the second highest OVD screening will be submitted for analyses.

Fractional Organic Carbon Analysis Samples

A soil sample will be collected from the first boring (B-1) at a depth equal to 1 foot below the bottom of the tank pit. The sample will be placed in a laboratory-prepared jar, properly labeled

and submitted to a laboratory to determine the fractional organic carbon (f_{oc}) content. The sample used for field screening may be submitted for this analysis.

Soil Properties Samples

Two Shelby tube soil samples will be collected in the unsaturated zone, within or below the zone of suspected soil contamination. These samples will be collected from a boring next to the fourth boring (B-4). Based on the subsurface conditions encountered at boring B-4, one sample will be collected at the depth anticipated to represent the zone of highest permeability; the second sample will be collected immediately above the water table. If one of the Shelby tube samples meets both of these criteria, the other Shelby tube sample will be collected at a depth where the second highest permeability is expected.

3.4 Analytical Methods

3.4.1 Petroleum Analysis

Tank N-12 was documented in SOW #110 to contain gasoline; therefore, soil samples selected for laboratory analyses will be tested for benzene, toluene, xylene, ethylbenzene, methyl-tertiary-butyl-ether (MTBE), and TPH-GRO. Due to inconsistencies in records on the contents of the UST, soil samples will be analyzed for TPH-diesel range organics (TPH-DRO). In addition, one soil sample from each boring will be analyzed for volatile organic compounds (VOCs) at the request of the BRAC Closure Team (BCT). For laboratory analytical methods, refer to Section 6.11.

3.4.2 Fractional Organic Carbon Analysis

In determining the f_{oc} content of the soil, the laboratory will use one of the following methods: Walkey/Black, Lloyd Kahn, or ASTM Method D2974-87 (Nelson & Summers).

3.4.3 Soil Property Analysis

The two Shelby tube soil samples will be tested to determine the soil permeability in the unsaturated zone within any zone of suspected contamination and below it. If the visual observation and the OVD screening indicate that contamination is not present at the B-4 location, then the undisturbed soil samples will be collected without consideration for contamination. Permeability testing will be in accordance with either Section 2.8 (Triaxial Cell) or 2.9 (Pressure-Chamber Permeameter) of Method 9100 of *Test Methods for Evaluating Solid Waste*, Third Edition (SW-846). The laboratory will be asked to select the most permeable section of the sample and to determine the following properties:

Permeability	centimeters (cm)/second (sec)
Volumetric Air Content	cm^3-air/cm^3-soil
Volumetric Water Content	cm^3-H_2O/cm^3-soil
Total Soil Porosity	cm^3/cm^3-soil
Soil Bulk Density	g-soil/cm^3-soil
Fractional Organic Carbon	g-carbon/g-soil

The laboratory will indicate whether the sample came from the vadose zone or the capillary fringe. The sample determined to have the highest permeability will indicate the applicable cleanup levels for the various test parameters. The cleanup levels are listed in Table 3-2.

3.5 Boring Abandonment

All soil borings not converted into groundwater monitoring wells will be grouted with a mixture of Portland cement and 4%-6% powdered bentonite using a grout density of 13.5 to 14.1 pounds (lbs)/gallon (gal). Grouting will continue until the grout flowing out of the borehole has a density of at least 13.5 lbs/gal. If water is present in the boring or the borehole is more than 30 feet deep, a tremie pipe will be used to place the grout. The upper 2 feet of the boring does not have to remain filled with grout at completion and may be filled with material appropriate for the location.

Table 3-2
Soil Cleanup Levels (ppm)

	Benzene		TPH	
Soil Permeability	**Drinking Water**	**Non-Drinking Water**	**Drinking Water**	**Non-Drinking Water**
> 10-4 cm/sec	5	25	100	250
10-4 to 10-6 cm/sec	25	50	250	500
< 10-6 cm/sec	50	100	500	1000

Notes:
All results are in parts per million or milligrams per kilogram.
cm/sec = centimeters per second
TPH = Total Petroleum Hydrocarbon

3.6 Decontamination Procedures

The decontamination procedures to be used at this site are outlined in Section 6.4.

3.7 Investigation-Derived Waste

Auger cuttings generated from the soil boring will be containerized in 55-gallon steel drums and segregated by soil boring. This material will be sampled and analyzed for benzene, TPH-GRO, and TPH-DRO. If benzene concentrations are below 5ppm and TPH concentrations (GRO + DRO) are below 100 ppm, then the cuttings material will be removed from the drum and spread onsite. The empty drums will be triple rinsed and turned over to the NSA Memphis Public Works department. If TPH concentrations (GRO + DRO) and benzene concentrations exceed 100 ppm and 5 ppm respectively, then additional samples will be analyzed for Toxicity Characteristic Leaching Procedure (TCLP) benzene and TCLP lead. Analytical results from these tests will be used to facilitate disposal of this material as a special waste. If TCLP benzene and TCLP lead concentration exceed the regulatory limits for a special waste (0.5 mg/L and 5.0 mg/L, respectively), then this material will be turned over to the NSA Memphis Public Works department for disposal.

4.0 GROUNDWATER INVESTIGATION PROCEDURES

4.1 Number, Type, and Location of Monitoring Wells

TDEC UST regulations require the installation of at least four monitoring wells to assess groundwater conditions. The four required well locations will correspond to the locations of the converted soil borings, which include one upgradient location (B-1/MW-1), two downgradient locations (B-2/MW-2; B-3/MW-3), and one location as near the suspected release point as possible (B-4/MW-4). The single-cased monitoring wells will be installed in the uppermost water-bearing zone. The general direction of groundwater flow in the area has been determined to be to the west (E\A&H, *Final Environmental Assessment Report Tanks 7, 303, 1241*, November 1993). Proposed boring/monitoring well locations are shown on Figure 3-1.

If additional groundwater data becomes necessary, three supplementary groundwater monitoring wells are proposed to help identify contaminant movement. The location of these wells will be determined after the initial well sampling has been completed and analyzed.

Monitoring wells will be identified by applying a unique number to each well using the following format and guidelines:

FORMAT: 1 2 3 4 5 6 7 8

1 2 3 — The first three digits will designate the site (N12).

4 — This digit represents the matrix of the sample. G will be used to designate groundwater.

5 6 7 8 — These four digits are for the monitoring well identification. The first two digits will be well number (i.e., 01, 02) followed by the unit that the well is screened (LS = loess, UF = upper fluvial, LF = lower fluvial).

4.2 Drilling Methods

The original borings will be advanced by hollow-stem auger drilling techniques approximately 10 feet into the saturated zone or approximately 20 to 30 feet bgs. Bedrock will not be encountered during drilling. Based on previous drilling in the area, the saturated zone should be encountered from 10 to 20 feet bgs. Advancing the borings 10 feet into the saturated zone will allow for installation of a 15-foot well screen in accordance with TDEC recommendations.

4.3 Single-Cased Well Installation Procedures

Based on previous well installations in the area, groundwater monitoring wells will be constructed using single-cased installations. The following paragraphs detail the steps to be followed. Should it become apparent that double-cased monitoring wells are needed, the procedures described in the *TDEC UST Environmental Assessment Guidelines (EAG)*, August 1996 (pages 8-10) are to be followed.

- **Casing and Screen Type** — The casing and screen shall be constructed of 2-inch ID, pre-cleaned, flush threaded, Schedule 40 PVC. The screen, which is to have 0.01-inch factory milled slots, will be terminated with a threaded end cap. The casing will be terminated with a locking, watertight cap.

- **Screen Length and Placement** — The screen should be long enough and placed so that it intersects the water table at all times. A 15-foot screen should have 10 feet of screen below the water table and 5 feet above it. A centralizer shall be used in all single-cased

monitoring wells with a total depth of more than 20 feet. The centralizer shall be placed below the screened interval at the bottom of the well.

- **Minimum Borehole Diameter** — The borehole diameter will be at least 4 inches larger than the outside diameter of the well casing. For example, a 2.5-inch OD casing would require a 6.5-inch diameter borehole. A waiver is granted in cases where a 5.5-inch OD or larger core barrel is used to drill the bedrock portion of the hole; however bedrock will not be encountered at this site.

- **Placement and Type of Filter Pack** — At least 6 inches of the filter pack material will be placed under the bottom of the well screen to provide a firm footing. The filter pack will extend 2 feet above the screened section. A weighted tape will be used to help prevent bridging and to ensure the proper placement of the filter pack. If the total depth of the borehole exceeds 30 feet, a tremie pipe will be used to properly place the filter pack. The use of a tremie pipe is **not required** if the well is installed through a hollow-stem auger. The filter pack shall consist of clean, washed, well sorted silica sand. To reduce particulate infiltration in the well, the formation grain size encountered will be considered when selecting the filter pack grain size.

- **Placement and Type of Filter Pack Seal** — The filter pack seal will be placed atop the filter pack and be at least 2 feet thick. The filter pack seal will consist of high solids pure bentonite pellets. A weighted tape will be used to help prevent bridging and to ensure proper placement of the filter pack seal. If the total depth of the borehole exceeds 30 feet, a tremie pipe will be used to place the seal. The use of a tremie pipe is **not required** if the well is installed through a hollow-stem auger. If the bentonite seal is placed above the water table, 2 gallons of potable water will be used to hydrate the pellets. The hydration time for the bentonite pellets will be at least one hour.

