

**WORK PLAN  
TCE INVESTIGATION AT  
ORGANIZATIONAL MAINTENANCE SHOP 28  
ALABAMA NATIONAL GUARD  
1622 SOUTH BROAD STREET  
MOBILE, ALABAMA**

**PREPARED FOR:  
UNITED STATES ARMY CORP OF ENGINEERS  
MOBILE DISTRICT  
109 ST. JOSEPH STREET  
MOBILE, ALABAMA 36602**

**CONTRACT No. W91278-04-D-0044  
TASK ORDER 0006**

**PREPARED BY:  
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## **LIST OF ACRONYMS**

*ADEM* – Alabama Department of Environmental Management  
*ALNG* – Alabama National Guard  
*AMSL* – Above Mean Sea Level  
*ARBCA*– Alabama Risk Based Corrective Action  
*BGS* – Below Ground Surface  
*BTEX* – Benzene, Toluene, Ethylbenzene, and Total Xylenes  
*CoC* – Chemical of Concern  
*CFR* – Code of Federal Regulations  
*DoD* – Department of Defense  
*DPT* – Direct Push Technology  
*DO* – Dissolved Oxygen  
*FTL* – Field Team Leader  
*GCAL* – Gulf Coast Analytical Laboratory, Inc.  
*IDW* – Investigation Derivative Waste  
*ISL* – Initial Screening Level  
*HASP* – Health and Safety Plan  
*MCL* – Maximum Contaminant Level  
*MTBE* – Methyl *Tertiary* Butyl Ether  
*OMS* – Organizational Maintenance Shop  
*PID* – Photo-ionization Detector  
*PI* – Preliminary Investigation  
*PM* – Project Manager  
*PPE* – Personal Protective Equipment  
*PRG* – Preliminary Remediation Goal  
*PSV* – Preliminary Screening Values  
*PZ* – Piezometer  
*QAPP* – Quality Analysis Project Plan  
*QA/QC* – Quality Analysis/ Quality Control  
*RFI* –Request for Information  
*SI* - Secondary Investigation  
*SOP* – Standard Operating Procedures  
*SP* – Sampling Plan  
*SSTL* – Site Specific Target Level  
*TAT* –Turn Around Time  
*TCE* – Trichloroethylene  
*TW* – Temporary Well  
*USACE* – United States Army Corps of Engineers  
*USEPA* – United States Environmental Protection Agency  
*VOC* – Volatile Organic Compound  
*WP*– Work Plan

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# 1.0 Introduction

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Aerostar Environmental Services, Inc. (AEROSTAR) has been contracted by the United States Army Corps of Engineers (USACE), to perform a Comprehensive Site Investigation at the Organizational Maintenance Shop (OMS) 28 located at 1622 South Broad Street in Mobile, Alabama.

This Work Plan (WP) has been developed for the project site, herein after referred to as OMS 28. The Work Plan addresses issues which are site-specific to the project site. This section presents the project site history, scope of work, project schedule, meeting requirements, and reporting requirements in accordance with the contract agreement.

## 1.1 Project Information and Description

**PROJECT NO:** AEROSTAR Project No. 0405-517-07

**CLIENT:** USACE, Mobile District

**PROJECT/SITE NAME:** OMS 28

**SITE ADDRESS:** 1622 South Broad Street, Mobile, Alabama

**AEROSTAR PROJECT MANAGERS:** Emilie Wien and Tiffany Whitson

**AEROSTAR OFFICE:** Mobile, Alabama

### 1.1.1 Site Description and History

OMS 28 is located in Mobile County, near downtown Mobile, between Interstate 10 and Mobile Bay. The area is relatively flat with an elevation of 20 to 30 feet above mean sea level (AMSL). The subject property is located in Section 1, Township 4 South, Range 1 West and at approximate location Longitude 88°03' 42" West and Latitude 30°39' 11". The site location is depicted in **Figure 1** and the site vicinity is depicted in **Figure 2**.

A single 2,000 gallon gas/diesel underground storage tank (UST) was removed from OMS 28 in October 1992. Following submission of a closure report, a Preliminary Investigation (PI) was requested and performed between 1992 and 1993 and a Secondary Investigation (SI) was conducted between April and October 1994.

In August 2005, Bechtel-S submitted a SI Addendum. During the SI Addendum, monitor well MW-8, a downgradient well, was installed. Benzene, toluene, ethylbenzene, and total xylenes (BTEX), methyl tertiary butyl ether (MTBE), naphthalene and lead were not detected above the Alabama Department of Environmental Management (ADEM) Initial Screening Levels (ISLs) in MW-8; however, the reporting limits for MW-8 were higher than the other groundwater samples due to the dilution (by the laboratory) of this sample by a factor of 20. Dilution was required due to the interference by trichloroethylene (TCE) in the sample. The TCE is not related to the gasoline/diesel fuel tank being investigated and is believed to be the result of a localized solvent spill. No other

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groundwater samples collected during this event were diluted by the laboratory.

In March 2005, all of the wells onsite were sampled and analyzed for a full volatile organic compound (VOC) scan. With the exception of monitor well MW-8, TCE was not detected in the groundwater samples collected from the onsite monitor wells. TCE was detected in the groundwater samples collected from monitor well MW-8 and the duplicate (MW-8) at concentrations of 460 micrograms per liter ( $\mu\text{g/L}$ ) and 430  $\mu\text{g/L}$ , respectively; which is above the Maximum Contaminant Level (MCL) of 5  $\mu\text{g/L}$ . Cis-1,2-Dichloroethene was the only other volatile detected in the groundwater samples collected from monitor well MW-8 and the duplicate (MW-8) at concentrations of 11  $\mu\text{g/L}$  and 10  $\mu\text{g/L}$ , respectively; which is below the MCL of 70  $\mu\text{g/L}$ .

In 2005, the Alabama National Guard (ALNG) installed five temporary wells at the site to further delineate the TCE plume. The wells were installed by hand with a filter pack of sand and with hand cut screen. TCE was detected in the groundwater sample collected from temporary well TW-4 at a concentration of 1.9  $\mu\text{g/L}$ , which is below the MCL of 5  $\mu\text{g/L}$ . None of the remaining wells sampled showed detectable concentrations of TCE. All monitor wells were sampled with a bailer during this event. Two of the temporary wells were converted into piezometers (PZ-1 and PZ-2). The locations of the temporary wells, piezometers, and monitor wells are depicted on **Figure 3**.

Along with the SI Addendum, Bechtel-S also submitted an ARBCA assessment in August 2005. Based on a conversation with Mr. John Pierce, ADEM, on November 4, 2005, the Site Specific Target Levels (SSTL) developed in the ARBCA have not been approved.

### **1.1.2 Records Review**

Available records from the ADEM files and other sources will be reviewed to gain an overall perspective of the current site conditions and potential environmental concerns related to the subject property. These records and documents include:

- *Alabama Risk Based Corrective Action Report submitted by Bechtel-S Corp, dated August 2005;*
- *Secondary Investigation Addendum Report submitted by Bechtel-S Corp, dated August 2005;*
- *Historical Sanborn Fire Insurance Maps;*
- *Recent and historical aerial photographs of the site located at the City of Mobile, Planning Department;*
- *USGS topographic maps;*
- *USDA surface soil maps; and*
- *Internet resources (aerial photographs, topographic maps).*

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### **1.1.3 Regional Geology and Hydrogeology**

To date, two environmental assessment reports, an ARBCA and a SI Addendum Report, were provided to AEROSTAR that are helpful in describing site soil classification. The SI Addendum assessment included soil and groundwater sampling, which provided the following description of the site geology and hydrogeology.

Geologic units outcropping near OMS 28 range from Tertiary to Quaternary Age. Quaternary alluvial and terrace deposits overlie Tertiary deposits adjacent to the floodplains of the larger streams and rivers, and along Mobile Bay.

The major aquifers in the vicinity of OMS 28 include the Miocene, Pliocene-Pleistocene (also known as the Citronelle), and the alluvial-coastal aquifers. Although these aquifers represent different lithological units, they generally respond as a single hydrogeologic unit to large or long-term stresses. However, at a smaller scale there may be little hydraulic connection between units.

Groundwater at OMS 28 is encountered between 2 and 5 feet below ground surface (BGS). Locally, the aquifer consists of fine sand. Groundwater flow is to the west to northwest across the site. All wells onsite are completed across the water table. No site-specific data on deeper hydrogeological units is available.

### **1.1.4 Addressed Concern and Considerations**

The purpose of this assessment is to conduct a reasonable level of inquiry to identify the source of onsite impact of TCE by former uses of the property. Since no subsurface assessment has previously been conducted on the property to delineate TCE or to our knowledge on the adjoining properties, the scope of work was designed to assess areas most likely to be sources of contaminants without being exhaustive in approach.

### **1.1.5 Applicable Regulatory Standards**

Each aspect of this site assessment will be based on compliance with published regulatory criteria and/or guidance. The contaminants of concern for this assessment are regulated by several environmental standards and regulations including federal and state hazardous waste constituent standards. For this assessment, the ADEM Preliminary Screening Values (PSV) is the environmental standard to which the individual constituents will be compared to initially evaluate the baseline of the subject property. The PSVs are a compilation of allowable concentrations of possible environmental contaminants from the various applicable regulations, acts, and health exposure sources. Risk-based correction action guidelines may be applicable to evaluate conditions at the site to the site workers and/or occupants based on the assessment results. PSVs for constituents in groundwater are equivalent to MCLs listed in ADEM Administrative Code R. 335-7-2 (Primary Drinking Water Standards) or ADEM Administrative Code R. 335-7-3 (Secondary Drinking Water Standards) or analogous federal safe drinking water regulations (40 CFR 141). For

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constituents where there are no MCLs, PSVs will be consistent with the United States Environmental Protection Agency (USEPA) Region 9 Preliminary Remediation Goals (PRG) for Tap Water.

PSVs for soil will address specific exposure routes that must be evaluated individually: (1) ingestion, (2) inhalation, and (3) the protection of groundwater. PSVs to address ingestion and inhalation will be consistent with the USEPA Region 9 PRGs for each exposure scenario. PSVs for the protection of groundwater will be developed in accordance with the most recent edition of the USEPA *Soil Screening Guidance: User's Guide*.

## **1.2 Scope of Work**

AEROSTAR will furnish all labor, equipment, lower-tier subcontractors, materials, supplies, and all else necessary to completely perform the Scope of Work identified herein. All work shall be completed in compliance with current federal, state, and local regulations, and in accordance with standard industry practice.

### **1.2.1 Health and Safety**

Worker and community safety is of the utmost importance on this project. AEROSTAR and its subcontractors will comply with the health and safety requirements outlined in the Health and Safety Plan (HASP). The HASP was submitted under separate cover for approval by the *USACE*. All site workers shall be 40-hour OSHA HAZWOPER trained as specified in 29 CFR 1910.120 and shall be current with the 8-hour OSHA refresher. AEROSTAR will be responsible for providing all required personal protective equipment (PPE) for its workers and subcontractors in accordance with the HASP, upon approval by *USACE*.

AEROSTAR assumes that the work will be performed in Level D PPE.

### **1.2.2 Facility Site Safety and Security**

Workers shall be required to comply with the site safety and security regulations while working at OMS 28. If required, AEROSTAR and its subcontractors will provide proof of U.S. citizenship for each employee to perform work on this project. AEROSTAR will provide facility safety and security protocol for workers' review prior to the commencement of site activities.

### **1.2.3 Requests for Information**

When information/direction is required, AEROSTAR will submit requests for information (RFI) in writing to *USACE* in order to document a specific problem, question or concern, and the answer or direction obtained in response to the RFI. The RFI shall include, as a minimum, a complete description of the problem/question/concern, a reasonable response date, and the signature of AEROSTAR's representative.



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## 1.2.4 Environmental Protection

The work to be performed at OMS 28 may have adverse impacts on the environment. AEROSTAR will perform/install temporary controls to minimize the environmental impacts and to meet the intent of federal, state, and local regulations designed to protect the environment. The temporary controls will include, but are not limited to: site access control; erosion and sediment controls (silt fence, hay bales, etc.), if needed; construction debris and waste control; water pollution control; dust control; and spill control.

## 1.3 Resources

AEROSTAR will provide the appropriate personnel, equipment, subcontractors, materials, supplies, and all else necessary to completely perform the Scope of Work.

## 1.4 Project Schedule

The proposed work schedule is included in **Appendix A**. Certain activities are dependent on the review and approval of work plans and pre-mobilization submittals, and their scheduled starting dates may be altered if the review periods are extended.

The schedule will be extended, as appropriate, for unforeseen delays such as inclement weather and other factors beyond AEROSTAR's control.

## 1.5 Meetings

AEROSTAR will schedule physical arrangements for meetings through the progress of site construction work; prepare meeting agenda with regular participant input; distribute written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions; and reproduce and distribute copies of minutes within two days after each meeting with *USACE*. The project meetings shall include, but are not limited to: a pre-construction meeting and daily tailgate meetings.

### 1.5.1 Pre-Construction Meeting

Prior to any onsite construction work, AEROSTAR will schedule a pre-construction meeting to discuss the following subjects, at a minimum:

- Required schedules
- Sequencing of critical path work items
- Progress payment procedures
- Project changes and clarification procedures (including RFIs)
- Use of site, access, office and storage areas, security, and temporary facilities
- Major product delivery and priorities
- AEROSTAR's Health and Safety Plan and representative (including required employee records)

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## **1.5.2 Daily Tailgate Meetings**

A daily tailgate meeting will be held each morning at the site by AEROSTAR to discuss the following subjects, as a minimum:

- The work planned for the day
- Changes in work assignment
- Health and safety issues
- Review problems encountered the previous day
- Sign the safety task assignment form prior to beginning any work onsite

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## **2.0 Execution Plan**

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This section provides the technical approaches for each of the onsite activities included in the Scope of Work. AEROSTAR will furnish all labor, equipment, materials, lower-tier subcontractors, supplies, and all else necessary to completely perform the Scope of Work identified herein. All work shall be completed in compliance with current federal, state, and local regulations, and in accordance with standard industry practice.