- **Placement and Type of Annular Grout** — The annular grout will extend from the top of the filter pack seal to within 2 feet of the surface. The annular grout will consist of a mixture of Portland cement and 4%-6% powdered bentonite with a grout density of 13.5 to 14.1 lbs/gal. If water is present in the boring or the depth to the filter pack seal is greater than 30 feet, a tremie pipe will be used to ensure proper placement of the grout. The use of a tremie pipe is **not required** if the well is installed through a hollow-stem auger.

- **Surface Completion (Flush Mount)** — The final 2 feet of the annular space will be filled with concrete terminating with a flush-mounted manhole with a watertight, bolt-down, loadbearing cover. Manholes will be concreted in place with the concrete sloped away from the manhole to divert surface drainage. A locking watertight cap will be used for below-grade installations. All wells will be clearly marked with permanent well tags in accordance with established guidelines for Navy monitoring wells. Surface completions will be used in traffic areas.

- **Construct Wellhead Pad (Above-grade)** — Mix and pour concrete for the wellhead pad. Concrete must extend below the frost line and to the top of grout. It may be convenient to first fill the annulus to the bottom of the pad form and then set the locking well cover. After the protective casing has been installed, the remaining concrete should be poured into the pad form. Finish the concrete pad so that it slopes away from the wellhead in all directions with a minimum thickness of 6 inches. If weather conditions warrant, cover the concrete until cured. Lock the well cover. Set the protective posts (4-inch diameter, 6-feet long, 1/4-inch thickness, concrete-filled) in the concrete pad at a depth of 3 feet. Above grade completions will be used at locations in grassy areas.

4.4 Well Development, Surveying, and Water Level Measurements

Well development

Monitoring wells will be developed after the cement/grout in the annular space of the well has cured for at least 24 hours. Development is conducted to condition the walls of the geologic formation near the borehole. Monitoring wells can be developed using various techniques such as bailing, surging and bailing, or surging and pumping. Monitoring well development will proceed until the water withdrawn is relatively free of turbidity, based on the geology of the area, and pH, temperature, and specific conductivity have stabilized (pH = $\pm$ 0.5 units, temperature = $\pm$ 1° C, conductivity = $\pm$ 10%) over three consecutive readings.

Surveying

Surveying will be performed to obtain the following information:

- The elevation of the established and documented point on the top of each well casing correlated with a mean sea level (msl) datum, if available.

- The distance and angle from monitoring well four (MW-4) to the established and documented point on the top of each well casing shall be measured. All angles shall be measured from magnetic north. This data shall be used to establish the monitoring well location map.

Water Level Measurements

Before well development a water level will be measured and the following formula used to calculate the volume of water necessary to purge the well.

Static Volume Formula:

For a two-inch inner diameter well:

$$V = 0.041\ d^2h \text{ or,}$$

$$V = 0.163\ h$$

Where:

V = volume of water in gallons

d = diameter of well in inches

h = depth of water in feet (total well depth — static water level)

All water level measurements, including total well depth measurements, shall be referenced from an established and documented point at the top of the well casing. Measurements shall be referenced with mean sea level datum to the nearest 0.01 foot.

Static water levels will be measured using an electronic water level indicator. Measurements shall be taken at least 24 hours after completion of well development, but before purging. Static water levels shall be taken before each sampling event. If free product is encountered during water level measurements, the thickness of the free product will be measured to the nearest 0.01 foot.

All downhole equipment will be new and disposable or properly decontaminated between each sampling location.

4.5 Groundwater Sampling

Groundwater samples will initially be collected from the four monitoring wells installed as a part of this assessment and subsequently from the three additional monitoring wells should installation become necessary. Groundwater will not be sampled from any well containing 0.01 foot or more free product. The following procedures shall be used for groundwater sampling.

4.5.1 Purging

The static water level in each well will be determined and the well volume calculated before sampling. At least three well volumes shall be purged from each well before sampling. If the well is purged dry before removing three well volumes, no further purging is required. Samples shall be collected as soon as a sufficient volume of groundwater has recharged into the well.

4.5.2 Sample Containers and Preservation

Sample containers shall be pre-cleaned and sealed by the distributor or laboratory. Sample bottles for analytes will follow the parameters listed in Section 6.9.1.

4.5.3 Collection Method

All groundwater samples will be collected using new, disposable or dedicated bailers. To reduce agitation of the sample, the bailer shall be lowered slowly into the water column. When the sample is being transferred from the bailer to the sample container, care will be taken to reduce agitation. When volatile organic samples are being collected, the sample container will be completely filled so that air bubbles are not trapped inside. Care shall be taken to have minimal overflow so that the preservative is not lost.

Samples will be immediately labeled, placed on ice in a cooler and chilled to approximately 4° C. They will be maintained at this temperature until delivered to the state-approved laboratory. A chain-of-custody form completed for each groundwater sample collected, will be signed by the person collecting the sample and the laboratory receiving the sample. Sample security shall be maintained during all phases of transport.

No sampling equipment shall be placed directly on the ground or other possibly contaminated surface before insertion into a well. All sampling equipment will be placed on clean plastic sheeting or other appropriate material during all sampling activities.

4.5.4 Disposal of Purge and Development Water

Disposal of purge and development water derived from the installation of groundwater monitoring wells is discussed in Section 4.9, Investigation-Derived Waste (IDW).

4.6 Analytical Methods

The analytical methods are discussed further in Section 6.11. Tank N-12 was documented in the SOW #110 as containing gasoline; therefore, groundwater samples selected for laboratory analyses will be tested for benzene, toluene, xylene, ethylbenzene, MTBE, and TPH-GRO. Due to inconsistencies in records on UST contents and at the request of the BCT, VOCs and TPH-DRO have been added to the analyses mandated by the state of Tennessee.

4.7 Groundwater Classification Procedure

4.7.1 Water Use Survey

A water use survey will be completed for the surrounding area in accordance with *TDEC UST EAG*, August 1996. This includes a field survey within a one-quarter mile radius of the UST site to determine the existence of any water use supplies. In addition, a records search will be performed for an area within a one-half mile radius of the UST site to determine the existence of any water use supplies. If a drinking water supply is identified, then the user will be personally contacted and a water use survey form completed for each water supply identified. If any aquifer or water source is being used by the citizens of the state, then the aquifer or water source will be classified as a drinking water supply.

If any drinking water supply (well or spring) is found within a one-half mile radius of the UST site, justification may be provided describing why the water supply should not be used in classifying the impacted aquifer or water source as a drinking water supply. The justification will include the direction of groundwater flow and the hydrogeologic characteristics (i.e., hydrologic boundaries).

4.7.2 Analytical Sampling

To determine if the impacted groundwater meets the primary and secondary drinking water standards of Rule 1200-5-1, the well with the lowest petroleum-based contamination shall be tested for iron and manganese. The analytical method is presented in Section 6.11. If results indicate that concentrations are below the established secondary standard for both parameters, a second sample shall be collected and analyzed for the remaining primary and secondary standards. If the impacted groundwater fails to meet any of the primary or secondary standards and is not a drinking water source as determined in the water use survey, it may be classified as a nondrinking water supply.

Due to the findings of other groundwater tests in the vicinity, it is not anticipated that the shallow water-bearing zone at this site will pass the secondary standards for iron or manganese. It is assumed that a pumping test will be unnecessary for these reasons; however, should one become necessary, the procedure outlined in the *TDEC UST EAG*, August 1996 (page 14) shall be followed.

4.7.3 Slug Test

Rising-head slug tests will be conducted at three to four of the monitoring wells to provide hydraulic conductivity data on the uppermost water-bearing unit at the tank site. This information will allow better assessment of the hydrogeology at the site and aid in any remedial design effort which may be needed. Slug tests will be conducted after well development and groundwater sampling activities are complete to minimize contamination.

The tests will be conducted using a pressure transducer and data logger to continuously measure and record water level data after the rapid insertion or removal of a stainless steel slug into the water column. Hydraulic conductivities will then be determined using the computer program

AQTESOLV (Aquifer Test Solver) by the Geraghty and Miller Modeling Group. This information will be used to prepare a Corrective Action Plan, if one is necessary.

4.8 Decontamination Procedures

The decontamination procedures are discussed in Section 6.4.

4.9 Investigation-Derived Waste

All purge water and water resulting from well development will be containerized in 55-gallon drums. This material will be sampled and analyzed for VOCs and ignitability. If concentrations are within discharge limits and if approved by the publicly owned treatment works (POTW) and NSA Public Works Department, EnSafe Inc. will pump this material to the POTW through the base's oil-water separator. The empty drums will be triple rinsed and turned over to the NSA Memphis Public Works Department. If concentrations exceed the discharge limits, this material will be turned over to the NSA Memphis Public Works Department for disposal.

5.0 HEALTH AND SAFETY PLAN

5.1 Introduction

As part of the U.S. Navy's Installation Restoration Program, the following site-specific health and safety plan (SSHSP) has been prepared for the investigation of a former UST adjacent to Building N-12 at NSA Memphis.

This SSHSP is to be used in conjunction with the approved NSA Memphis *Comprehensive Health and Safety Plan* (CHASP). Copies of both this plan and the CHASP will be onsite during all field operations.

Applicability

Current Hazardous Waste Operations and Emergency Response (HAZWOPER) training certificates for EnSafe employees and subcontractors anticipated to be conducting fieldwork will be filed onsite and available for review. Individuals whose certifications are not on file, or those who have more recent certificates (have attended a refresher course), will provide the Site Supervisor with copies of their certificates before being allowed to enter a work area.

Current Occupational Safety and Health Administration (OSHA) refresher training certificates will be available onsite for all employees involved in field activities. All subcontractors, Department of Defense oversight personnel, and any other site visitors must provide health and safety certification with appropriate refresher course documentation prior to site entry.