### **2.1 Scope of Work**

The objective of this project is to perform a Comprehensive Site Assessment to delineate TCE in the soil and groundwater at the above referenced facility. The components of the work to be performed at OMS 28 include the following:

- Mobilization and Site Setup
- Soil Sampling and Monitoring Well Installation
- Groundwater Sampling
- Decontamination and Demobilization
- Reporting

#### **2.1.1 Mobilization and Site Setup**

This task includes mobilizing personnel, equipment, subcontractors, and materials to the site and establishing temporary facilities to conduct the project activities. The contractor will review all regulations, and standard operating procedures (SOPs) regarding vehicle movement and control inside the facility. All location provisions will be observed including notifications and communication requirements. The contractor will minimize disturbance to any operations during project activities. The contractor also will consult with onsite *USACE/ALNG* personnel to evaluate area access, placement of equipment, and traffic flow to minimize the effect of this work on facility operations.

Prior to the commencement of work at the site, AEROSTAR will install site controls including construction barricades and security fencing and prepare the decontamination area and equipment laydown area, if necessary. Initially, AEROSTAR will mobilize to the site to sample TW-1, TW-3, TW-4, TW-5, PZ-1, and PZ-2. Groundwater samples will be collected from TW-1, TW-3, TW-4, TW-5, and PZ-1 and submitted for laboratory analysis of Target Compound List (TCL) Volatiles per EPA Method 8260, TCL Semi-Volatiles per EPA Method 8270, TCL Pesticides per EPA Method 8081, TCL PCBs per EPA Method 8082, and the Target Analyte List (TAL) Metals. The groundwater sample collected from PZ-2 will be submitted for laboratory analysis of TCE according to EPA Method 8260.

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## 2.1.2 Utility Locators

Prior to mobilization, AEROSTAR will contact Alabama One Call in order to have all utilities located onsite and on the adjoining properties where work is to be performed.

## 2.1.3 Soil Sampling, Groundwater Sampling and Monitor Well Installation

AEROSTAR will conduct soil and groundwater sampling with monitor well installation in up to three phases. AEROSTAR will advance up to twenty-four (23) soil and groundwater borings using a combination of hand auger and direct push technology (DPT) during Phase 1 and 2 of the assessment. Phase 3 of the assessment, if needed, will include the installation of four monitor wells. If delineation activities are completed during Phase 1, installation of the four monitor wells will occur, based on those results, during Phase 2. AEROSTAR will place appropriate markers, such as flags with boring numbers, at each boring location for easy visual inspection. The proposed Phase 1 soil and groundwater boring locations are shown on **Figure 4**.

Singley Environmental Services, Inc. (Singley) of Pensacola, Florida, will provide DPT services. The soil and groundwater samples will be submitted to a Department of Defense (DoD) certified laboratory for analysis. The DoD laboratory that will be utilized during this investigation will be Gulf Coast Analytical Laboratory, Inc. (GCAL) of Baton Rouge, Louisiana. GCAL renewed their DoD certification through a Self Declaration Form submitted on May 4, 2005. A copy of the Self Declaration Form is located in **Appendix B**. GCAL will be utilized during all phases of this assessment. The laboratory reporting limits for the contaminants of concern during this assessment are shown in **Appendix C**.

### 2.1.3.1 Phase 1

#### **Soil Sampling Activities**

Up to 12 soil borings will be advanced in the vicinity of the assumed source area (MW-8) utilizing a hand auger to a total depth of 10 feet below ground surface (BGS) in order to collect soil samples for analysis.

The placement of the initial soil borings are shown on Figure 3.

Soil samples will be collected continuously from each boring from ground surface to 10 feet BGS for field screening using a photo-ionization detector (PID). Two soil samples will be collected for laboratory analysis from each boring in accordance with the Revised March 2005 Alabama Investigative Remediation Guidance Document which states: "Surface soil samples should be obtained from all borings drilled and should be collected from between the surface and 12-inches below ground surface. All surface soil samples should be collected as grab samples. Subsurface soil samples should be taken from each boring at no more than five-foot intervals." One soil sample will be collected between 0 and

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12" BGS and one soil sample will be collected between 12" and the groundwater interface. All soil samples collected during Phase 1 will be sent for laboratory analysis of TCL Volatiles per EPA Method 8260, TCL Semi-Volatiles per EPA Method 8270, TCL Pesticides per EPA Method 8081, TCL PCBs per EPA Method 8082, and the TAL Metals. AEROSTAR will request a three-day turn around time (TAT) for results prior to initiating Phase 2 of the soil delineation activities.

### **Groundwater Sampling Activities**

Based on the results from the historical sampling results and the initial groundwater sampling activities of TW-1, TW-3, TW-4, TW-5, PZ-1, and PZ-2, up to 11 direct push borings will be advanced utilizing DPT downgradient of the known TCE contamination at TW-4 and in the area between TW-1 and TW-3 to complete the delineation of the TCE in the groundwater. The borings will be advanced to an approximate depth of 25 feet BGS or five feet past the first encounter of groundwater in order to collect groundwater samples for laboratory analysis. The placement of the direct push borings are shown in Figure 4.

AEROSTAR will collect a groundwater sample from each boring using a stainless steel screen tip adapter from the DPT rig. A total of 11 groundwater samples will be collected from the borings for analysis of TCE according to EPA Method 8260. AEROSTAR will request a three-day TAT for results prior to initiating Phase 2 of the groundwater delineation activities.

#### **2.1.3.2 Phase 2**

Based upon the soil and groundwater analytical results from Phase 1, AEROSTAR will return to the site to complete the delineation of the soil and groundwater, if needed. Soil and groundwater samples will be collected using a combination of hand auger and DPT and submitted to a DoD certified laboratory for analysis as stated in Phase 1 described previously. If the TCE plume was delineated in the soil and groundwater during the Phase 1 activities, the permanent monitor wells will be installed as outlined in Section 2.1.3.3 of this report.

In addition, during Phase 2, a NAPL FLUTE™ liner will be inserted into one boring in order to determine if TCE is accumulating in the subsurface. The flute liner will be placed in the area of the boring with the highest TCE soil and groundwater concentrations from Phase 1. A description of the NAPL FLUTE™ liner from the manufacturer is located in **Appendix D**.

#### **2.1.3.3 Phase 3**

Four monitor wells will be installed based on the results of the DPT delineation activities. Each monitor well will be installed using a hollow-stem auger drill rig modified for the DPT rig. All monitor wells will be advanced to an approximate depth of 25 feet BGS or 5 feet beyond the first encounter of groundwater. Soil samples will be collected continuously from each boring from ground surface to the groundwater interface for field screening using a PID. Two soil samples will be collected for laboratory analysis from each boring in accordance with the

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Revised March 2005 Alabama Investigative Remediation Guidance Document which states: "Surface soil samples should be obtained from all borings drilled and should be collected from between the surface and 12-inches below ground surface. All surface soil samples should be collected as grab samples. Subsurface soil samples should be taken from each boring at no more than five-foot intervals." One soil sample will be collected between 0 and 12" BGS and one soil sample will be collected between 12" and the groundwater interface. The eight soil samples collected during Phase 3 will be sent for laboratory analysis of TCL Volatiles per EPA Method 8260, TCL Semi-Volatiles per EPA Method 8270, TCL Pesticides per EPA Method 8081, TCL PCBs per EPA Method 8082, and the TAL Metals.

Well construction will consist of 20 feet of 2-inch outer diameter, 0.010-inch factory slotted PVC screen with sufficient 2-inch outer diameter PVC riser to extend to the ground surface. Well screens will be set so that they intersect the water table. The annulus of the borehole will be filled with 20/40-sieve quartz sand to approximately one foot above the top of the screen. A 2-foot layer of bentonite pellets will then be gravity fed into the annulus of the borehole. This layer of bentonite pellets will be saturated with tap water and allowed to hydrate. Following hydration of the bentonite pellets, sufficient Portland cement grout will be gravity fed into the annulus of the borehole until 3 to 4 inches of the PVC riser pipe will be left exposed. An 8-inch diameter bolted manhole style cover with a 12-inch apron will be placed over the borehole. This manhole cover will be grouted into place in a 2-by-2-foot by 4-inch-thick pad of Portland cement. Wells installed on the Airport Authority property will stick up approximately 3 feet with protective casing. Wells installed on the ALNG property will be flush-mount. A locking expandable cap will be placed on each well and secured with a keyed lock to prevent tampering. The estimated depth of each well is 25 feet BGS. Singley will install the monitor wells.

After construction, all wells will be developed with a submersible pump until produced waters are clear and free of fines. All purge water will be containerized in 55-gallon drums and characterized for proper disposal. Refer to Section 3 for the Groundwater Sampling and Analysis Plan. The monitor wells will be developed between 48-hours and 7-days after grout installation. A copy of the ADEM Groundwater Sampling Plan is located in **Appendix E**.

Upon completion of the installation of the four new monitor wells, each new well will be surveyed by a Professional Land Surveyor (PLS) and tied into the existing monitor wells using conventional survey equipment. The Alabama datum used to survey the previous wells will be utilized to survey the newly installed wells. The information obtained during the survey will be used to determine site groundwater flow direction and the likely direction of groundwater contaminant migration at the site.

Elevations will be obtained from the top of each monitor well casing to the nearest 0.010 foot using conventional survey equipment. The top of casing elevations will be relative to MSL elevations as shown on a United States Geological Survey (USGS) Topographic Map of the site (approximately 25 feet MSL). Groundwater depths will be measured from the same point on the

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monitoring well casing from which the elevation was obtained (north side of casing).

Groundwater samples will be collected from the four newly installed monitor wells (MW-9 through MW-12), three existing monitor wells, temporary monitor well TW-1 (installed by the ALNG) and submitted for laboratory analysis of TCL Volatiles per EPA Method 8260, TCL Semi-Volatiles per EPA Method 8270, TCL Pesticides per EPA Method 8081, TCL PCBs per EPA Method 8082, and the TAL Metals. The monitor wells will not be sampled earlier than 14-days after development.

### **2.1.4 Soil Sampling Protocol**

All soil sample collection, preparation, and decontamination procedures will be performed in accordance the Alabama Environmental Investigation and Remediation Guidance document, revised March 2005. Soil sampling will be performed as outlined in the USEPA Region IV EISOPQAM Section 12.4.

AEROSTAR will use a combination of hand-auger and DPT in order to collect soil samples. Two soil samples will be collected for laboratory analysis from each boring in accordance with the Revised March 2005 Alabama Investigative Remediation Guidance Document which states: "Surface soil samples should be obtained from all borings drilled and should be collected from between the surface and 12-inches below ground surface. All surface soil samples should be collected as grab samples. Subsurface soil samples should be taken from each boring at no more than five-foot intervals." One soil sample will be collected between 0 and 12" BGS and one soil sample will be collected between 12" and the groundwater interface. Soil borings advanced using a hand auger will be advanced to a maximum depth of 10 feet BGS. Soil borings advanced using a DPT rig will be advanced to a maximum depth of 25 feet BGS.

Subsurface soil samples will be collected at 2-foot intervals for field screening and laboratory analysis. Soil samples collected from each sampling interval will be divided equally into two samples. One sample was placed into a clean mason jar and sealed with aluminum foil and a screw cap for later headspace analysis with a PID. The second twin sample will be placed into a sample jar, labeled accordingly, and placed into a cooler with ice.

Field screening will be conducted utilizing headspace analysis techniques with a PID. The PID will be calibrated in accordance with the manufacturer's specifications prior to initiation of its use on the project. Background ambient air readings will be recorded prior to each headspace reading.

Field screening results will be used to determine the distribution of VOC concentrations in soil during field activities, and to select soil samples for subsequent laboratory analysis.

All samples retained for laboratory analysis will be placed on ice prior to shipment to the laboratory. Disposable nitrile gloves will be worn during sample handling and changed between each sample acquisition. All sampling equipment will be decontaminated between soil borings by a wash with Alconox®

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detergent, followed by a rinse with isopropyl alcohol and then distilled water.

### **2.1.5 Groundwater Sampling Protocol**

AEROSTAR will conduct groundwater sampling and analysis in accordance with the ADEM Investigation and Remediation Guidance Manual, revised March 2005. AEROSTAR's WorkPlan will also be used to establish the appropriate protocols and quality assurance/quality control (QA/QC) requirements. All sampling methods will comply with the appropriate ADEM and federal guidelines referenced in Section 1.1.5 and all other requirements referenced in the solicitation.

Prior to purging the wells, static water level measurements will be collected in all designated wells using an electronic sensor with tape graduated in 0.01 foot increments. The well caps will be removed from all of the designated wells to allow for equilibration of the water table prior to water level measurements. The depth to water will be recorded from the mark on the top of the well casing facing north and recorded in the field logbook.

Prior to groundwater sampling, each well will be purged using a low-flow peristaltic pump in accordance with the ADEM's SOP Scope of Work for Groundwater Sampling, revised March 2005. Purge water will be containerized and stored in the *USACE* specified location. AEROSTAR anticipates all liquid investigative derived waste (IDW) will be drummed during purging activities and temporarily stored onsite until disposal by the contractor.

Field measurements of dissolved oxygen (DO), turbidity, pH, temperature, and specific conductivity will be made during initial purging and at five-minute intervals thereafter utilizing a flow through cell.

Groundwater samples will be collected once field parameters have stabilized within approved SOP requirements over three consecutive measurements. Groundwater samples will be collected in appropriate sample containers supplied by the subcontracted laboratory, placed on ice in a shipping cooler, and delivered to the approved subcontracted laboratory for analysis.

AEROSTAR will perform decontamination procedures consistent with the ADEM Scope of Work for Groundwater Sampling (March 2005) following each well sampled.

### **2.1.6 Decontamination and Demobilization**

Before leaving the work area, personnel and equipment will be decontaminated after coming in contact with contaminated material. All debris and/or rinsate generated during the decontamination activities will remain inside the exclusion zone until it can be placed into containers for proper storage and subsequent disposal. Equipment will be thoroughly decontaminated to remove any contamination adhering to the component surfaces.

Decontamination of personnel and PPE will be performed in accordance with 29 Code of Federal Regulation (CFR) 1910.120.



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Before traveling from an exclusion zone to a clean area, all decontaminated equipment will be inspected and documented by the contractor.

### **2.1.7 Reporting**

AEROSTAR will prepare a TCE Comprehensive Site Investigation report presenting historical data gathered during the records review, investigative methodology, findings, and conclusions from the assessment. The format of the report will be in accordance with ADEM Guidelines for a PI Report. Sampling logs, chain-of-custody forms, field forms, and analytical reports will be included in the Appendices of the report.