5.2 Site Characterization

5.2.1 Site Description

The UST adjacent to Building N-12 was a underground storage tank for gasoline and diesel.

5.2.2 Work Areas

Site control will be established and maintained around any ground-intrusive activities in accordance with the recommendations in the U.S. Environmental Protection Agency's *Interim Standard Operating Safety Guides*, revised September 1982. Three general zones of operation will be established in the field 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 is the area where contamination is identified. All personnel within it must use the prescribed levels of personal protective equipment (PPE). The exclusion zone boundary (hotline) is established based upon the suspected presence of contaminated materials. The boundary may be adjusted based on subsequent observations and/or measurements of the contaminant concentrations and/or level of effort. Gross decontamination of personnel (i.e., protective coveralls, gloves, etc.) will occur in the work area, as required, with most personnel decontamination activities occurring in a decontamination area. Only authorized personnel with at least of 40 hours health and safety training meeting the requirements of OSHA Title 29 Code of Federal Regulations (CFR) Part 1910.120 and three days of supervised field experience are permitted within the exclusion and contamination reduction zones.

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

- Assist his or her partner.
- 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 site manager, his representative, or others if emergency help is needed.

A decontamination area will serve as the **contamination reduction zone** for most site activities and will serve as a buffer between the primary exclusion zone and the support zone. It 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 PPE. Exiting the contamination reduction zone requires the removal of all contaminants through compliance with established decontamination procedures (Section 5.7).

The support zone is the outermost area and is considered an uncontaminated or clean area. It contains the first-aid equipment and other supplies and equipment necessary to support, exclusion and contamination reduction zone activities. Normal street clothes can be worn here.

5.2.3 Work Area Access

Authorized personnel will be allowed access to work areas as long as they follow the requirements of this SSHSP and the CHASP. See also Work Area Access, Section 7.1.2 of the CHASP.

5.2.4 Work Zones

The actual work zone locations will be based on physical layout of the site, work task requirements, and current meteorological conditions (see Figure 5-1).

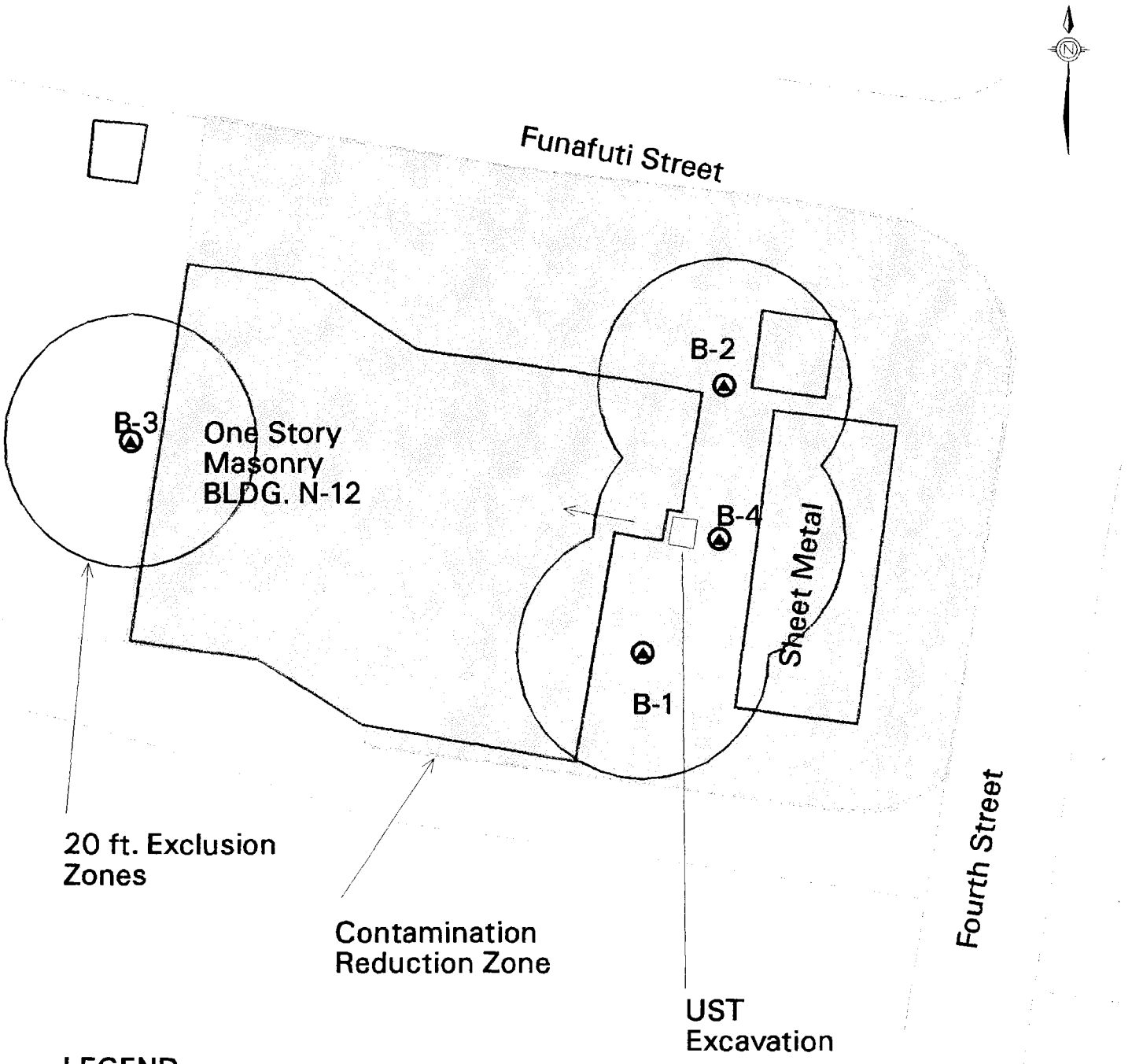
5.3 Site Activities

5.3.1 Monitoring Well Installation

Monitoring wells will installed using a mobile drill rig.

5.3.2 Soil Sampling

Soil samples will be collected during monitoring well installation.



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Plan of Action
UST N-12
NSA Memphis

FIGURE 5-1
Work Zones

5.3.3 Groundwater Sampling

Groundwater samples will be collected from the completed monitoring wells.

5.4 Chemical Hazards

Exposure guidelines for chemical hazards expected to be encountered at the site are listed in Table 5-1. The constituents that may be encountered include: benzene, toluene, ethyl benzene, lead, xylene, and diesel. Additional constituents identified during site activities will be incorporated in the health and safety plan addendum. Material Safety Data Sheets (MSDS) for the constituents listed below are included as Appendix B.

Table 5-1
Exposure Guidelines for Site Chemical Hazards

Chemical Name	Odor Threshold	OSHA PEL[a]	ACGIH TLV[b]	NIOSH REL[c]	Site Action Levels (ppm) [d,e]	Air Monitoring Device [f]
Benzene	61 ppm	1 ppm	10 ppm	0.1 ppm	0.05 ppm	PID or FID
Toluene	40 ppm	100	50	100	25	PID or FID
Acetone	100 ppm	1000	750	250	125	PID or FID
Ethyl Benzene	ppm	100	100	100	50	PID or FID
Lead	N.A.	.050 mg/m^3	0.15 mg/m^3	0.1 mg/m^3	.025 mg/m^3	N.A.
Xylene	Not Listed	100	100	100	50	PID or FID
Diesel	ppm	none	Not Listed	100	50	PID or FID

Notes:
[a] = 29 CFR 1910.1000, Table Z-1-A. Limits for Air Contaminants, as amended through 1/15/91.
[b] = 1990-1991 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, ACGIH
[c] = NIOSH Pocket Guide to Chemical Hazards, June 1990
[d] = Site Action Levels calculated as 50% of TLV or PEL (as measured by NIOSH methods)-whichever is lower
[e] = Site Action levels for unknown VOCs as measured by Real Time Photoionization detector = 1 ppm. Site Action levels (for upgrading from Level C to Level B) for unknown VOCs as measured by Real Time Photoionization detector = 5 ppm.
[f] = A photoionization detector (PID) or a flame ionization detector (FID) will be used.
mg/m^3 = milligram per cubic meter
REL = Recommended Exposure Limit
Material Safety Data Sheet for the listed materials are included in Appendix B.

5.5 Operations and Physical Hazards

Physical hazards typically encountered during environmental investigations will be present onsite. These hazards include heat-related illnesses, slippery surfaces, lifting, and use of heavy equipment. The Site Supervisor and Site Health and Safety Officer (SHSO) shall be aware of the potential for heat stress and other weather-related illnesses, and as necessary, implement appropriate work regimens to minimize the likelihood of field personnel becoming ill.

Heavy equipment operations will be conducted in accordance with the procedures outlined in the CHASP, Attachment B. When conducting operations or survey work on foot, personnel will walk at all times. Running greatly increases the probability of slipping, tripping, and falling.

5.6 Employee Protection

Employee protection for this project includes standard safe work practices, NSA Memphis rules of conduct, PPE, personal decontamination procedures, and equipment for extreme weather conditions, work limitations, and exposure evaluation.

5.6.1 Standard Safe Work Practices

See Section 7.5.1 of the CHASP for Standard Safe Work Practices.

5.6.2 NSA Memphis General Rules of Conduct

See Section 7.5.2 of the CHASP for NSA Memphis General Rules of Conduct.

5.6.3 Selection of Personal Protective Equipment

It is important that PPE 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 PPE required, based on experience and sound safety practices.