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## 3.0 Analysis Plan

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This soil and groundwater analysis plan details the analysis matrix for the acquisition of soil and groundwater data for delineation of the TCE plume at OMS 28.

### 3.1 Soil Analysis

Soil samples will be collected for laboratory analysis from each soil boring representing the interval of 0 to 12" BGS and 12" BGS to the groundwater interface. All soil samples will be submitted for analysis to a DoD certified laboratory. The DoD laboratory that will be utilized during this investigation will be Gulf Coast Analytical of Baton Rouge, Louisiana. Gulf Coast Analytical renewed their DoD certification through a Self Declaration Form submitted on May 4, 2005. A copy of the DoD Self Declaration Form is located in **Appendix B**.

Thirty-two soil samples (24 soil samples from the initial 12 soil borings and 8 soil samples from the four proposed monitor well locations) will be analyzed for TCL Volatiles per EPA Method 8260, TCL Semi-volatiles per EPA Method 8270, TCL Pesticides per EPA Method 8081, TCL PCBs per EPA Method 8082, and TAL Metals per the EPA Method 200/6000 Series. The analytical parameters for the soil samples, including field duplicates, rinsate blanks, MS/MSD, Holding Times, Sample Container Type/volume and preservatives are summarized in **Table 1**.

### 3.2 Groundwater Analysis

AEROSTAR will collect a groundwater sample from each DPT boring during Phase 1 activities using a stainless steel screen tip adapter from the DPT rig. A total of 11 groundwater samples will be collected from the borings for analysis of TCE according to EPA Method 8260. AEROSTAR will request a three-day TAT for results prior to initiating Phase 2 of the groundwater delineation activities.

Approximately seven groundwater samples (MW-6, MW-8 through MW-12, and temporary monitor well TW-1) will be collected and analyzed for TCL Volatiles per EPA Method 8260, TCL Semi-volatiles per EPA Method 8270, TCL Pesticides per EPA Method 8081, TCL PCBs per EPA Method 8082, TAL Metals per EPA Method 200/6000 Series. Trip blanks will be included in each cooler containing groundwater samples and analyzed for TCL Volatiles. The analytical parameters for the groundwater samples, including trip blanks, field duplicates, rinsate blanks, MS/MSD, Holding Times, Sample Container Type/volume and preservatives are summarized in **Table 2**.

AEROSTAR will perform decontamination procedures consistent with the Alabama Environmental Investigation and Remediation Document (revised March 2005) following each well sampled. ADEM Groundwater Sampling procedures are included as **Appendix E**.

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## 4.0 Waste Management Plan

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AEROSTAR will arrange for the transportation and disposal of all generated wastes. IDW will be handled and coordinated between AEROSTAR and *USACE*. AEROSTAR will be responsible for manifesting and ultimately disposing of the IDW. *USACE* personnel will provide generator certification and signature for all waste documentation.

Liquid IDW will be temporarily stored in properly labeled 55-gallon drums identified with labels marked "Awaiting analysis" and stored in a *USACE* specified location. A composite sample will be collected from the soil and groundwater stored in each drum in accordance with the ADEM regulations. The analytical parameters for the IDW samples are summarized in **Table 3**. The samples will be submitted to a DoD approved laboratory for the analysis required by the permitted hazardous waste facility which includes TCLP Metals and EPA 601 Volatiles/BTEX compounds for drummed solids/soil cuttings and EPA 601 Volatiles/BTEX compounds only for drummed liquids. Industrial Water Services of Mobile, Alabama have been contracted to dispose of the drums. They have indicated they will accept the laboratory data collected during the site assessment activities for the volatile analysis.

Any contaminated solid wastes will be temporarily placed in labeled 55-gallon drums identified with "Awaiting Analysis" labels and stored in the *USACE* specified location. Uncontaminated general construction debris exceeding one cubic foot will be placed within properly labeled containers or placed in stockpiles, pending offsite disposal.

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## **5.0 Quality Assurance/Quality Control Plan**

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This Quality Assurance Project Plan (QAPP) has been prepared to provide QA/QC requirements for sampling activities, sample analyses, and other tests that will generate data as part of the activities performed for the project. This QAPP has been prepared in accordance with the EPA *Guidance for Quality Assurance Project Plans* EPA QA/G-5 (U.S. EPA, December 2002).

QA involves all those planned and systematic actions necessary to provide adequate confidence that field activities will be performed satisfactorily and safely. The goal of QA is to ensure that activities are planned and performed according to accepted standards and practices to ensure that the resulting data are valid and useable for the project decision-making process, while continuing to meet safety requirements. QC is an integral part of the overall QA function and is comprised of all those actions necessary to control and verify that project activities and the resulting data meet established requirements.

The requirements of this document apply to AEROSTAR and its subcontractors. Deviations from these procedures will be documented in the final report.

### **5.1 Laboratory Work Group**

The selected laboratory is responsible for analyzing samples collected during field activities, in accordance with the sampling plan (SP) and the laboratory's quality assurance plan. The laboratory project manager (PM) or client service manager acts as a liaison between field and laboratory operations and is responsible for the following:

- Receipt of sample custody from the field team members, verification of sample integrity, and transfer of sample fractions to the appropriate analytical departments.
- Coordination of sample analyses to meet project objectives.
- Preparation of analytical reports.
- Review of laboratory data for compliance with method requirements.
- Review of any QC deficiencies reported by the analytical department manager.
- Coordination of any data changes resulting from review by the project QA supervisor or the PM.
- Completion of data package deliverables.
- Response to questions from the project team during the data quality evaluation process.

### **5.2 Project Communication**

Effective communication among all project personnel shall be established and maintained throughout the course of the project. At the beginning of the project, and/or at the start or end of major milestones, the PM will prepare written project instructions that will be distributed to all team members. These instructions will document project and task objectives and each team member's responsibility in

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meeting the objectives, as well as a budget and schedule for successfully executing the work.

Before field activity begins, a project team meeting will be held to review the project objectives. Periodic meetings will be held to review data validity, technical evaluations, major decisions, and overall progress toward completing the project. Additionally, a team kickoff meeting will be held before work on each task is started. Senior personnel may participate in the meetings to help focus the project approach and to define specific issues.

During the field investigation phase of this project, the field team will meet daily to review the status of the project and to discuss technical and safety issues. When necessary, other meetings will be scheduled or the field team leader (FTL) will meet individually with field personnel, EPA personnel, or State personnel to resolve problems.

During the field effort, the FTL will be in regular telephone or face-to-face contact with the project team. When significant problems or decisions requiring additional authority occur, the FTL will immediately contact the PM for assistance. The FTL will coordinate communication with the laboratory through sample collection, sample analysis, and data quality evaluation and consult with the PM.

### **5.3 Special Training, Requirements, and Certifications**

The Project Manager works with the project delivery manager to assemble a project team that has the necessary experience and technical skills. Part of the work planning process is to identify special training requirements or certifications necessary to execute the project successfully. Special training or certifications required beyond the normal routine requirements have not been identified for this project.

### **5.4 Documentation and Records**

This section defines which records are critical to the project and what information needs to be included in reports, as well as the data reporting format and the document control procedures to be used. It is imperative for the defensibility of critical decisions made at the site that proper documents and records be maintained for the field and offsite data gathering activities, so that specific events can be recreated or independently evaluated. The Project Manager will be responsible for organizing, storing, and cataloging all project information. The Project Manager is also responsible for collecting records and support data from all project team members. Individual project team members may maintain separate notebooks for individual tasks. Any files necessary to be retained in the permanent file will be forwarded to the Project Manager for real-time archiving upon preparation. Permanent files will not be retained in individual team member's possession but will be forwarded to the Project Manager at the close of the project. Copies of permanent records may be retained in their individual files for use during the project and discarded at the close of the project. Personal copies of permanent records will not be forwarded to the Project Manager at the close of the project; it is the individual's responsibility to ensure records in their

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possession are archived in real-time.

## 5.5 Field Documentation

Primary fieldwork includes sampling for chemical characterization. Applicable documents and records include the following:

- Field logbook to record data collection activities and observations (including date and time, sample locations, depth, health and safety measures, weather conditions, sampling personnel, analyses requested, and sketches).
- Sample collection field sheets or chain-of-custody (COC) documentation.
- Field instrument calibration and maintenance logs.
- Additionally, field quality control and corrective action documents may be generated as a result of field audits.

## 5.6 Data Quality Objectives for Measurement Data

All samples will be delivered to a DoD approved laboratory for a predetermined turnaround time. The laboratory also will have an ADEM-approved Comprehensive Quality Assurance Plan. The sampling and analytical requirements are listed in **Appendix C**. The analytical laboratory will be provided a copy of the required detection limits for each analyte for both soil and groundwater samples.

All analytical results will be validated or qualified according to general guidance provided in the National Functional Guidelines for Inorganic Review (EPA 540/R-94/013, February 1994). Additionally, the data will be evaluated for adherence to the U.S. DoD Quality Systems Manual for Environmental Laboratories Final Version 2 (June 2002).

The electronic deliverable will be provided by the laboratory as specified in the data management section of the work plan.

## 5.7 Quality Control Samples

Field QA/QC will include field instrument calibration, compliance with sample holding times, collecting field QC samples, and by daily reviews by the field geologist. Three types of field QC samples will be collected during this investigation: trip blanks, field duplicates, and rinsate blanks, as outlined in Tables 1 and 2. Quality control samples shall be taken from at least 10% of the field sample locations with a minimum of one sample per matrix. Each groundwater sample will be field tested for turbidity, pH, specific conductivity, and temperature. The testing laboratory and AEROSTAR will adhere to the quality control program, including spikes, blanks, and duplicates, of EPA SW-846 and ER 1110-1-263. Results will be reported in dry weight per EPA SW-846, which requires % solids determination.

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## 6.0 Approval

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This Work Plan has been written for use by AEROSTAR only. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

### 6.1 Original Plan

Written By: Tiffany H. Whitson

Date: \_\_\_\_\_

Approved By: Carrie L. Kruchell P.G.