The Project Health and Safety Officer (PHSO) will determine the appropriate level of PPE prior to the initial site entry based on the best available information. PPE requirements are subject to change as site information is updated or changes. **The decision to upgrade or downgrade levels of PPE shall be made by the PHSO.**

Field activities will be initiated in Modified Level D protection except when stated otherwise in this plan or when site conditions (e.g., sampling results from previous studies) indicate that modified Level D is inappropriate. Modified Level D protection consist of a hard hat, appropriate chemical-resistant gloves (vinyl or nitrile), eye protection, and chemical-resistant, steel-toed boots. Chemical protective coveralls (full length sleeves and pants) will be worn if free product or contaminants identified as skin irritants are encountered. This level of protection was selected because the concentrations of contaminants detected in previous studies were low and free product was not detected.

PPE upgrades to Level C will be initiated if airborne concentrations exceed 10 parts per million (ppm) above the background concentration in the breathing zone or if the concentration of any contaminant exceeds 50% of the OSHA Permissible Exposure Limit (See Section 5.6.4). See Table 7-1 in the CHASP for the specific criteria for use and equipment for each level of protection.

5.6.4 Air Monitoring

Previous site investigations indicate that workers may be exposed to low concentrations of chemicals including VOCs, combustible gases/vapors. Based on site history and existing sampling data, "worst case" contaminated areas will be identified before field activities begin.

Air monitoring using a photoionization detector (PID) and/or other appropriate sampling equipment will be conducted prior to beginning field activities at a new exclusion zone and during ground-disturbing activities. The PID will be field calibrated to measure VOCs relative to a 100 ppm isobutylene standard. If VOCs are detected downhole, colorimetric detector tubes and/or other sampling media may be used to determine the identification and approximate concentration of these compounds.

A combustible gas indicator (CGI) will be used during all soil borings and well installations. The CGI will be field-calibrated to measure flammable gases relative to a 23% lower explosive limit (LEL) methane standard. Downhole CGI readings will be collected continuously during all soil-disturbing operations. Field activities will immediately cease if downhole readings exceed 10% LEL. If CGI readings do not subside, the area will be carefully investigated and mapped. Operations may not proceed until readings are below 10% LEL. The area will be immediately evacuated and the situation reevaluated to determine how to proceed.

If breathing zone levels exceed 10 ppm above background or site conditions indicate that additional health and safety precautions are needed, field activities in the area shall stop. Field staff shall notify the Site Supervisor of the situation and he/she shall contact both the Project Manager and the PHSO. The PHSO will be responsible for reassessing the hazards and prescribing revised health and safety requirements as necessary, including upgraded PPE requirements, revised work schedules, and revised decontamination procedures. (Typically, PPE will be upgraded to Level C assuming that cartridge respirators are appropriate, otherwise Level B.) See Table 6-1 of the CHASP for specific criteria for each protection level. Work shall not proceed until breathing zone concentrations return to background levels and it is reasonably anticipated that breathing zone samples will stay approximately at background levels, or the chemical constituent(s) are identified and appropriate PPE is donned.

Field monitoring values will be recorded in a field logbook and copies must be posted for field personnel review.

PIDs, CGIs, and other monitoring equipment shall be calibrated daily their proper function verified before being used. Throughout the day this equipment shall be periodically checked to ensure it is working properly. A final calibration shall be conducted at the end of the workday, at which time each instrument will be checked to ensure it is free from surface contamination. Field staff shall note in their field notebooks that they conducted these calibrations and checks and note whether the equipment was functioning properly. When equipment is malfunctioning, it should be brought to the attention of the Site Supervisor or SHSO, who will arrange to repair or replace that equipment as needed.

5.6.5 Procedures and Equipment for Extreme Hot or Cold Weather Conditions

See CHASP Section 7.5.5.

Severe Weather Conditions

All fieldwork shall immediately cease at the first sign of thunder or lightning. Field personnel shall perform emergency personal and equipment decontamination (see Section 5.7) and seek immediate shelter.

5.7 Personal Decontamination

See Section 7.5.6 of the CHASP for information on personal decontamination.

5.7.1 Personal Decontamination Procedures

See Section 7.5.6.1 of the CHASP for information on personal decontamination procedures. All wastes (soil and water) generated during personal decontamination will be consolidated with the excavated soil and building debris.

5.7.2 Closure of the Personal Decontamination Station

All disposable clothing and plastic sheeting used during site activities will be double-bagged and discarded in a labeled refuse container. Decontamination and rinse solutions will be placed in a 55-gallon barrel for later analysis and disposal. All washtubs, pails, buckets, etc. will be washed, rinsed, and dried at the end of each workday.

5.8 Work Limitations

All site activities will be conducted during daylight 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 annually to continue working onsite.

5.9 Exposure Evaluation

See Section 7.5.8 of the CHASP for information on exposure evaluation.

5.10 Medical Monitoring Program

See CHASP Section 7.6.

5.11 Authorized Personnel

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

- Principal-in-Charge — Dr. James Speakman (EnSafe)
- Task Order Manager/Project Manager — Ms. Allison Dennen (EnSafe)
- Project Health and Safety Officer — Mr. Bill Bradshaw (EnSafe)
- Onsite Supervisor — Ms. Allison Dennen (EnSafe)
- Engineer-in-Charge — Mr. John Karlyk (SOUTHNAVFACENGCOM)
- NSA Memphis Site Contact — Mr. Randy Wilson

5.11.1 Responsibilities of Onsite Supervisor

See Section 7.7.1 of the CHASP for responsibilities of the site manager.

5.11.2 Responsibilities of Site Health and Safety Officer

See Section 7.7.2 of the CHASP for responsibilities of SHSO.

5.11.3 Responsibilities of Onsite Field Staff

See Section 7.7.3 of the CHASP for responsibilities of onsite field staff.

5.12 Emergency Information

All hazardous waste site activities present a risk to onsite personnel. Risk is minimized during routine operations by establishing good work practices, staying alert, and using proper PPE. 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, Mr. Randy Wilson, the NSA Memphis site contact, will be informed and the appropriate contact from the following list will be made:

Contact	Agency or Organization	Telephone
Randy Wilson	NSA Memphis	(901) 874-5461
John Karlyk	SOUTHNAVFACENGCOM EIC	(803) 820-5624
Law Enforcement	NSA Memphis Base Security	9-911
Fire Department	NSA Memphis	9-911

Contact	Agency or Organization	Telephone
Ambulance Service	Naval Hospital, Millington Navy Road	(901) 874-5801/5802 or 9-911
Hospital	Methodist North Hospital 3960 Covington Pike	(901) 372-5211 or 9-911
Southern Poison Control Center	—	(901) 528-6048
Allison Dennen	EnSafe	(901) 372-7962
Bill Bradshaw	EnSafe	(901) 372-7962

John Karlyk, Southern Division Engineer-in-Charge (SOUTHNAVFACENGCOM EIC) will be contacted after appropriate emergency measures have been initiated onsite.

5.12.1 Site Resources

Cellular telephones may be used for emergencies and communication/coordination with NSA Memphis. First-aid and eyewash equipment will be available at the work area.

5.12.2 Emergency Procedures

Conditions that may constitute an emergency include any member of the field crew being involved in an accident or experiencing any adverse effects or symptoms of exposure while onsite or if a condition is discovered that suggests the situation is more hazardous than anticipated.

The following emergency procedures should be followed:

- Site work area entrance and exit routes will be planned and emergency escape routes delineated by the Site Health and Safety Officer. Copies of the emergency contacts and routes will be posted onsite.

- If any member of the field team experiences any effects or symptoms of exposure while on the scene, the entire field crew will immediately stop work and act according to the SHSO's instruction.

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

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

- If an accident occurs, the Site Manager is to complete an Accident Report Form (see Attachment B of CHASP) for submittal to the managing principal-in-charge of the project.

- If a member of the field crew suffers a personal injury, the SHSO will call **(901) 372-5211 (Methodist North Hospital) or 9-911** (serious injury) to alert appropriate emergency response agencies or administer onsite 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 chemical exposure, the affected areas should be flushed immediately with copious amounts of clean water, and if the situation dictates, the SHSO should alert appropriate emergency response agencies, or personally ensure that the exposed individual is transported to the nearest medical facility for prompt treatment. (See Appendix C for map to the emergency medical facility.) An Accident Report Form will be completed for any such incident.

Additional information on appropriate chemical exposure treatment methods will be provided through the MSDSs, which are in the NSA Memphis Field Trailer.

5.13 Forms

The following forms will be used in implementing this SSHSP:

- Plan Acceptance Form
- Plan Feedback Form
- Exposure History Form
- Accident Report Form

The Plan Acceptance Form will be filled out by all employees working onsite before site activities begin. 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 Site Manager and the individual(s) for whom the form is intended. Examples of each form are provided in Appendix D. **All completed forms must be returned to the Project Manager at EnSafe, Memphis, Tennessee.**

6.0 QUALITY ASSURANCE PLAN

6.1 Introduction

This section presents policies, project organization, objectives, and functional activities along with quality assurance/quality control (QA/QC) measures intended to achieve the quality assurance goals of the POA at NSA Memphis.

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

Applicable Guidance Documents:

- Environmental Protection Agency. (February 1991). *Standard Operating Procedures and Quality Assurance Manual.* Athens, Georgia.

- *Test Methods for Evaluation of Solid Waste (Physical/Chemical Methods), SW-846*, Third Edition, Update III, December 1996.

- SOUTHNAVFACENGCOM *Guidelines for Groundwater Monitoring Well Installation, Revision 4*, March 1989.