Date: \_\_\_\_\_

### 6.2 Revisions

Revisions Made By: \_\_\_\_\_

Date: \_\_\_\_\_

Revisions to Plan: \_\_\_\_\_

Date: \_\_\_\_\_

Revisions Approved By: \_\_\_\_\_

Date: \_\_\_\_\_

## FIGURES



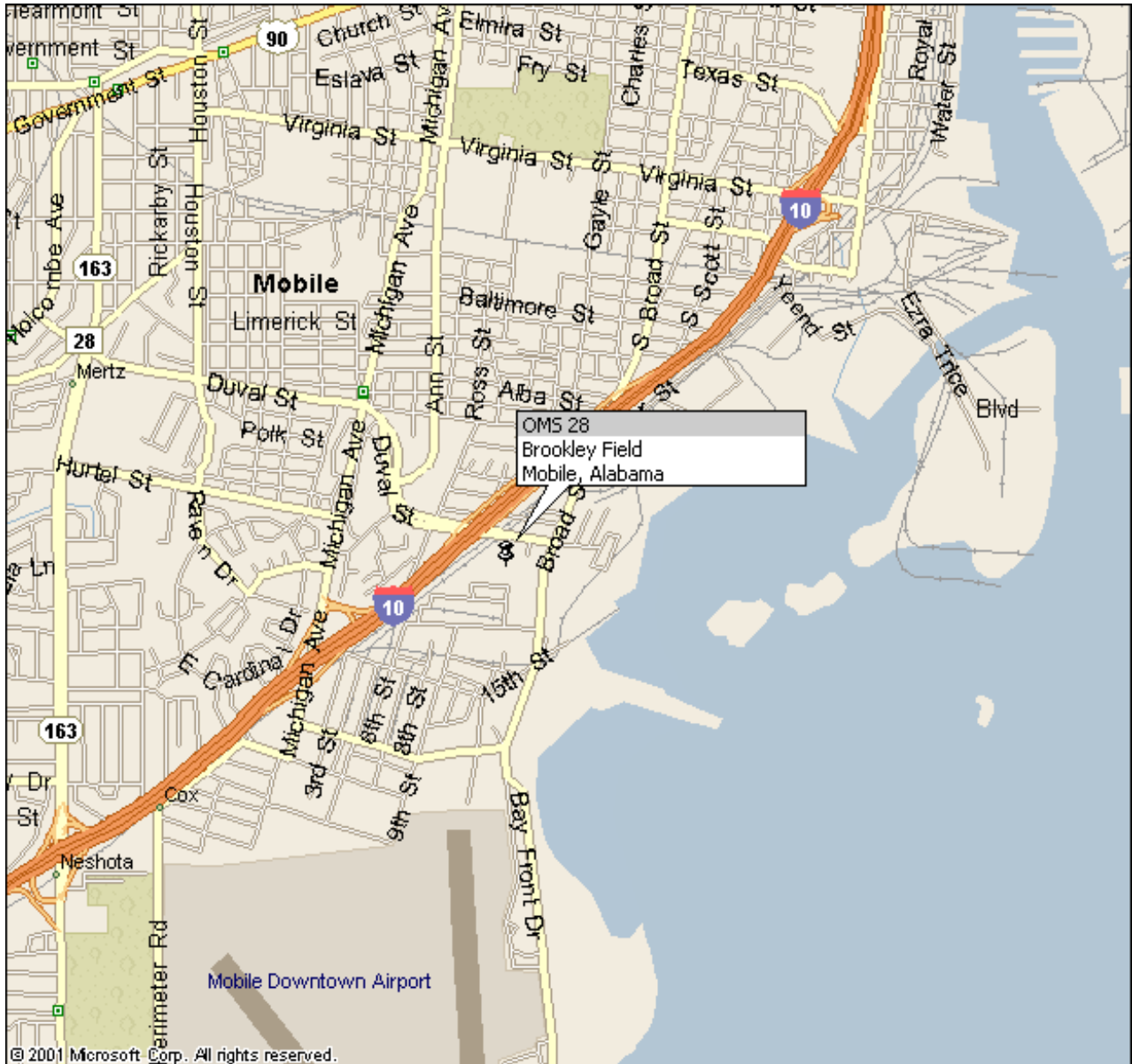


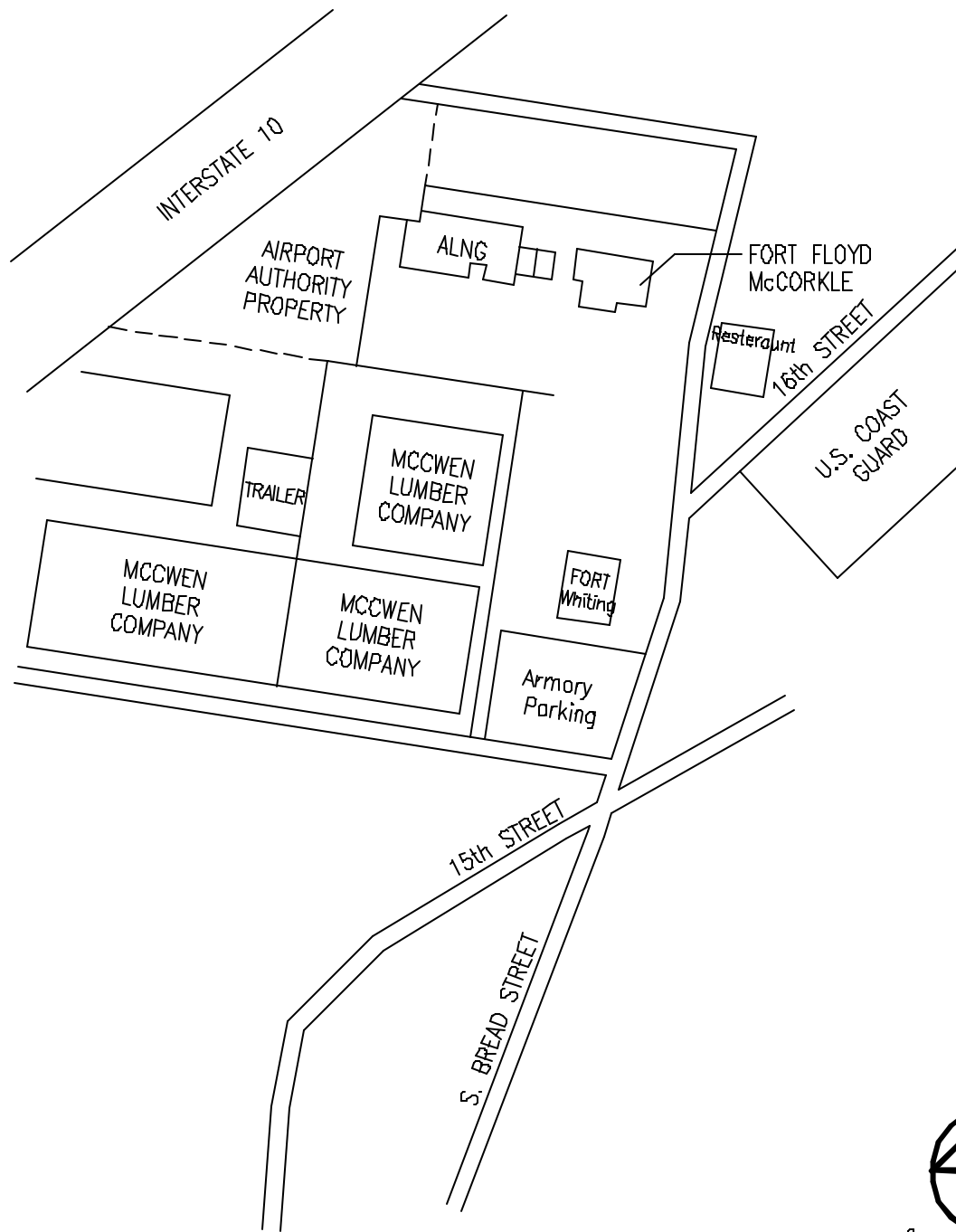
FIGURE 1 - SITE LOCATION MAP



OMS 28  
ALABAMA NATIONAL GUARD  
1622 SOUTH BROAD STREET  
MOBILE, ALABAMA

DRAWN BY: EAW

REFERENCE: MAP OF  
MOBILE, ALABAMA  
PREPARED BY: THE  
MICROSOFT CORP.



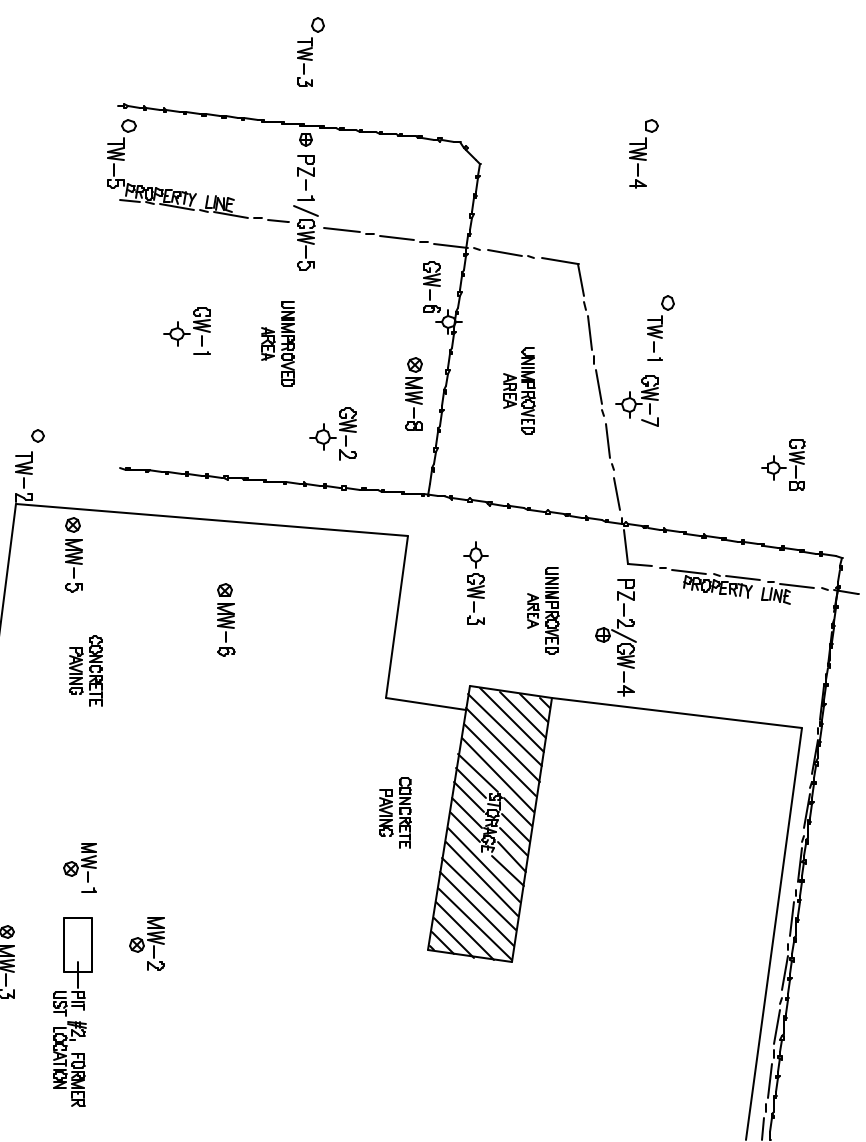
JOB #: 0405-538-02

FIGURE 2. SITE AND VICINITY MAP



OMS 28  
 1622 SOUTH BROAD STREET  
 MOBILE, ALABAMA

SCALE: 1" = 450'-0"  
 DATE: JANUARY 11, 2006  
 DRAWN BY: E.W.



**LEGEND**

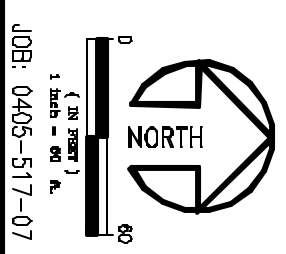
- PROPERTY BOUNDARY
- - - - FENCE
- ⊗ MONITORING WELL
- ⊕ PIEZOMETER
- GROUNDWATER GRAB SAMPLE
- ▭ BUILDING

FIGURE 3. TEMPORARY WELLS, PIEZOMETERS, AND MONITOR WELL LOCATION MAP



OMS 28  
 1622 SOUTH BROAD STREET  
 MOBILE, ALABAMA

DRAWN BY: EW  
 SCALE: 1" = 60'-0"  
 DATE: 1/6/06



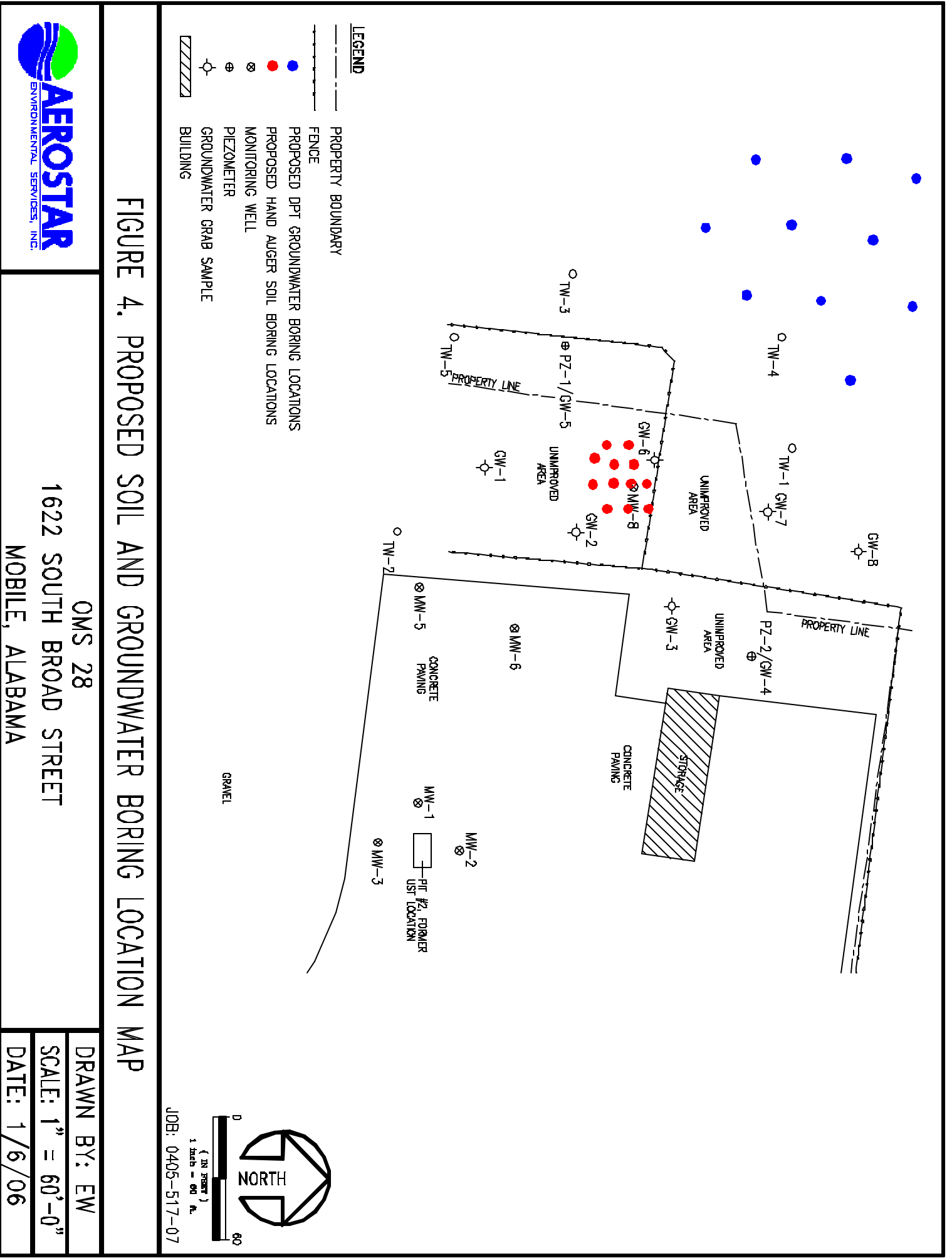
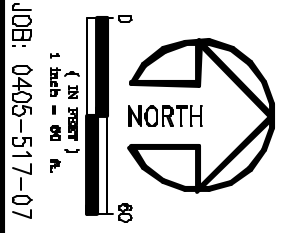


FIGURE 4. PROPOSED SOIL AND GROUNDWATER BORING LOCATION MAP



OMS 28  
 1622 SOUTH BROAD STREET  
 MOBILE, ALABAMA

DRAWN BY: EW  
 SCALE: 1" = 60'-0"  
 DATE: 1/6/06



JOB: 0405-517-07

# **TABLES**

**TABLE 1**  
**ORGANIZATIONAL MAINTENANCE SHOP 28**  
**MOBILE, ALABAMA**  
**SAMPLING AND ANALYSIS REQUIREMENTS FOR SOIL**

Media	Analyses	Method	Field Samples	Trip Blanks	Field Duplicates	Rinsate Blanks	MS/MSD	Holding Times	Sample Container Type / Volume	Preservatives
OMS 28 SOIL *	Volatiles	EPA Method 8260B	32	NA	4	1*	2	14 days from sampling to analysis	Three 40-mL vials with PTFE septa caps	Two 40-mL vials will contain sodium bisulfate preservative and one 40-mL vial will contain methanol preservative; Samples will be preserved at 4°C
	Semi-volatiles	EPA Method 8270C	32	NA	4	1*	2	14 days (from collection to extraction)/ 40-days (from extraction to analysis)	Two 8 oz soil jars with Teflon lined caps	None; Samples will be preserved at 4°C
	Pesticides	EPA Method 8081	32	NA	4	1*	2	14 days (from collection to extraction); 40-days (from extraction to analysis)	Two 8 oz soil jars with Teflon lined caps	None; Samples will be preserved at 4°C
	PolyChlorinated Byphenals (PCBs)	EPA Method 8082	32	NA	4	1*	2	14 days (from collection to extraction); 40-days (from extraction to analysis)	Two 8 oz soil jars with Teflon lined caps	None; Samples will be preserved at 4°C
	TAL Metals	200/6000 Series	32	NA	4	1*	2	180 days (from collection to analysis) for all analytes except mercury. Mercury holding time is 28-days	Two 8 oz soil jars with Teflon lined caps	None; Samples will be preserved at 4°C

Notes: NA- Not Applicable

24 Soil Samples from the 12 soil borings and 8 soil samples from the four permanent monitor wells

\*If the rinsate source changes, one sample will be collected from each new source

**TABLE 2**  
**ORGANIZATIONAL MAINTENANCE SHOP 28**  
**MOBILE, ALABAMA**  
**SAMPLING AND ANALYSIS REQUIREMENTS FOR GROUNDWATER**

Sample ID	Analyses	Method	Field Samples	Trip Blanks	Field Duplicates	Rinsate Blanks	MS/MSD	Holding Times	Sample Container Type / Volume	Preservatives
OMS 28 Groundwater*	Volatiles	EPA Method 8260B	24	2	3	2	2	14 days from collection to analysis	Two 40-mL glass with PTFE septa caps	Hydrochloric Acid; Samples will be preserved at 4°C
	Semi-volatiles	EPA Method 8270C	12	NA	2	1	1	7 days (from collection to extraction)/ 40-days (from extraction to analysis)	One 1 Liter amber glass container with Teflon lined cap	None; Samples will be preserved at 4°C
	Pesticides	EPA Method 8081	12	NA	2	1	1	7 days (from collection to extraction)/ 40-days (from extraction to analysis)	One 1 Liter amber glass container with Teflon lined cap	None; Samples will be preserved at 4°C
	PolyChlorinated Byphenals (PCBs)	EPA Method 8082	12	NA	2	1	1	7 days (from collection to extraction)/ 40-days (from extraction to analysis)	One 1 Liter amber glass container with Teflon lined cap	None; Samples will be preserved at 4°C
	TAL Metals	200/6000 Series	12	NA	2	1	1	6 months (from collection to analysis) with the exception of mercury. Mercury holding time is 28-days.	One 16 ounce plastic/HDPE container	Nitric Acid; Samples will be preserved at 4°C

Notes: NA- Not Applicable

\*Includes 11 DPT Groundwater Samples and 13 Groundwater Samples collected from MW-6, MW-8 through MW-12, PZ-1, PZ-2, and temporary monitor wells TW-1 through TW-5.

**TABLE 3**  
**ORGANIZATIONAL MAINTENANCE SHOP 28**  
**MOBILE, ALABAMA**  
**SAMPLING AND ANALYSIS REQUIREMENTS FOR INVESTIGATION DERIVED WASTE**

<b>Sample ID</b>	<b>Analyses</b>	<b>Field Samples</b>	<b>Holding Times</b>	<b>Sample Container Type / Volume</b>	<b>Preservatives</b>
<i>Soils</i>	TCLP Metals, and Volatiles/BTEX per EPA Method 601. Can utilize the volatiles laboratory data collected from the soil samples during assessment activities	1	TCLP Metals: 180-days (from collection to analysis) for all analytes except mercury, and 180-days from TCLP extraction to analysis. Mercury's holding time is 28-days.	Two, 8-oz glass soil jars with Teflon lined caps	None, Samples will be preserved at 4°C.
<i>Liquids</i>	Volatiles/BTEX per EPA Method 601. Can utilize the laboratory data collected from the groundwater samples during assessment activities	NA	NA	NA	NA



**TABLE 2**  
**ORGANIZATIONAL MAINTENANCE SHOP 28**  
**MOBILE, ALABAMA**  
**SAMPLING AND ANALYSIS REQUIREMENTS FOR GROUNDWATER**

**Appendix A**  
**Work Schedule**

**ORGANIZATIONAL MAINTENANCE SHOP 28  
MOBILE, ALABAMA  
SCHEDULE  
FY 2005/2006**

		Nov	Dec	Jan	Feb	Mar	Apr	May	June
	Task								
Task 1:	Work Plan/HASP Submittal								
Task 2:	Boring Installation and Collection of Soil and Groundwater Samples								
Task 3:	TCE DRAFT Report								
Task 4:	TCE FINAL Report								

**Appendix B**  
**GCAL Self Declaration Form**

**SELF DECLARATION FORM** – The following form is to provided to the candidate environmental laboratory by the COR, filled-out and returned by the laboratory (including required documentation, and evaluated by the COR for policy compliance before the laboratory can provide environmental analytical support to USACE contracts. Before testing services can be performed by the laboratory, the COR will notify the candidate laboratory of the acceptability of the declaration and supporting documentation. The form is to be updated on an annual basis.

Legal name of  
laboratory: Gulf Coast Analytical Laboratories, Inc.

Street  
address: 7979 GSRI Avenue, Baton Rouge, LA 70820

Name of  
Owner: Charles Patrick Byrne

Owner address  
(if different): \_\_\_\_\_

Phone number: (225) 769-4900

E-Mail  
address: patb@gcal.com

Laboratory  
director: Scott Bailey

Phone number: (225) 769-4900

E-Mail  
address: scottb@gcal.com

Quality  
Assurance Officer: Allison Naquin

Phone number: (225) 769-4900

E-Mail  
address: allison.naquin@gcal.com

**ENCLOSURE 3**

The undersigned persons understand and acknowledge that:

a. Laboratory operations, which will be utilized for testing in support of environmental analytical testing for USACE, are in full compliance with the DOD Quality Systems Manual (Version 3), including NELAC Standard Chapter 5 and Appendix requirements). All written documentation provided to USACE, accompanying this declaration, accurately reflect policy/practices implemented by laboratory staff.

b. The Laboratory will notify USACE immediately of change in status of laboratory operations that may affect on-going compliance as declared per item a.

c. The Laboratory acknowledges that USACE may audit the laboratory, relative to policy compliance at any time deemed appropriate; and will allow a designated COR full access to information and facilities to conduct such audit operations.

d. Signatories are authorized to sign this form on behalf of the owner and that there are no misrepresentations in the information provided in the initial laboratory assessment package.

Signature of

Quality Assurance Officer:

Allison Naguin

Date:

5/4/05

Signature of

Laboratory Director:

Scott Bandy

Date:

05/04/05

**Note** – A completed declaration form is to be accompanied by a copy of the laboratory's most current Quality Assurance Manual (including QA SOPs and Ethics program policies/procedures), appropriate sample prep and analytical SOPs, and corresponding performance data (MDL studies and LCS ranges) as well as documentation related to NELAP Accreditation(s), as appropriate.

ENCLOSURE 3

**Appendix C**  
**Laboratory Reporting Limits**

# Detection Limits

## Gulf Coast Analytical Laboratories

**Queue:** HACH

**Method:** 9034

<b>Analyte</b>	<b>Name</b>	<b>MDL</b>	<b>PQL</b>	<b>Units</b>	<b>Matrix</b>
18496-25-8	Sulfide	80	80	mg/kg	S
18496-25-8	Sulfide	1	2	mg/L	W



# Detection Limits

## Gulf Coast Analytical Laboratories

**Queue:** ICP

**Method:** SW-846 6010B

<b>Analyte</b>	<b>Name</b>	<b>MDL</b>	<b>PQL</b>	<b>Units</b>	<b>Matrix</b>
7429-90-5	Aluminum	.274	8	mg/kg	S
7440-36-0	Antimony	.217	2.4	mg/kg	S
7440-38-2	Arsenic	.219	1.6	mg/kg	S
7440-39-3	Barium	.015	.4	mg/kg	S
7440-41-7	Beryllium	.0024	.2	mg/kg	S
7440-42-8	Boron	.761	40	mg/kg	S
7440-43-9	Cadmium	.008	.2	mg/kg	S
7440-70-2	Calcium	1.966	4	mg/kg	S
7440-45-1	Cerium		.4	mg/kg	S
7440-47-3	Chromium	.333	.4	mg/kg	S
16065-83-1	Chromium (III)	.314	1	mg/kg	S
7440-48-4	Cobalt	.017	.4	mg/kg	S
7440-50-8	Copper	.0474	.4	mg/kg	S
7439-89-6	Iron	.406	4	mg/kg	S
7439-92-1	Lead	.113	.6	mg/kg	S
7439-93-2	Lithium	.131	2	mg/kg	S
7439-95-4	Magnesium	.835	4	mg/kg	S
7439-96-5	Manganese	.023	.6	mg/kg	S
7439-98-7	Molybdenum	.052	1.2	mg/kg	S
7440-02-0	Nickel	.032	1.6	mg/kg	S
7440-09-7	Potassium	2.279	8	mg/kg	S
7782-49-2	Selenium	.188	1.6	mg/kg	S
7440-21-3	Silicon	1.695	2	mg/kg	S
7440-22-4	Silver	.025	.4	mg/kg	S
7440-23-5	Sodium	1.366	40	mg/kg	S
7440-24-6	Strontium	.04	.4	mg/kg	S
7440-28-0	Thallium	.089	.8	mg/kg	S
7440-31-5	Tin	.646	4	mg/kg	S
7440-32-6	Titanium	.024	4	mg/kg	S
7440-39-3TTB	True Total Barium	2.25	500	mg/kg	S
7440-62-2	Vanadium	.046	.8	mg/kg	S
7440-66-6	Zinc	.066	.8	mg/kg	S
7440-67-7	Zirconium	.025	.4	mg/kg	S

# Detection Limits

## Gulf Coast Analytical Laboratories

**Queue: ICP**

**Method: SW-846 6010B**

<b>Analyte</b>	<b>Name</b>	<b>MDL</b>	<b>PQL</b>	<b>Units</b>	<b>Matrix</b>
7429-90-5	Aluminum	.0232	.2	mg/L	W
7440-36-0	Antimony	.0013	.06	mg/L	W
7440-38-2	Arsenic	.0039	.04	mg/L	W
7440-39-3	Barium	.0004	.01	mg/L	W
7440-41-7	Beryllium	.00007	.005	mg/L	W
7440-42-8	Boron	.0205	1	mg/L	W
7440-43-9	Cadmium	.0001	.005	mg/L	W
7440-70-2	Calcium	.0259	.1	mg/L	W
7440-45-1	Cerium		.01	mg/L	W
7440-47-3	Chromium	.0008	.01	mg/L	W
16065-83-1	Chromium (III)	.005	.01	mg/L	W
7440-48-4	Cobalt	.0005	.01	mg/L	W
7440-50-8	Copper	.003	.01	mg/L	W
MET-002	Ferric Iron	.0075	.1	mg/L	W
000-01-5	Hardness		.66	mg/L	W
7439-89-6	Iron	.005	.1	mg/L	W
7439-92-1	Lead	.0012	.015	mg/L	W
7439-93-2	Lithium	.0031	.05	mg/L	W
7439-95-4	Magnesium	.0152	.1	mg/L	W
7439-96-5	Manganese	.0007	.015	mg/L	W
7439-98-7	Molybdenum	.0013	.05	mg/L	W
7440-02-0	Nickel	.0006	.04	mg/L	W
7440-09-7	Potassium	.0648	.5	mg/L	W
7782-49-2	Selenium	.0045	.04	mg/L	W
7440-21-3	Silicon	.0169	.05	mg/L	W
7440-22-4	Silver	.0008	.01	mg/L	W
7440-23-5	Sodium	.0415	1	mg/L	W
7440-24-6	Strontium	.0006	.05	mg/L	W
7440-28-0	Thallium	.0013	.02	mg/L	W
7440-31-5	Tin	.0031	.025	mg/L	W
7440-32-6	Titanium	.0005	.1	mg/L	W
7440-62-2	Vanadium	.0007	.02	mg/L	W
7440-66-6	Zinc	.0018	.02	mg/L	W

# Detection Limits

## Gulf Coast Analytical Laboratories

Queue: GCSV

Method: SW-846 8081A

Analyte	Name	MDL	PQL	Units	Matrix
72-54-8	4,4'-DDD	.47	4	ug/Kg	S
72-55-9	4,4'-DDE	.65	4	ug/Kg	S
50-29-3	4,4'-DDT	.25	4	ug/Kg	S
309-00-2	Aldrin	.32	2	ug/Kg	S
60-57-1	Dieldrin	.28	4	ug/Kg	S
959-98-8	Endosulfan I	.34	2	ug/Kg	S
33213-65-9	Endosulfan II	.56	4	ug/Kg	S
1031-07-8	Endosulfan sulfate	.53	4	ug/Kg	S
72-20-8	Endrin	.34	4	ug/Kg	S
7421-93-4	Endrin aldehyde	.67	4	ug/Kg	S
53494-70-5	Endrin ketone	.84	4	ug/Kg	S
76-44-8	Heptachlor	.21	2	ug/Kg	S
1024-57-3	Heptachlor epoxide	.71	2	ug/Kg	S
72-43-5	Methoxychlor	1.25	20	ug/Kg	S
8001-35-2	Toxaphene	9.37	200	ug/Kg	S
319-84-6	alpha-BHC	.32	2	ug/Kg	S
5103-71-9	alpha-Chlordane	.36	2	ug/Kg	S
319-85-7	beta-BHC	.54	4	ug/Kg	S
319-86-8	delta-BHC	.32	2	ug/Kg	S
58-89-9	gamma-BHC (Lindane)	.63	2	ug/Kg	S
5103-74-2	gamma-Chlordane	.44	2	ug/Kg	S

# Detection Limits

## Gulf Coast Analytical Laboratories

**Queue:** GCSV

**Method:** SW-846 8081A

<b>Analyte</b>	<b>Name</b>	<b>MDL</b>	<b>PQL</b>	<b>Units</b>	<b>Matrix</b>
72-54-8	4,4'-DDD	.00392	.1	ug/L	W
72-55-9	4,4'-DDE	.01112	.1	ug/L	W
50-29-3	4,4'-DDT	.01165	.1	ug/L	W
309-00-2	Aldrin	.00522	.05	ug/L	W
60-57-1	Dieldrin	.00942	.1	ug/L	W
959-98-8	Endosulfan I	.00553	.05	ug/L	W
33213-65-9	Endosulfan II	.01556	.1	ug/L	W
1031-07-8	Endosulfan sulfate	.00507	.1	ug/L	W
72-20-8	Endrin	.01664	.1	ug/L	W
7421-93-4	Endrin aldehyde	.00967	.1	ug/L	W
53494-70-5	Endrin ketone	.00852	.1	ug/L	W
76-44-8	Heptachlor	.00877	.05	ug/L	W
1024-57-3	Heptachlor epoxide	.01463	.05	ug/L	W
72-43-5	Methoxychlor	.00427	.5	ug/L	W
8001-35-2	Toxaphene	.55	5	ug/L	W
319-84-6	alpha-BHC	.00422	.05	ug/L	W
5103-71-9	alpha-Chlordane	.00547	.05	ug/L	W
319-85-7	beta-BHC	.00847	.05	ug/L	W
319-86-8	delta-BHC	.00464	.05	ug/L	W
58-89-9	gamma-BHC (Lindane)	.0051	.05	ug/L	W
5103-74-2	gamma-Chlordane	.01083	.05	ug/L	W