6.2 Quality Assurance/Quality Control Objectives

In general, QA objectives conducted as part of the Navy technical services contract assess and document the precision, accuracy, representativeness, completeness, and comparability of all sampling and analysis performed. Quality criteria are outlined here to assure suitability for intended use of data obtained during projects. U.S. Environmental Protection Agency [USEPA] Data Quality Objective (DQO) Level III will be used for this investigation.

6.2.1 Field Measurements

Quality assurance objectives for parameters to be measured in the field by EnSafe Inc. personnel are presented in Table 6-1. Field measurements will include pH, temperature, specific conductance, and static groundwater level. Field equipment shall be calibrated daily in accordance with the manufacturer's specifications and recorded in the field logbook.

Table 6-1
Field Measurements QA Targets

Field Measurements	Method #	Matrix	Precision		Accuracy	Completeness
pH	150.1	Water	± 0.5 S.U.		± 0.2 S.U.	90%
Temperature	170.1	Water	± 1.0° C		± 0.2° C	90%
Specific Conductivity	120.1	Water	± 10%		± 1% of full scale	90%
Static Water Level	Manufacturer's SOP	Water	± 0.01 ft.		± 0.05 feet	90%
PID/FID	–	Air	± 10 ppm		± 2 ppm	90%
Well Head Points	–	Spatial	Standard Land Surveying Methods	± 5%	± 0.1 feet	100%
			GPS	± 5%	± 3.0 cm	100%
		Vertical	Standard Land Surveying Methods	± 0.05 feet	± 0.01 feet	100%
			GPS	5 %	± 3.0 cm	100%

Notes:
– = not applicable
SOP = Standard Operating Procedure

6.2.2 Laboratory Analyses

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. Anticipated general QA goals for these methods are presented in Table 6-2.

Table 6-2
Laboratory Measurement QA Objectives

Parameter	Precision (RPD)	Accuracy (% Recovery)	Completeness
Benzene/BTEX/MTBE	±25%	70% - 130%	95%
Total VOCs	±25%	70% - 130%	95%
TPH-GRO	±25%	70% - 130%	95%
TPH-DRO	±25%	70% - 130%	95%
TCLP Benzene	±25%	70% - 130%	95%
TCLP Lead	20%	75% - 125%	95%
Ignitability/Flashpoint	—	—	—
Iron and Manganese	20%	75% - 125%	95%

Note:
— = not applicable
BTEX = benzene, toluene, ethylbenzene, xylene

6.2.3 Precision and Accuracy

Methods of assessing precision and accuracy measurements are discussed in Section 6.13 of this document. General precision and accuracy goals for laboratory analytical procedures (USEPA Level III) are also provided in Table 6-2.

6.2.4 Representativeness

Soil and groundwater monitoring well samples will be collected and well parameters will be measured in accordance with the USEPA Region IV Environmental Compliance Branch *Standard Operating Procedures and Quality Assurance Manual, February 1991* (SOP/QAM) to ensure that samples collected during this investigation will be representative of the area of concern.

6.2.5 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 for this assessment.

6.2.6 Comparability

Comparability is assured through the use of established methods of sampling and analysis as specified in the USEPA SOP/QAM.

6.3 Project Organization and Responsibilities

Project coordination responsibilities lie with the SOUTHNAVFACENGCOM Engineer-In-Charge (EIC). The following sections describe the project chain-of-command.

6.3.1 Oversight

Engineering Field Division is responsible for providing the EIC who provides the site information and history, logistical assistance, assists in specifying the sites requiring investigation and reviews results and recommendations. The EIC is responsible for coordinating procurement, finance, and reporting; for communicating comments from other technical reviewers to the subcontractors; and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

State or Local Oversight will be provided by TDEC for this investigation. The POA will be prepared in accordance with TDEC requirements and guidelines. The investigation results will be presented to the TDEC in the form of a Environmental Assessment Report (EAR). This field investigation has been requested in accordance with the requirements of the TDEC Division of Underground Storage Tanks *Environmental Assessment Guidelines* (August 1996).

6.3.2 Investigation Performance

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

Engineering Subcontractor

EnSafe will serve as the Engineering Subcontractor for this project. As such, EnSafe is responsible for designing and implementing the field investigation. The EnSafe Task Order Manager is Allison Dennen.

Analytical Laboratory

The analytical laboratory employed by EnSafe must be a State-approved laboratory. 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 directly 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. Work will be performed in a manner consistent with other appropriate federal, state, and local guidelines, rules, regulations, and criteria.

6.4 Decontamination Procedures

Prior to any drilling activities, the drill rig and any other equipment to be used during the assessment shall be inspected for lubricant or other fluid leaks and repaired as necessary. All over-the-hole portions of the drilling equipment shall be steam cleaned before use and as necessary between boring locations. All downhole equipment (augers, drill rods, tools, etc.) shall be steam-cleaned prior to use and between all subsequent boring locations.

All sampling equipment that is not pre-cleaned and disposable (stainless-steel scoops, split spoons, etc.) and all monitoring equipment, shall be properly decontaminated before each use by being:

cleaned with a laboratory-grade detergent wash, triple-rinsed with distilled water, and, allowed to air dry (if time permits).

6.5 Soil Borings

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

6.5.1 Soil Sampling Procedures

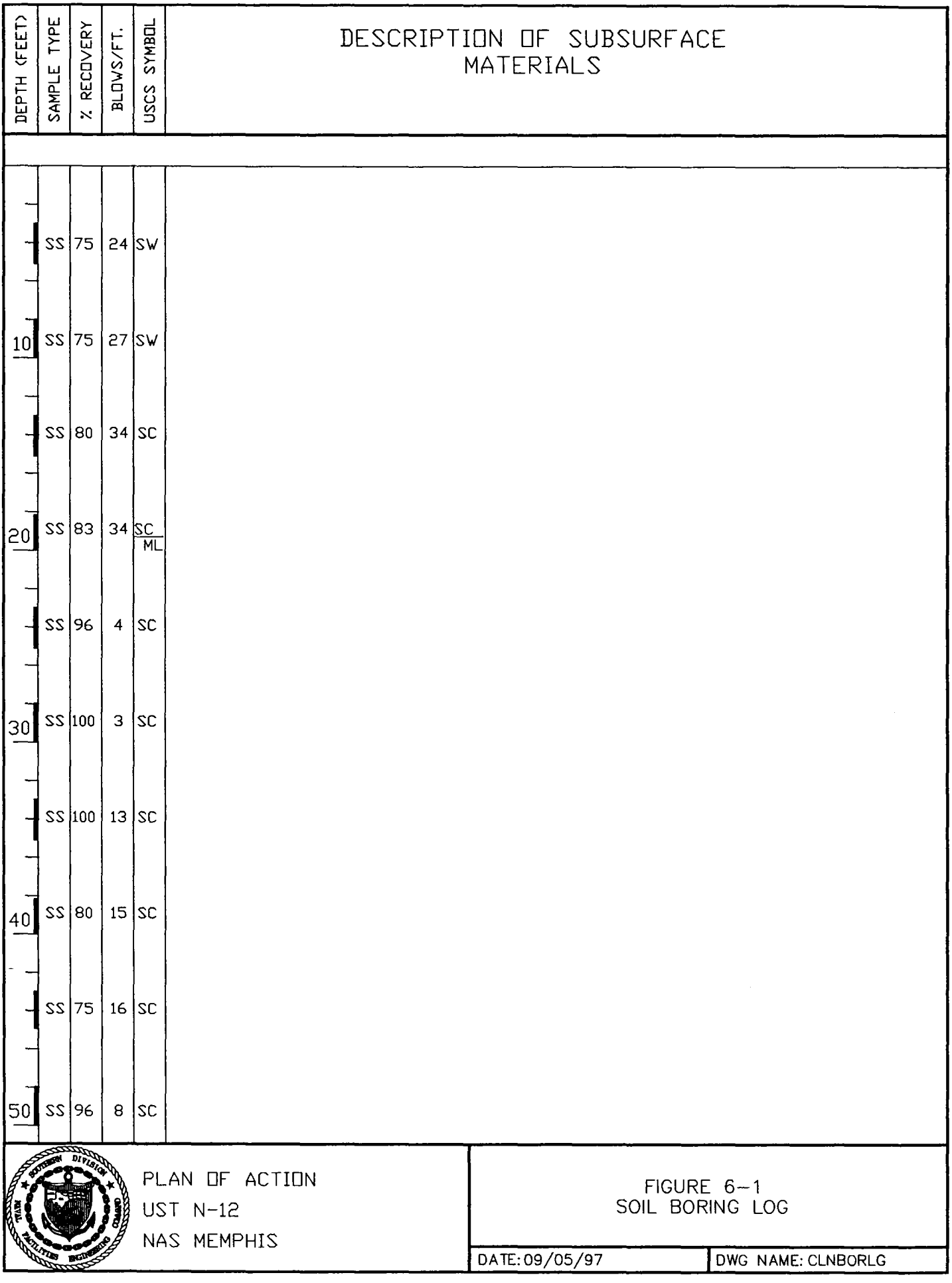
Seven soil borings will be installed and sampled in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation*. Selected soil samples from each boring will be submitted for laboratory analysis.

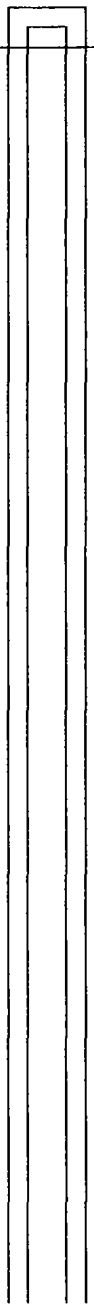
6.5.2 Soil Sample Documentation

EnSafe 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 6-1) 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 EnSafe project file.

6.6 Monitoring Well Installation

Monitoring well installation procedures are described in Section 4.3. Figure 6-2 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,


DEPTH (FEET)
SAMPLE TYPE
% RECOVERY
BLOWS/FT.
USCS SYMBOL
DESCRIPTION OF SUBSURFACE MATERIALS
SS 75 24 SW
10
SS 75 27 SW
SS 80 34 SC
20
SS 83 34 SC/ML
SS 96 4 SC
30
SS 100 3 SC
SS 100 13 SC
40
SS 80 15 SC
SS 75 16 SC
50
SS 96 8 SC
PLAN OF ACTION
UST N-12
NAS MEMPHIS
FIGURE 6-1
SOIL BORING LOG
DATE: 09/05/97
DWG NAME: CLNBORLG

DEPTH (FEET)	SAMPLE INTERVAL	SAMPLE NUMBER	PID (PPM)	DESCRIPTION OF SUBSURFACE MATERIALS	WELL CONSTRUCTION DETAILS
					
2					
4					
6					
8					
10					
12					
14					
16					
18					
20					
22					
24					
26					
28					
30					

DRILLER:

DRILLING AND SAMPLING METHOD:

DATE OF COMPLETION:

PLAN OF ACTION
UST N-12
NSA MEMPHIS

FIGURE 6-2
MONITORING WELL SCHEMATIC

DATE: 09/05/97

DWG NAME: CLNMONWL

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).

6.7 Monitoring Well Development

Upon completion of the monitoring wells, each well will be developed in accordance with the USEPA 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.

6.8 Groundwater Sampling

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

6.8.1 Static Water Level Measurement

Two sets of static water level measurements will be performed on all monitoring wells in accordance with the USEPA 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.

6.8.2 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	=	± 0.5 S.U.
Temperature	=	± 1° C
Conductivity	=	± 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 logbook and the well will be sampled as soon as possible after recovery. Well purging will be performed using a disposable or dedicated PVC bailer which is manually lowered and removed from the well.

6.8.3 Groundwater Sampling Procedures

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 USEPA SOP/QAM.

6.8.4 Groundwater Sample Documentation

EnSafe 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.

6.9 Sample Management

Refer to the procedures listed below to containerize, preserve, and package samples. Ship all samples to the selected laboratory via overnight delivery the day the samples are collected. Do not store samples overnight *unless* arrangements have been made with the laboratory. If samples *are* stored overnight, record the temperature of the storage container in the field logbook. Sample containers will be checked to ensure that proper preservatives have been added.

6.9.1 Sample Containers, Preservatives, Holding Times

Appropriate numbers of sample containers, preservatives, and trip blank samples will be provided by the laboratory. All glass containers must have Teflon-lined caps. Sample containers shall be pre-cleaned and sealed by the distributor or laboratory. Turnaround time is 28 days. Sample bottles for analytes will follow the parameters listed in Table 6-3.

6.9.2 Sample Preservation

The sample containers will be pre-preserved by the laboratory or will be purchased pre-preserved. All samples requiring chemical preservation will be preserved immediately upon collection in the field.

Table 6-3
Sample Containers and Preservatives

Parameter	Container	Preservative (Pre-preserved)
Water Samples		
BTEX/MTBE	two 40-ml glass vials with Teflon-lined septa	four drops of 1:1 hydrochloric acid, 4°C
Volatile Organic Compounds (VOCs)	three 40-ml glass vials with Teflon-lined septa	four drops of 1:1 hydrochloric acid, 4°C
TPH, Gasoline Range Organics (GRO)	two 40-ml glass vials with Teflon-lined septa	200-μL of 50% hydrochloric acid, 4°C
TPH, Diesel Range Organics (DRO)	two 1-liter amber glass bottles with Teflon-lined lid	5-ml of 1:1 hydrochloric acid, 4°C
Iron and Manganese	500-ml or 1-liter poly bottle	nitric acid, 4°C
Ignitability and Flashpoint	250-ml glass bottle with Teflon-lined lid	4°C
Soil Samples		
BTEX/MTBE	100-ml glass jar with Teflon-lined lid	4°C
VOCs	100-ml glass jar with Teflon-lined lid	4°C
TPH-GRO	100-ml glass jar with Teflon-lined lid	4°C
TPH-DRO	250-ml glass jar with Teflon-lined lid	4°C
TCLP for Benzene	100-ml glass jar with Teflon-lined lid	4°C
TCLP for Lead	100-ml glass jar with Teflon-lined lid	4°C

The following procedures will be followed when preserving samples.

1. Care will be taken to ensure that the samples are not overpreserved. Overpreserved samples may be considered dangerous goods and will require shipment in accordance with procedures described in the current Dangerous Goods Regulations.

2. When testing the pH of the sample, use a disposable pipette to obtain a sample to place on the paper. Do not insert the pH paper into the sample bottle because the pH paper may contain trace amounts of arsenic.

6.9.3 Packaging Samples for Shipment

Pack all samples for shipment to avoid breakage and to prevent cross-contamination.

Sample Packaging Procedures:

1. Select a cooler in good repair. Seal the drain plug on the inside and outside of the cooler with tape to prevent leakage.

2. Ensure that the cooler is clean and of sufficient quality for shipping purposes.

While Packaging Samples:

3. Place every sample container in a sealable plastic bag. Three FOC vials of the same sample may be bagged together.

4. To prevent breakage, place 2 to 4 inches of inert packing material on the bottom of the cooler and *either*:

   — Wrap samples in bubble wrap packing material or other suitable material. Seal the protective wrap around the containers with tape. Protective wrap is not required for plastic containers, but take care when packing the coolers so that the containers do not directly touch each other.

   or

— Place the bagged containers inside the cooler so the bottles do not touch each other. Place cooling material (e.g., bagged ice, blue ice) around and in between the samples. Completely fill any remaining space with inert packing material such as vermiculite or cellulose insulation.

5. Include a temperature blank or temperature strip in each sample cooler, if required by laboratory.

6. Place double-bagged ice inside the cooler to chill the samples to 4°C (± 2°C).

7. Fasten the top of the cooler's large plastic bag with tape.

8. Place a chain-of-custody record describing the contents of each cooler in a plastic bag and seal it inside each cooler.

9. Seal the cooler with tape and custody seals so that the cooler cannot be opened without breaking the seal.

Labeling the Package

10. Clearly print the words "This End Up" or "This Side Up" on the top of the outer cooler. Place upward pointing arrows on the sides of the package.

11. Mark the cooler with the addresses of the shipper and receiver.

12. If more than one cooler is to be shipped, mark the coolers with the sequential number of the cooler and the total number of coolers (e.g., 1 of 3, 2 of 3, and 3 of 3).

6.9.4 Sample Labels

Samples will be identified by completing sample labels and affixing them to the outside of each sample container. Each sample will be logged in the field logbook at the time of collection. A sample label is provided in Figure 6-3. Labels will include site, sample identification, collection time and date, method of preservation, sampler identification, and the analyses to be conducted.

Figure 6-3
Sample Label

EnSafe Inc. (901) 372-7962
Site: NSA Memphis Sample Number: Preservative: 4°C Analysis: Date: Time: Sampler:

Samples will be identified by applying a unique number to each sample using the following format and guidelines:

FORMAT: *X X X / 1 2 3 4 5 6 7 8 9 0*

X X X / — This prefix relates all samples to the assessment. The prefix **is not considered part of the actual sample ID**. The prefix for samples collected in support of this assessment is "MEM".

1 2 3 — The first three digits are for the site where the sample was collected: sites, plumes, buildings, background, etc.

4 — This digit represents the matrix of the sample or the type of QC sample it is. Abbreviations for matrices and QC samples collected in this assessment are listed below:

S — soil (surface and borings)
C — soil duplicate sample
G — groundwater
H — groundwater duplicate sample
Z — liquid waste (including IDW drums)
V — solid waste (including IDW drums)
K — MS sample
X — MSD sample
T — trip blank
E — equipment rinsate blank
F — field blank

5 6 7 8 — These four digits correlate the QC sample with the field samples associated with it. A simple way to accomplish this is to use the sampling location, for example the boring or well number, of a sample collected on the same day as the QC sample. This also will help keep the QC samples blind to the laboratory.

5 6 7 8 — These four digits are for the sampling location: boring or well number, existing well ID, etc. For QC samples, these four digits correlate the QC sample with the field samples affected by it. An easy way to accomplish this is to use the sampling location, for example the boring or well number,

of a sample collected on the same day as the QC sample. This will also help to keep the QC samples blind to the laboratory.

9 0 — The final two digits represent the sample-specific identification: depth to the nearest foot, depth interval, serial number for water and QC samples, etc.

All assigned sample numbers will be documented in the field logbooks to ensure that sample numbers are not duplicated.

6.9.5 Sample Chain-Of-Custody

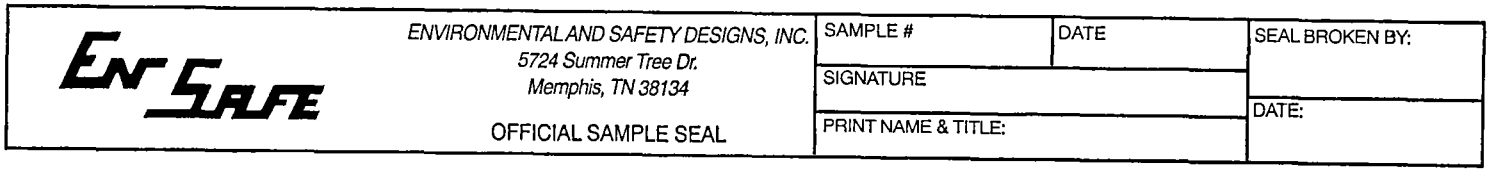
Instructions on maintaining chain-of-custody on samples are listed below.