# Detection Limits

## Gulf Coast Analytical Laboratories

Queue: GCSV

Method: SW-846 8082

Analyte	Name	MDL	PQL	Units	Matrix
12674-11-2	Aroclor-1016	5.37	40	ug/Kg	S
11104-28-2	Aroclor-1221	9.17	40	ug/Kg	S
11141-16-5	Aroclor-1232	10.05	40	ug/Kg	S
53469-21-9	Aroclor-1242	11.73	40	ug/Kg	S
12672-29-6	Aroclor-1248	7.81	40	ug/Kg	S
11097-69-1	Aroclor-1254	6.49	40	ug/Kg	S
11096-82-5	Aroclor-1260	5.42	40	ug/Kg	S

# Detection Limits

## Gulf Coast Analytical Laboratories

Queue: GCSV

Method: SW-846 8082

Analyte	Name	MDL	PQL	Units	Matrix
12674-11-2	Aroclor-1016	.25	1	ug/L	W
11104-28-2	Aroclor-1221	.23	1	ug/L	W
11141-16-5	Aroclor-1232	.2	1	ug/L	W
53469-21-9	Aroclor-1242	.25	1	ug/L	W
12672-29-6	Aroclor-1248	.13	1	ug/L	W
11097-69-1	Aroclor-1254	.21	1	ug/L	W
11096-82-5	Aroclor-1260	.24	1	ug/L	W

# Detection Limits

## Gulf Coast Analytical Laboratories

Queue: MSSV

Method: SW-846 8270C

Analyte	Name	MDL	PQL	Units	Matrix
126-68-1	0,0,0-Triethylphosphorothioate	46.5	330	ug/Kg	S
634-66-2	1,2,3,4-Tetrachlorobenzene	15.3	330	ug/Kg	S
95-94-3	1,2,4,5-Tetrachlorobenzene	39.3	330	ug/Kg	S
120-82-1	1,2,4-Trichlorobenzene	10.559	330	ug/Kg	S
95-50-1	1,2-Dichlorobenzene	10.562	330	ug/Kg	S
122-66-7	1,2Diphenylhydrazine/Azobenzen	7.162	330	ug/Kg	S
99-35-4	1,3,5-Trinitrobenzene	330	330	ug/Kg	S
541-73-1	1,3-Dichlorobenzene	10.5	330	ug/Kg	S
99-65-0	1,3-Dinitrobenzene	330	330	ug/Kg	S
123-91-1	1,4 Dioxane	330	330	ug/Kg	S
106-46-7	1,4-Dichlorobenzene	9.088	330	ug/Kg	S
100-25-4	1,4-Dinitrobenzene	20	330	ug/Kg	S
130-15-4	1,4-Naphthoquinone	43.7	660	ug/Kg	S
106-50-3	1,4-Phenylenediamine	330	330	ug/Kg	S
111-29-5	1,5-Pentanediol		660	ug/Kg	S
629-11-8	1,6-Hexanediol		660	ug/Kg	S
90-12-0	1-Methylnaphthalene	7.979	330	ug/Kg	S
134-32-7	1-Naphthylamine	330	330	ug/Kg	S
2687-25-4	2,3 and/or 3,4-Diaminotoluene	18.3	660	ug/Kg	S
58-90-2	2,3,4,6-Tetrachlorophenol	75.4	330	ug/Kg	S
95-80-7M	2,4 and/or 2,6-Diaminotoluene	20.9	660	ug/Kg	S
95-95-4	2,4,5-Trichlorophenol	6.715	330	ug/Kg	S
88-06-2	2,4,6-Trichlorophenol	14.829	330	ug/Kg	S
120-83-2	2,4-Dichlorophenol	8.613	330	ug/Kg	S
105-67-9	2,4-Dimethylphenol	22.388	330	ug/Kg	S
51-28-5	2,4-Dinitrophenol	56.544	1670	ug/Kg	S
121-14-2	2,4-Dinitrotoluene	14.85	330	ug/Kg	S
87-65-0	2,6-Dichlorophenol	55	330	ug/Kg	S
606-20-2	2,6-Dinitrotoluene	8.001	330	ug/Kg	S
934-34-9	2-(3H) Benzothiazolone	41.5595	330	ug/Kg	S
149-30-4	2-(3H)Benzothiazolethione	146	750	ug/Kg	S
53-96-3	2-Acetylaminofluorene	57.5	330	ug/Kg	S
91-58-7	2-Chloronaphthalene	8.922	330	ug/Kg	S

95-57-8	2-Chlorophenol	5.278	330	ug/Kg	S
91-57-6	2-Methylnaphthalene	9.35	330	ug/Kg	S
91-59-8	2-Naphthylamine	330	330	ug/Kg	S
88-74-4	2-Nitroaniline	21.64	1670	ug/Kg	S
88-75-5	2-Nitrophenol	13.152	330	ug/Kg	S
109-06-8	2-Picoline	75.8	330	ug/Kg	S
2409-55-4	2-tertbutyl-4- methylphenol	19.39	330	ug/Kg	S
91-94-1	3,3'-Dichlorobenzidine	41.454	660	ug/Kg	S
119-93-7	3,3'-Dimethylbenzidine	330	330	ug/Kg	S
56-49-5	3-Methylcholanthrene	31.7	330	ug/Kg	S
99-09-2	3-Nitroaniline	9.103	1670	ug/Kg	S
101-14-4	4,4'-Methylenebis(2-cloroanili	660	660	ug/Kg	S
534-52-1	4,6-Dinitro-2- methylphenol	17.31	1670	ug/Kg	S
92-67-1	4- Aminobiphenyl	330	330	ug/Kg	S
101-55-3	4-Bromophenyl phenyl ether	8.056	330	ug/Kg	S
59-50-7	4-Chloro-3- methylphenol	13.24	330	ug/Kg	S
106-47-8	4-Chloroaniline	29.099	330	ug/Kg	S
7005-72-3	4-Chlorophenyl phenyl ether	8.783	330	ug/Kg	S
100-01-6	4-Nitroaniline	23.878	1670	ug/Kg	S
100-02-7	4-Nitrophenol	43.381	1670	ug/Kg	S
56-57-5	4-Nitroquinoline- 1-oxide	44.3	330	ug/Kg	S
98-54-4	4-Tert- Butylphenol	21.2	330	ug/Kg	S
99-55-8	5-Nitro- <i>o</i> -toluidine	330	330	ug/Kg	S
57-97-6	7,12-Dimethylbenz(a)anthracene	46.9	330	ug/Kg	S
83-32-9	Acenaphthene	8.606	330	ug/Kg	S
208-96-8	Acenaphthylene	9.749	330	ug/Kg	S
98-86-2	Acetophenone	7.096	330	ug/Kg	S
79-06-1	Acrylamide		660	ug/Kg	S
62-53-3	Aniline	6.4	330	ug/Kg	S
120-12-7	Anthracene	9.454	330	ug/Kg	S
140-57-8	Aramite	68.3	330	ug/Kg	S
1912-24-9	Atrazine (Aatrex)	16.936	660	ug/Kg	S
100-52-7	Benzaldehyde	25.255	660	ug/Kg	S
92-87-5	Benzidine	44.537	1320	ug/Kg	S
56-55-3	Benzo(a)anthracene	8.803	330	ug/Kg	S
50-32-8	Benzo(a)pyrene	8.743	330	ug/Kg	S
205-99-2	Benzo(b)fluoranthene	11.639	330	ug/Kg	S
191-24-2	Benzo(g,h,i)perylene	8.751	330	ug/Kg	S



207-08-9	Benzo(k)fluoranthene	13.524	330	ug/Kg	S
65-85-0	Benzoic acid	154	1670	ug/Kg	S
95-16-9	Benzothiazole	21.768	330	ug/Kg	S
100-51-6	Benzyl alcohol	9.761	330	ug/Kg	S
92-52-4	Biphenyl	9.702	330	ug/Kg	S
111-91-1	Bis(2-Chloroethoxy)methane	11.367	330	ug/Kg	S
111-44-4	Bis(2-Chloroethyl)ether	10.282	330	ug/Kg	S
108-60-1	Bis(2-Chloroisopropyl)ether	12.821	330	ug/Kg	S
117-81-7	Bis(2-Ethylhexyl)phthalate	8.901	330	ug/Kg	S
85-68-7	Butyl benzyl phthalate	10.812	330	ug/Kg	S
105-60-2	Caprolactam	68.355	330	ug/Kg	S
86-74-8	Carbazole	8.529	330	ug/Kg	S
510-15-6	Chlorobenzilate	55.4	330	ug/Kg	S
218-01-9	Chrysene	7.724	330	ug/Kg	S
1319-77-3	Cresols	25.689	666	ug/Kg	S
84-74-2	Di-n-butyl phthalate	24.721	330	ug/Kg	S
117-84-0	Di-n-octyl phthalate	7.19	330	ug/Kg	S
2303-16-4	Diallate (Avadex)	45.5	330	ug/Kg	S
226-36-8	Dibenz(a,h)acridine	20	330	ug/Kg	S
53-70-3	Dibenz(a,h)anthracene	8.345	330	ug/Kg	S
132-64-9	Dibenzofuran	12.254	330	ug/Kg	S
77-73-6	Dicyclopentadiene	10	330	ug/Kg	S
84-66-2	Diethyl phthalate	14.701	330	ug/Kg	S
60-51-5	Dimethoate	51.3	660	ug/Kg	S
617-94-7	Dimethyl benzyl alcohol	330	330	ug/Kg	S
131-11-3	Dimethyl phthalate	10.883	330	ug/Kg	S
88-85-7	Dinoseb	52.4	330	ug/Kg	S
101-84-8	Diphenyl Ether	330	330	ug/Kg	S
122-39-4	Diphenylamine	14.2	330	ug/Kg	S
298-04-4	Disulfoton	55.8	660	ug/Kg	S
56-38-2	Ethyl Parathion	330	330	ug/Kg	S
62-50-0	Ethyl methanesulfonate	330	330	ug/Kg	S
52-85-7	Famphur	64.4	660	ug/Kg	S
206-44-0	Fluoranthene	9.716	330	ug/Kg	S
86-73-7	Fluorene	8.489	330	ug/Kg	S
87-82-1	Hexabromobenzene	24.2	330	ug/Kg	S
118-74-1	Hexachlorobenzene	10.628	330	ug/Kg	S
87-68-3	Hexachlorobutadiene	12.639	330	ug/Kg	S

77-47-4	Hexachlorocyclopentadiene	7.162	330	ug/Kg	S
67-72-1	Hexachloroethane	13.84	330	ug/Kg	S
70-30-4	Hexachlorophene	660	660	ug/Kg	S
1888-71-7	Hexachloropropene	43.9	330	ug/Kg	S
142-62-1	Hexanoic Acid		660	ug/Kg	S
95-13-6	Indene	20	330	ug/Kg	S
193-39-5	Indeno(1,2,3-cd)pyrene	14.028	330	ug/Kg	S
465-73-6	Isodrin	51.4	330	ug/Kg	S
78-59-1	Isophorone	8.409	330	ug/Kg	S
120-58-1	Isosafrole	49.2	330	ug/Kg	S
143-50-0	Kepone	1650	1670	ug/Kg	S
108-31-6	Maleic anhydride	174	660	ug/Kg	S
91-80-5	Methapyriline	38.4	330	ug/Kg	S
298-00-0	Methyl Parathion	56.5	660	ug/Kg	S
1705-85-7	Methyl chrysene	20	330	ug/Kg	S
66-27-3	Methyl methanesulfonate	61.3	330	ug/Kg	S
120-75-2	Methylbenzothiazole	29.42	330	ug/Kg	S
91-20-3	Naphthalene	9.66	330	ug/Kg	S
98-95-3	Nitrobenzene	12.391	330	ug/Kg	S
706-78-5	Octachlorocyclopentene		330	ug/Kg	S
608-93-5	Pentachlorobenzene	26.4	330	ug/Kg	S
76-01-7	Pentachloroethane	74.1	330	ug/Kg	S
82-68-8	Pentachloronitrobenzene	69.5	330	ug/Kg	S
87-86-5	Pentachlorophenol	85.948	1670	ug/Kg	S
109-52-4	Pentanoic Acid		660	ug/Kg	S
62-44-2	Phenacetin	40.7	330	ug/Kg	S
85-01-8	Phenanthrene	10.731	330	ug/Kg	S
108-95-2	Phenol	10.742	330	ug/Kg	S
298-02-2	Phorate	57.1	660	ug/Kg	S
88-99-3	Phthalic Acid		1330	ug/Kg	S
85-44-9	Phthalic anhydride		1330	ug/Kg	S
23950-58-5	Pronamide	65.4	330	ug/Kg	S
129-00-0	Pyrene	10.356	330	ug/Kg	S
110-86-1	Pyridine	19.846	330	ug/Kg	S
91-22-5	Quinoline	20	330	ug/Kg	S
299-84-3	Ronnel	38.9	330	ug/Kg	S
94-59-7	Safrole	44.5	330	ug/Kg	S
126-33-0	Sulfolane		660	ug/Kg	S