- Sample containers will be labeled and placed in a cooler immediately following sample collection. All samples shall remain in the physical custody of the field personnel or in a designated secured area until sample shipment. An example of the sample label is provided in Figure 6-3.

- Custody seals will be affixed to sample coolers prior to shipment. An example of the custody seal is provided in Figure 6-4.

Chain-of-Custody Record

The chain-of-custody form will be used to record the custody of the samples. An example of the chain-of-custody form is provided in Figure 6-5. The following information will be recorded in the appropriate spaces on the form.



EN SAFE

800-588-7962
MEMPHIS, TENNESSEE
CHARLESTON,SC; CINCINNATI,OH; DALLAS,TX; JACKSON,TN; KNOXVILLE,TN;
LANCASTER,PA; NASHVILLE,TN; NORFOLK,VA; PENSACOLA,FL; RALEIGH,NC;
COLOGNE, GERMANY

FIGURE 6-4
ENSAFE INC. CUSTODY SEAL

DWG DATE: 09/05/97 | DWG NAME: BORDER

Environmental and Safety Designs, Inc.

EN SAFE (SM)

5724 SUMMER TREES DR. MEMPHIS, TN. 38134 *(901)372-7962
NASHVILLE, TN., PENSACOLA, FL., AND RALEIGH, NC.

FIGURE 6-5
CHAIN OF CUSTODY RECORD

PAGE _____ OF _____

CLIENT _____ PROJECT MANAGER _____

ADDRESS _____ TELEPHONE NO. _____

PROJECT NAME/NUMBER _____ FAX. NO. _____

MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) _____

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED								REMARKS
					TEMP.	CHEMICAL										

RELINQUISHED BY:	DATE	RECEIVED BY	DATE	RELINQUISHED BY:	DATE	RECEIVED BY	DATE
SIGNATURE _____		SIGNATURE _____		SIGNATURE _____		SIGNATURE _____	
PRINTED _____	TIME	PRINTED _____	TIME	PRINTED _____	TIME	PRINTED _____	TIME
COMPANY _____		COMPANY _____		COMPANY _____		COMPANY _____	
REASON _____		REASON _____		REASON _____		REASON _____	

METHOD OF SHIPMENT: _____
SHIPMENT NO. _____
SPECIAL INSTRUCTION: _____

COMMENTS: _____

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☐ DISPOSED OF (ADDITIONAL FEE)
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS (ADDITIONAL FEE)
- ☐ RETURNED TO CUSTOMER

CHANCUST

Information about EnSafe Inc.:

- Client name (EnSafe Inc.) and address
- Project Name/Number (NSAMEM/Contract Task Order [CTO] Number)
- Project Manager's Name
- Signature of Sampler(s)
- Chain-of-custody (COC) #
- Blanket Purchase Agreement/Service Order (BPA/SO) #

Information about the Sample:

- Field sample identification (as described in previous section)
- Date and time of collection (24-hour clock)
- Type of sample
- Type and size of sample containers
- Preservation temperature and chemical
- Number of sample containers/sample
- The type of laboratory analysis required
- Comments such as "strong odor" or "high concentration suspected" go in the remarks section

Information about Shipment:

- When sample custody is transferred, document it in the appropriate section of this form.

- The person relinquishing custody must print his or her name, company name, the reason for the transfer, date, time, and sign the form.

- Note the method of shipment and the air-bill number of the shipment on the chain-of-custody form.

- During shipment, the chain-of-custody form must be sealed in a plastic bag and placed inside the shipping cooler.

- Note any special instructions (e.g., priority turnaround) or comments in the comments section of the chain-of-custody form, and discuss them with the laboratory before sample collection and shipment.

Specific instructions on transferring custody and shipment of samples are listed below.

Transferring Custody

1. Ship samples overnight to the selected analytical laboratory. Record the air-bill number in the appropriate section on the chain-of-custody record and in the field notebook.

2. When relinquishing custody to a shipper, advise the laboratory of any time constraints on analysis. Notify the laboratory as early in the week as possible regarding samples intended for Saturday delivery.

3. Fax a copy of the COC to laboratory before their receipt of cooler.

6.10 Documentation

6.10.1 Field Records

EnSafe personnel will maintain field records in permanently bound, waterproof field logbooks. Each logbook will be dedicated to an individual project. The names of the field sampling team leader and all team members, 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 of each entry recorded. At the end of each day's activity, or entry of a particular event if appropriate, a sampling team member should initial and draw a diagonal line at the conclusion of the entry 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.

6.10.2 Document Control

The term *document control* refers to the maintenance of investigation project files. Documents as outlined below shall be kept in 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 EnSafe 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.

6.11 Analytical Procedures

This investigation will follow the analytical procedures described below.

6.11.1 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 NSA Memphis base coordinate grid system.

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

6.11.2 Laboratory Analyses

Tank N-12 was documented in the SOW #110 as containing gasoline; therefore, groundwater samples selected for laboratory analyses will be tested for benzene, toluene, xylene, ethylbenzene, MTBE, and TPH-GRO. Due to inconsistencies in records on UST contents, and at the request of the BCT, VOCs and TPH-DRO have been added to the analyses mandated by the state of Tennessee.

The laboratory will use the *Test Methods for Evaluating Solid Waste*, SW-846 following the purge and trap procedures for the soil samples in Method 5030. The actual constituent analysis using gas chromatography with a photoionization detector shall follow Method 8021. The practical quantitation limit for any individual constituent using this method is 0.002 ppm for low level soil samples. All results shall be reported in ppm. Because both TPH-GRO and TPH-DRO are to be included in the analyses, the results of TPH-GRO and TPH-DRO will be summed (TPH-GRO+TPH-DRO) and reported as TPH.

Parameters and Analytical Methods to be Used:

The parameters and analytical methods are presented in Table 6-4. The promulgated methods are shown; however, if the laboratory has not yet converted to these methods, the method shown in parentheses will be used. All samples will be analyzed at DQO Level III. All samples will be analyzed in accordance with *Test Methods for Evaluation of Solid Waste (Physical/Chemical Methods), SW-846, 3rd Edition, Update III* USEPA, December 1996).

Table 6-4
Analytical Methods

Parameter	Soil Sample Methods	Water Sample Methods
BTEX/MTBE	8021 (8020)	8021 (8020)
Total VOCs	8260 (8240)	8260 (8240)
TPH-GRO	8015 Modified	8015 Modified
TPH-DRO	8015 Modified	8015 Modified
TCLP for Benzene and Lead	1311:8021,6010\7000	—
Ignitability/Flashpoint	—	1010
Iron and Manganese	—	6010

Note:
— = not analyzed

6.11.3 Calibration Procedures and Frequency

The analytical laboratory will perform analytical instrument calibration in accordance with specific instrument methods by reference.

EnSafe plans to calibrate field equipment such as pH, specific conductance, and temperature meters and OVDs 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.

6.12 Data Reduction, Validation, and Reporting

Laboratory procedures for data reduction and reporting will be based on standard operating procedures. The specific procedures for data reduction, validation and reporting will be based on those outlined for Level III QC data in the laboratory QA Plan.

EnSafe'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.

6.13 Field and Laboratory Quality Control Checks

Internal laboratory control checks used by the laboratory will be conducted in the laboratory by the laboratory staff. EnSafe 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 types and frequency of blank and other control check sample collection is determined using DQO Level III as a guideline and is provided in Table 6-5. For Level III QC, quality control measures can be discussed for sampling and analysis as follows.

Table 6-5
Quality Control Sample Collection Frequencies

Trip Blank:	One per sample shipping cooler containing VOC samples
Rinsate Blank:	One per sampling event (week) per sampled media
Field Blank:	One per sampling event (week) .
Duplicates:	One per 20 water and soil samples collected
MS/MSD:	One per 20 water and soil samples collected; matrix is to be the same sample used for duplicate analysis
Temperature Blank:	One per sample shipping cooler

Notes:
Trip blanks are for volatile organic analysis only.
MS/MSD = Matrix Spike/Matrix Spike Duplicate Samples

6.13.1 Field Data Quality

Field work will be conducted and/or supervised by EnSafe 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 EnSafe 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 6.5.1 and 6.8.3. 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. 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 original 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 analysis. 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.

6.13.2 Analytical Data Quality

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 analyses of the contaminants 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 analyses. Matrix spikes and matrix spike duplicates will be analyzed at a frequency of one per 20 samples per matrix.

6.13.3 Field Data Package

The field data package will include field records and measurements obtained at a site by EnSafe personnel in accordance with *SOUTHDIV Guidelines for Groundwater Monitoring Well Installation*. The package, including all field records and measurements obtained at the site by EnSafe sampling personnel, may be validated by the project QA officer utilizing the 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 and sampling equipment rinsate 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.

6.13.4 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 USEPA precision and accuracy statements for the analytical methods employed. The analytical data package review procedure includes the procedures 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, 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 labeled suspect and sufficient only for qualitative purposes.

6.14 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.

6.14.1 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.

6.14.2 Laboratory Systems Audit

A laboratory systems audit is routinely conducted at least biannually by EnSafe. 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).

6.14.3 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 6.12, a performance evaluation audit of the laboratory may be conducted by EnSafe. 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 (USEPA or National Bureau of Standards traceable).

PE audits may also be conducted by reviewing the laboratory's results from "round-robin" certification testing. 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.

6.14.4 Regulatory Audits

It is understood that EnSafe field personnel and subcontract laboratories are also subject to quality assurance audits by the USEPA.

6.15 Preventive Maintenance

The field testing and monitoring equipment employed by EnSafe 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 a QAP.

6.16 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, 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 QAP.

6.17 Quality Assurance Reports

EnSafe will provide a data quality summary (QC Data Report) within the draft EAR. The draft EAR will be submitted to the SOUTHNAVFACENGCOM EIC within 30 calendar 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. After SOUTHNAVFACENGCOM and TDEC concurrence are received, EnSafe will prepare one of the following reports: 1) No Further Action Proposal, 2) Monitoring Only Proposal or 3) Corrective Action Proposal.

Appendix A

Closure Report

Omega Environmental Services

Appendix B

Material Safety Data Sheets

Appendix C

Directions to the Nearest Hospital

DIRECTIONS TO THE NEAREST MEDICAL FACILITIES

The nearest hospital **and** the nearest facility capable of treating chemical burns are the same facility, which is Methodist North Hospital. Therefore, there is only one set of directions. A map to the hospital is provided on the following page.

Nearest Hospital

Methodist North Hospital
3960 Covington Pike
Memphis, Tennessee

Emergency Room Telephone Number — (901) 372-5211

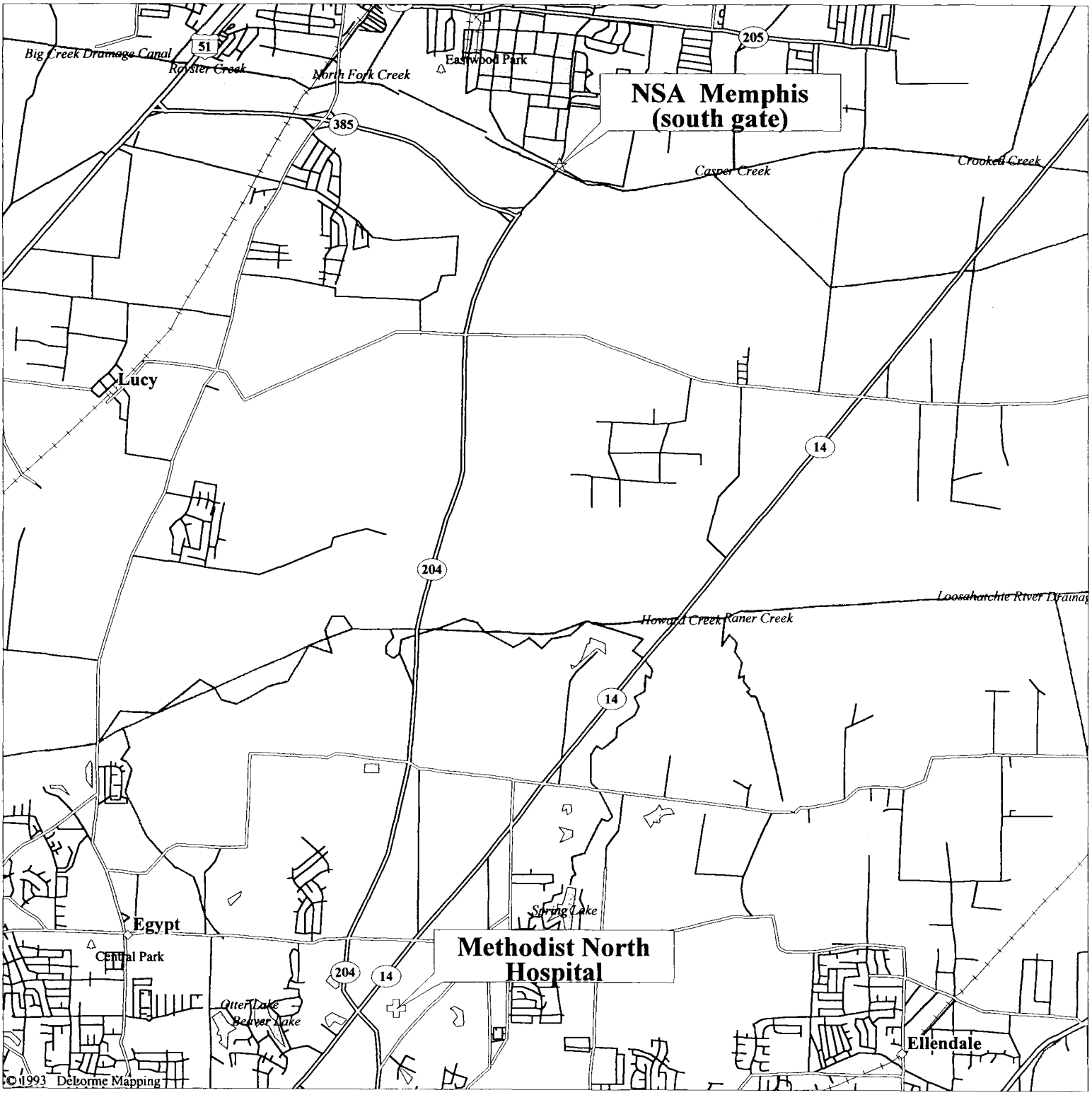
Directions to Methodist North Hospital from NAS Memphis Main Gate:

1) Exit site through South Gate (Singleton Parkway).

2) Continue on Singleton Parkway through the stop signs.

3) Singleton Parkway and Covington Pike will intersect at a red light (about 5 miles).

4) You will see the entrance to the emergency room 700 feet past this light on the left.



LEGEND

- Population Center
- State Route
- Town, Small City
- Park
- US Highway
- Street, Road
- Hwy Ramps
- Major Street/Road
- State Route
- US Highway
- Railroad
- River
- Open Water

Scale 1:62,500 (at center)

1 Miles

2 KM

Mag 13.00
Thu Dec 11 14:22:37 1997

Appendix D

Forms

PLAN ACCEPTANCE FORM

SITE HEALTH AND SAFETY PLAN

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

Job No: 136

Contract No: N62467-89-D-0318

Project: N-12 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. I certify I am in compliance with the applicable OSHA training requirements pertaining to the following:

Check all that apply

- ☐ 40-hour HAZWOPER training per 29 CFR 1910.120 (**required**)
- ☐ 8-hour HAZWOPER Refresher per 29 CFR 1910.120 (**required**; if applicable)
- ☐ 8-hour HAZWOPER Site Supervisor per 29 CFR 1910.120 (**required**; if applicable)
- ☐ First Aid (if applicable)
- ☐ CPR (if applicable)

_____

Signed

_____

Print Name

_____

Company

_____

Date

EMPLOYEE EXPOSURE HISTORY FORM

Employee: _____

Job Name: _____

Date(s) From/To: _____

Hours Onsite: _____

Contaminants (Suspected/Reported):

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

PLAN FEEDBACK FORM

Problems with plan requirements:

Unexpected situations encountered:

Recommendations for revisions:

ACCIDENT REPORT FORM

This form is required by Public Law 91-596 and must be kept in the establishments for 5 years. Failure to maintain can result in the issuance of citations and assessment of penalties.	**Case of File No.**

Location of Office:

1. Name

2. Mail address *(No. and street, city or town, State, and zip code)*

3. Location if different from mail address

Injured or Ill Employee

4. Name *(First, middle, and last)*	Social Security No.

5. Home address *(No. and street, city or town, State, and zip code)*

6. Age	7. Sex *(Check one)* Male ☐ Female ☐

8. Occupation *(Enter regular job title, not the specific activity he was performing at time of injury.)*

9. Department *(Enter name of department of division in which the injured person is regularly employed, even though he may have been temporarily working in another department at the time of injury.)*

The Accident or Exposure to Occupational Illness

If accident or exposure occurred on employer's premises, give address of plant or establishment in which it occurred. Do not indicate department or division within the plant or establishment. If accident occurred outside employer's premises at an identifiable address, give that address. If it occurred on a public highway or at any other place which cannot be identified by number and street, please provide place references locating the place of injury as accurately as possible.

10. Place of accident or exposure *(No. and street, city or town, State and zip code)*

11. Was place of accident or exposure on employer's premises? Yes ☐ No ☐

12. What was the employee doing when injured? *(Be specific. If he was using tools or equipment or handling material, name them and tell what he was doing with them.)*

13. How did the accident occur? *(Describe fully the events which resulted in the injury or occupational illness. Tell what happened and how it happened. Name any objects or substances involved and tell how they were involved. Give full details on all factors which led or contributed to the accident. Use separate sheet for additional space.*

Occupational Injury or Occupational Illness

14. Describe the injury or illness in detail and indicate the part of body affected. *(E.g. amputation of right index finger at second joint; fracture of ribs; lead poisoning; dermatitis of left hand, etc.)*

15. Name the object or substance which directly injured the employee/. *(For example, the machine or thing he struck against or which struck him; the vapor or poison he inhaled or swallowed; the chemical or radiation which irritated his skin; or in cases of strains, hernias, etc, the thing he has lifting, pulling, etc.)*

16. Date of injury or initial diagnosis of occupational illness	17. Did employee die? *(Check one)* Yes ☐ No ☐

Other

18. Name and address of physician

19. If hospitalized, name and address of hospital

Date of report	Prepared by *(Print)*	Official position