3689-24-5	Sulfotep	660	660	ug/Kg	S
297-97-2	Thionazine	90.9	330	ug/Kg	S
108-98-5	Thiophenol (Benzenethiol)	3.42	330	ug/Kg	S
95-80-7	Toluene diamine	39.2	330	ug/Kg	S
I-317	Toluene diisocyanate	203	330	ug/Kg	S
SVOA-001	Total Methylanthalene		330	ug/Kg	S
126-73-8	Tributyl Phosphate		660	ug/Kg	S
126-72-7	Tris(2,3-dibromopropyl)		660	ug/Kg	S
122-09-8	a,a-Dimethylphenethylamine	330	330	ug/Kg	S
1319-77-3MP	m,p-Cresol	12.257	330	ug/Kg	S
105-59-9	n-Methyldiethanolamine	20	330	ug/Kg	S
59-89-2	n-Nitroso morpholine	36	330	ug/Kg	S
924-16-3	n-Nitrosodi-n-butylamine	69.9	330	ug/Kg	S
621-64-7	n-Nitrosodi-n-propylamine	8.925	330	ug/Kg	S
55-18-5	n-Nitrosodiethylamine	51.2	330	ug/Kg	S
62-75-9	n-Nitrosodimethylamine	43.058	330	ug/Kg	S
86-30-6	n-Nitrosodiphenylamine	9.85	330	ug/Kg	S
10595-95-6	n-Nitrosomethylethylamine	93	330	ug/Kg	S
100-75-4	n-Nitrosopiperidine	25.5	330	ug/Kg	S
930-55-2	n-Nitrosopyrrolidine	330	330	ug/Kg	S
95-53-4	o and/or p - Toluidine	330	330	ug/Kg	S
95-48-7	o-Cresol	13.432	330	ug/Kg	S
90-43-7	o-Phenylphenol	23.2	330	ug/Kg	S
60-11-7	p-(Dimethylamino)azobenzene	41.3	330	ug/Kg	S
106-51-4	p-Benzoquinone		660	ug/Kg	S

# Detection Limits

## Gulf Coast Analytical Laboratories

Queue: MSSV

Method: SW-846 8270C

Analyte	Name	MDL	PQL	Units	Matrix
126-68-1	0,0,0-Triethylphosphorothioate	1.53	20	ug/L	W
634-66-2	1,2,3,4-Tetrachlorobenzene	.627	10	ug/L	W
95-94-3	1,2,4,5-Tetrachlorobenzene	2.02	20	ug/L	W
120-82-1	1,2,4-Trichlorobenzene	.2884	10	ug/L	W
95-50-1	1,2-Dichlorobenzene	.1553	10	ug/L	W
122-66-7	1,2Diphenylhydrazine/Azobenzen	.2036	10	ug/L	W
99-35-4	1,3,5-Trinitrobenzene	1.1	20	ug/L	W
541-73-1	1,3-Dichlorobenzene	.2375	10	ug/L	W
99-65-0	1,3-Dinitrobenzene	1.17	20	ug/L	W
123-91-1	1,4 Dioxane	.9551	2	ug/L	W
106-46-7	1,4-Dichlorobenzene	1.4304	10	ug/L	W
100-25-4	1,4-Dinitrobenzene	20	20	ug/L	W
130-15-4	1,4-Naphthoquinone	6.12	20	ug/L	W
106-50-3	1,4-Phenylenediamine	1.52	20	ug/L	W
111-29-5	1,5-Pentanediol		20	ug/L	W
629-11-8	1,6-Hexanediol		20	ug/L	W
90-12-0	1-Methylnaphthalene	.1458	10	ug/L	W
134-32-7	1-Naphthylamine	.937	20	ug/L	W
2687-25-4	2,3 and/or 3,4-Diaminotoluene	3.53	20	ug/L	W
4901-51-3	2,3,4,5-Tetrachlorophenol	1.422	10	ug/L	W
58-90-2	2,3,4,6-Tetrachlorophenol	2.22	20	ug/L	W
15950-66-0	2,3,4-Trichlorophenol	1.241	10	ug/L	W
935-95-5	2,3,5,6-Tetrachlorophenol	1.326	10	ug/L	W
608-27-5	2,3-Dichloroaniline	10	10	ug/L	W
MSSV35	2,4 and 2,5-Dichlorophenol	1.871	20	ug/L	W
95-80-7M	2,4 and/or 2,6-Diaminotoluene	1.7	20	ug/L	W
95-95-4	2,4,5-Trichlorophenol	.3729	10	ug/L	W
118-79-6	2,4,6-Tribromophenol		10	ug/L	W
88-06-2	2,4,6-Trichlorophenol	.41984	10	ug/L	W
120-83-2	2,4-Dichlorophenol	.29215	10	ug/L	W
105-67-9	2,4-Dimethylphenol	6.0012	10	ug/L	W
51-28-5	2,4-Dinitrophenol	2.1755	50	ug/L	W
121-14-2	2,4-Dinitrotoluene	.4	10	ug/L	W

87-65-0	2,6-Dichlorophenol	1.46	20	ug/L	W
606-20-2	2,6-Dinitrotoluene	.3541	10	ug/L	W
934-34-9	2-(3H) Benzothiazolone	1.1	10	ug/L	W
149-30-4	2-(3H)Benzothiazolethione	4.4	25	ug/L	W
53-96-3	2-Acetylaminofluorene	1.93	20	ug/L	W
91-58-7	2-Chloronaphthalene	.3262	10	ug/L	W
95-57-8	2-Chlorophenol	.3213	10	ug/L	W
91-57-6	2-Methylnaphthalene	.2158	10	ug/L	W
91-59-8	2-Naphthylamine	1.61	20	ug/L	W
88-74-4	2-Nitroaniline	.9813	50	ug/L	W
88-75-5	2-Nitrophenol	.37787	10	ug/L	W
109-06-8	2-Picoline	3.45	20	ug/L	W
2409-55-4	2-tertbutyl-4- methylphenol	.755	10	ug/L	W
MSSV34	3 and/or 4-Chlorophenol	.334	10	ug/L	W
91-94-1	3,3'-Dichlorobenzidine	.3071	20	ug/L	W
119-93-7	3,3'-Dimethylbenzidine	3.41	20	ug/L	W
609-19-8	3,4,5-Trichlorophenol	1.034	10	ug/L	W
95-77-2	3,4-Dichlorophenol	.8514	10	ug/L	W
56-49-5	3-Methylcholanthrene	1.84	20	ug/L	W
99-09-2	3-Nitroaniline	.2934	50	ug/L	W
101-14-4	4,4'-Methylenebis(2-cloroanili		20	ug/L	W
80-05-7	4,4-Isopropylidene diphenol		10	ug/L	W
534-52-1	4,6-Dinitro-2-methylphenol	.7593	50	ug/L	W
92-67-1	4-Aminobiphenyl	1.48	20	ug/L	W
101-55-3	4-Bromophenyl phenyl ether	.3928	10	ug/L	W
59-50-7	4-Chloro-3-methylphenol	.2834	10	ug/L	W
106-47-8	4-Chloroaniline	.3406	10	ug/L	W
7005-72-3	4-Chlorophenyl phenyl ether	.3549	10	ug/L	W
100-01-6	4-Nitroaniline	.8205	50	ug/L	W
100-02-7	4-Nitrophenol	1.7507	50	ug/L	W
56-57-5	4-Nitroquinoline-1-oxide	1.1	20	ug/L	W
98-54-4	4-Tert-Butylphenol	.837	10	ug/L	W
99-55-8	5-Nitro-o-toluidine	1.05	20	ug/L	W
57-97-6	7,12-Dimethylbenz(a)anthracene	1.34	20	ug/L	W
83-32-9	Acenaphthene	.21916	10	ug/L	W
208-96-8	Acenaphthylene	.2576	10	ug/L	W
98-86-2	Acetophenone	.397	10	ug/L	W
79-06-1	Acrylamide	10	20	ug/L	W

62-53-3	Aniline	.3401	10	ug/L	W
120-12-7	Anthracene	.3504	10	ug/L	W
140-57-8	Aramite	2.16	20	ug/L	W
1912-24-9	Atrazine (Aatrex)	.473	20	ug/L	W
100-52-7	Benzaldehyde	.46968	20	ug/L	W
92-87-5	Benzidine	7.1826	50	ug/L	W
56-55-3	Benzo(a)anthracene	.20548	10	ug/L	W
50-32-8	Benzo(a)pyrene	.13	10	ug/L	W
205-99-2	Benzo(b)fluoranthene	.244	10	ug/L	W
191-24-2	Benzo(g,h,i)perylene	.19918	10	ug/L	W
207-08-9	Benzo(k)fluoranthene	.2782	10	ug/L	W
65-85-0	Benzoic acid	1	50	ug/L	W
95-16-9	Benzothiazole	.982	10	ug/L	W
100-51-6	Benzyl alcohol	.2647	10	ug/L	W
92-52-4	Biphenyl	.1762	10	ug/L	W
111-91-1	Bis(2-Chloroethoxy)methane	.1917	10	ug/L	W
111-44-4	Bis(2-Chloroethyl)ether	.357	10	ug/L	W
108-60-1	Bis(2-Chloroisopropyl)ether	.28289	10	ug/L	W
117-81-7	Bis(2-Ethylhexyl)phthalate	.58519	10	ug/L	W
85-68-7	Butyl benzyl phthalate	.35578	10	ug/L	W
105-60-2	Caprolactam	.309	10	ug/L	W
86-74-8	Carbazole	.21394	10	ug/L	W
510-15-6	Chlorobenzilate	1.22	20	ug/L	W
218-01-9	Chrysene	.31135	10	ug/L	W
1319-77-3	Cresols	.592	20	ug/L	W
84-74-2	Di-n-butyl phthalate	.73546	10	ug/L	W
117-84-0	Di-n-octyl phthalate	.3371	10	ug/L	W
2303-16-4	Diallate (Avadex)	1.77	20	ug/L	W
226-36-8	Dibenz(a,h)acridine	.413	10	ug/L	W
53-70-3	Dibenz(a,h)anthracene	.2874	10	ug/L	W
132-64-9	Dibenzofuran	.2275	10	ug/L	W
77-73-6	Dicyclopentadiene	10	10	ug/L	W
84-66-2	Diethyl phthalate	.34245	10	ug/L	W
60-51-5	Dimethoate	2.7	20	ug/L	W
617-94-7	Dimethyl benzyl alcohol	.255	10	ug/L	W
131-11-3	Dimethyl phthalate	.20576	10	ug/L	W
68-12-2	Dimethylformamide		10	ug/L	W
88-85-7	Dinoseb	3.12	20	ug/L	W

101-84-8	Diphenyl Ether	10	10	ug/L	W
122-39-4	Diphenylamine	.295	10	ug/L	W
298-04-4	Disulfoton	.917	20	ug/L	W
56-38-2	Ethyl Parathion	1.3	20	ug/L	W
62-50-0	Ethyl methanesulfonate	1.18	20	ug/L	W
52-85-7	Famphur	1.36	20	ug/L	W
206-44-0	Fluoranthene	.23106	10	ug/L	W
86-73-7	Fluorene	.23047	10	ug/L	W
87-82-1	Hexabromobenzene	.98	10	ug/L	W
118-74-1	Hexachlorobenzene	.29052	10	ug/L	W
87-68-3	Hexachlorobutadiene	.331	10	ug/L	W
77-47-4	Hexachlorocyclopentadiene	1.8519	10	ug/L	W
67-72-1	Hexachloroethane	1.4532	10	ug/L	W
70-30-4	Hexachlorophene	10	20	ug/L	W
1888-71-7	Hexachloropropene	1.88	10	ug/L	W
142-62-1	Hexanoic Acid		20	ug/L	W
95-13-6	Indene	.918	10	ug/L	W
193-39-5	Indeno(1,2,3-cd)pyrene	.24015	10	ug/L	W
465-73-6	Isodrin	1.34	20	ug/L	W
78-59-1	Isophorone	.27071	10	ug/L	W
120-58-1	Isosafrole	1.32	20	ug/L	W
143-50-0	Kepone	10	20	ug/L	W
108-31-6	Maleic anhydride		20	ug/L	W
91-80-5	Methapyriline	.811	20	ug/L	W
298-00-0	Methyl Parathion	1.68	20	ug/L	W
1705-85-7	Methyl chrysene	2.76	10	ug/L	W
66-27-3	Methyl methanesulfonate	.953	20	ug/L	W
120-75-2	Methylbenzothiazole	.513	10	ug/L	W
91-20-3	Naphthalene	.21071	10	ug/L	W
98-95-3	Nitrobenzene	.2263	10	ug/L	W
706-78-5	Octachlorocyclopentene		10	ug/L	W
608-93-5	Pentachlorobenzene	1.79	20	ug/L	W
76-01-7	Pentachloroethane	1.79	10	ug/L	W
82-68-8	Pentachloronitrobenzene	1.07	20	ug/L	W
87-86-5	Pentachlorophenol	1.8683	50	ug/L	W
109-52-4	Pentanoic Acid		20	ug/L	W
62-44-2	Phenacetin	3.48	20	ug/L	W
85-01-8	Phenanthrene	.19096	10	ug/L	W

108-95-2	Phenol	.13181	10	ug/L	W
298-02-2	Phorate	1.91	20	ug/L	W
88-99-3	Phthalic Acid		40	ug/L	W
85-44-9	Phthalic anhydride	40	40	ug/L	W
23950-58-5	Pronamide	1.32	20	ug/L	W
129-00-0	Pyrene	.23356	10	ug/L	W
110-86-1	Pyridine	3.64884	10	ug/L	W
91-22-5	Quinoline	2.23	10	ug/L	W
299-84-3	Ronnel	.58	10	ug/L	W
94-59-7	Safrole	3.49	20	ug/L	W
126-33-0	Sulfolane		20	ug/L	W
3689-24-5	Sulfotep	2.13	20	ug/L	W
297-97-2	Thionazine	1.37	20	ug/L	W
108-98-5	Thiophenol (Benzenethiol)	9.66	10	ug/L	W
95-80-7	Toluene diamine	5.23	10	ug/L	W
I-317	Toluene diisocyanate	10	10	ug/L	W
SVOA-001	Total Methylnaphthalene		10	ug/L	W
126-73-8	Tributyl Phosphate		20	ug/L	W
126-72-7	Tris(2,3-dibromopropyl)		20	ug/L	W
122-09-8	a,a-Dimethylphenethylamine	10	20	ug/L	W
1319-77-3MP	m,p-Cresol	.9326	10	ug/L	W
124-18-5	n-Decane	10	10	ug/L	W
105-59-9	n-Methyldiethanolamine		50	ug/L	W
59-89-2	n-Nitroso morpholine	2.04	10	ug/L	W
924-16-3	n-Nitrosodi-n-butylamine	1.52	10	ug/L	W
621-64-7	n-Nitrosodi-n-propylamine	.2455	10	ug/L	W
55-18-5	n-Nitrosodiethylamine	1.69	10	ug/L	W
62-75-9	n-Nitrosodimethylamine	1.1342	10	ug/L	W
86-30-6	n-Nitrosodiphenylamine	.27	10	ug/L	W
10595-95-6	n-Nitrosomethylethylamine	1.38	10	ug/L	W
100-75-4	n-Nitrosopiperidine	1.45	20	ug/L	W
930-55-2	n-Nitrosopyrrolidine	10	20	ug/L	W
593-45-3	n-Octadecane	10	10	ug/L	W
95-53-4	o and/or p - Toluidine	2.45	20	ug/L	W
95-48-7	o-Cresol	.2402	10	ug/L	W
90-43-7	o-Phenylphenol	.758	10	ug/L	W
60-11-7	p-(Dimethylamino)azobenzene	1.7	20	ug/L	W
106-51-4	p-Benzoquinone		20	ug/L	W



# Detection Limits

## Gulf Coast Analytical Laboratories

Queue: HG

Method: SW-846 7470A

Analyte	Name	MDL	PQL	Units	Matrix
7439-97-6	Mercury	.00005	.0002	mg/L	W

# Detection Limits

## Gulf Coast Analytical Laboratories

Queue: HG

Method: SW-846 7471A

Analyte	Name	MDL	PQL	Units	Matrix
7439-97-6	Mercury	.002	.01	mg/kg	S

**Appendix D**  
**Flute™ Liner Description**

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 ©2002 FLUTE, Ltd. Co.

**FLUTE™**  
 Flexible Liner Underground Technologies, Ltd. Co.

A medley of innovative designs

THE COMPANY

APPLICATIONS

METHODS

SYSTEMS

PROCEDURES

AUXILIARY  
EQUIPMENT

COMPARISONS

PRICES

REFERENCES

EXPERIENCE

PUBLICATIONS

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## SYSTEMS

### NAPL FLUTE™

The NAPL FLUTE system addresses the problem of locating layers, filled fractures or globules of pure product trapped in the formation. The approach is to emplace in a punched or drilled hole, a fabric that reacts with the NAPL to produce a very obvious stain on the fabric where it contacts the pure product. The fabric (also called a cover when emplaced on a liner) is recovered by inverting the liner from the hole. This peeling process inverts the cover and liner to allow the cover to be removed without touching the hole wall at any other place than the original placement. The emplacements methods range from installation in the interior of a push rod (e.g., a cone penetrometer or Geoprobe) to everting the liner with the outer reactive cover into a core hole. Both techniques allow the cover to be emplaced against the hole wall without contact with any other portion of the hole wall. When the liner and reactive cover are in place, they are as shown in the drawing. The excess head in the liner above the water

table in the formation forces the liner strongly against the cover and against the hole wall. After the cover has reacted with the formation fluids, the tubing is lifted upwards, inverting the bottom end of the liner with the covering. As the tubing is pulled from the hole, the inverting liner follows it to the surface. After the entire liner/cover is peeled from the hole, the liner is pulled off the covering, exposing the inside surface of the cover. The stains on the inside surface are easily read for the location of the NAPL in the hole.

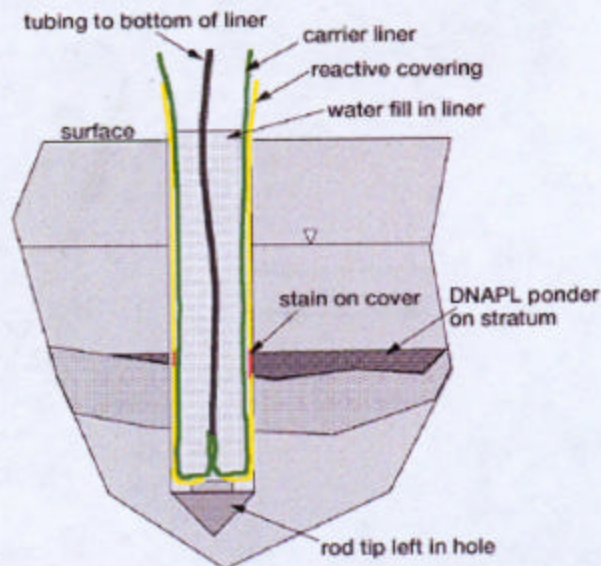
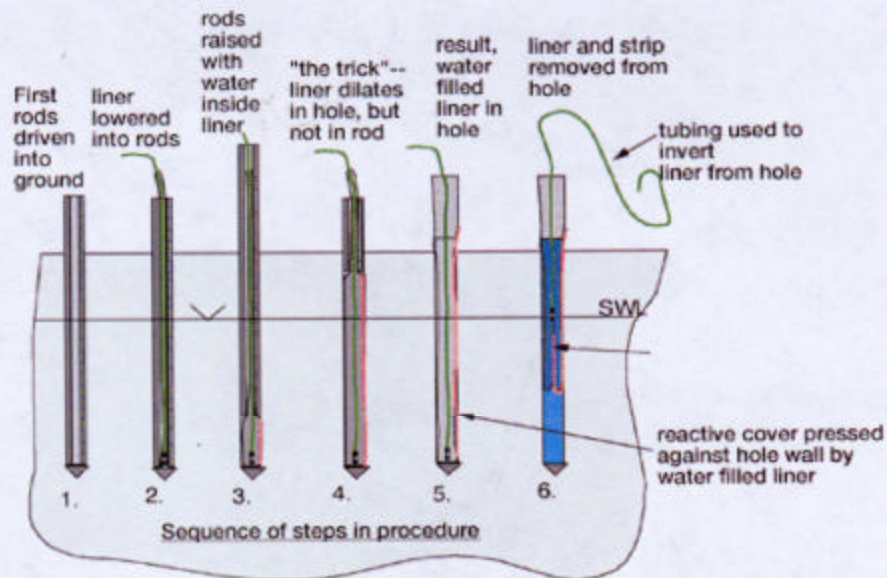


table in the formation forces the liner strongly against the cover and against the hole wall. After the cover has reacted with the formation fluids, the tubing is lifted upwards, inverting the bottom end of the liner with the covering. As the tubing is pulled from the hole, the inverting liner follows it to the surface. After the entire liner/cover is peeled from the hole, the liner is pulled off the covering, exposing the inside surface of the cover. The stains on the inside surface are easily read for the location of the NAPL in the hole.

The NAPL FLUTE installation via the interior of the push rods is shown in the stepwise drawing of the procedure (shown below). The essential feature of the method is that the liner dilates to support the hole wall, but it does not dilate inside of the rod. If it did, the friction is so large as to tear the liner as the rod is withdrawn. As it works, the liner expands against the hole wall as the rod exposes the wall. In that way, the reactive cover is pressed against any NAPL in the pore space or fractures of the formation.



This technique was first used at Cape Canaveral to locate a thick layer of TCE in the coastal sediments. Since then, it has been used in many states to test for the presence of free product in the formation. Earlier versions of the reactive cover used Sudan IV. Sudan IV has been replaced with a nontoxic dye. See [NAPL FLUTE users](#) for other installation experience.

The patented method for emplacing such a large assembly of covering, liner and tube in the interior of the rod and removing it without damage is unique to this system. The reactive cover is covered by another patent pending. Research is in progress for perfection of other reactive coverings to detect other kinds of compounds in the subsurface. Contact us at [info@flut.com](mailto:info@flut.com) for the most up to date procedure for this installation.

The installation into cored holes uses the technique for the everting liner installation very similar to that described in [Vadose FLUTE system](#) or [Water FLUTE system](#). In the unsaturated zone, the liner and covering are everted into the open hole from an air pressure canister. For installations into water filled holes, the liner is everted into the hole using the "JUST ADD WATER" technique. The results from a water driven eversion into a 3" core hole are displayed here.



TCE stains from fractures in a 3 in. core hole (note the boot toes for scale)

Contact us at [info@flut.com](mailto:info@flut.com) for additional information.

## **Appendix E**

# **ADEM Groundwater Sampling Procedures**

dressed with a stainless steel shovel, spatula knife, or spoon to remove the surface layer of soil that was smeared across the trench wall as the bucket passed. Samples from the bucket should be collected from within the large chunks that have not come into contact with the bucket surface.

- (c) Specialized Direct Push Technology includes Geoprobe<sup>®</sup> and Cone Penetrometer Rigs (or their equivalents). The technology allows the sampler to obtain soil samples from the desired depths without producing drill cutting and other Investigation-Derived Waste (IDW), and to collect in situ geophysical measurements of the subsurface material. Direct push technologies are most applicable in unconsolidated sediments typically to depths less than 100 feet and have played a major role in the development of expedited site assessments. Direct Push Systems are composed of two different systems, a single-rod system, and a cased system. Soil sampling tools used with the direct push systems include non-sealed soil samplers such as barrel samplers, split-barrel samplers, and thin-wall tube samplers, and sealed soil (piston) samplers.

Presently, direct push technology may be used as a screening tool to establish the boundaries of a groundwater contamination plume, applicable for the collection soil samples, and for establishing subsurface conditions through the various geophysical tools. Permanent monitoring wells installed by conventional drill rigs will be required to verify groundwater quality conditions.

Following the collection of a soil sample, the sample container should immediately be placed in an ice chest and cooled.

### C.3 Groundwater Sampling Methods

Groundwater sampling may be required for a variety of reasons such as examining potable or industrial water supplies, checking for and/or tracking contaminant plume movement in the vicinity of a land disposal or spill site, Resource Conservation Recovery Act (RCRA) compliance monitoring, and/or evaluating a site where historical information is minimal or non-existent but where it is thought that groundwater contamination may have occurred.

Groundwater samples are usually obtained from either temporary or permanently installed groundwater monitoring wells. Groundwater samples may also be obtained from a drilled boring or from a boring produced by the various direct push techniques. All groundwater samples from borings produced by drilling or a direct push technique are appropriate for screening only. A permanently installed groundwater monitoring well in accordance with Appendix B is required to verify all screening data.

- C.3.1 Purging and Purge Adequacy** - Purging is a process of removing stagnant water from a monitoring well immediately prior to sampling. Purging is conducted to ensure that all stagnant water has been removed from the well and that groundwater samples that are representative of actual aquifer conditions will be collected. In order to determine when a well has been adequately purged, field investigators should monitor the pH, specific conductance, temperature, and turbidity of the groundwater removed during purging. In addition, a minimum of 3 to 5 total well volumes should be removed. Prior to purging, the amount of water standing in the water column (water inside the well riser and screen)

should be determined. Initially, the field investigator should determine the diameter of the well. The water level and total well depth should then be measured and recorded. Specific methods to obtain the water level and total well depth are outlined in Section C.3.2 of this Appendix. The volume of water to be purged can then be determined by using several methods. One equation is  $V=0.041d^2h$ , where  $h$  = depth of water in feet,  $d$  = diameter of well in inches, and  $V$  = volume of water in gallons. Alternatively, the volume may be determined using a casing volume per foot factor for the appropriate diameter well. The water level is subtracted from the total depth, providing the length of the water column. This length is multiplied by the factor in the table below that corresponds to the appropriate well diameter, providing the amount of water (gallons) contained in the well. Other appropriate methods include the use of nomographs or other equations or formulas.

Well Casing Diameter vs. Volume (Gals)/Feet of Water	
Casing Size	Gallons/Ft of Water
1	0.041
2	0.165
3	0.367
4	0.653
5	1.02
6	1.469
7	1.999
8	2.611
9	3.305
10	4.08
11	4.934
12	5.875

An adequate purge is achieved when a minimum of 3 to 5 total well volumes of standing water has been removed, and when the pH, specific conductance, and temperature of groundwater have stabilized and the turbidity has either stabilized or is below 10 Nephelometric Turbidity Units (NTUs). Stabilization of the groundwater chemistry parameters occurs when pH measurements remain constant with 0.1 Standard Unit (SU), specific conductance varies no more than 10 percent, and the temperature is constant for at least three consecutive reading. Standard procedure is to collect an initial set of the groundwater chemistry parameters prior to all purging activities, with a set of parameters measured after each well volume has been removed. The conditions of all purging and sampling activities should be noted in the field log and on the Groundwater Sampling Data Form. If a well is pumped or bailed dry, this is considered an adequate purge and the well can be sampled following sufficient recovery (enough volume to allow filling of all sample container). It is not necessary to evaluate the well to dryness three times before it is sampled. The pH, specific conductance, temperature, and turbidity should be measured during collection of the sample from the recovered volume, as the measurements of record for the sampling event. All efforts should be made to avoid purging monitoring wells to dryness. This may be accomplished by slowing the purge rate.

### C.3.2. Water Level and Total Well Depth Measuring Techniques

- (a) Measuring the depth to the free groundwater surface can be accomplished by utilizing one of the following methods: electronic water level indicators, weighted tape, chalked tape, and/or other methods (for closed systems or permanent wells - sliding float method, air line pressure method, and electrical and automatic recording methods. Acoustic water level indicators are also available). The method chosen to measure water levels should be capable of measuring to the nearest 0.1 foot. All water levels should be made to an established reference point on the well casing. The reference point should be tied in with the NGVD (National Geodetic Vertical Datum). All water levels should be documented in the field records and on a Groundwater Sampling Data Form.
- (b) The total well depth measurement techniques, which can be used to determine the total well depth, include the bell sounder, weighted tape, and electronic water level indicators. This is accomplished by lowering the tape or cable until the weighted end is felt resting on the bottom of the well. All total well depth measurements should be made and recorded to the nearest 0.1 foot. All total well depth measurements should be made to an established reference point on the well casing. The reference point should be tied in with the NGVD. All total well depth measurements should be documented in the field records and on a Groundwater Sampling Data Form. All water level and total depth measuring equipment should be decontaminated in accordance with decontamination procedures outlined in Appendix E.

**C.3.3 Purging Techniques** Monitoring well purging is accomplished by using in-place plumbing and dedicated pumps or by using portable pumps/equipment when dedicated systems are not present. The equipment may consist of a variety of pumps, including peristaltic, large and small diameter turbine (electrical submersible), bladder, centrifugal, gear-driven positive displacement, or other appropriate pumps. The use of any of these pumps is usually a function of the depth of the well being sampled and the amount of water that is to be removed during purging. Whenever the head difference between the sampling location and the water level is less than the limit of suction and the volume to be removed is reasonably small, a peristaltic pump should be used for purging. Bailers may also be used for purging in appropriate situations. If a bailer is used it should be a closed-top bailer to attempt to inhibit turbid conditions.

The pump/hose assembly or bailer used in purging should be lowered into the top of the standing water column to pull water from the formation into the screened area of the well and up through the casing so that the entire static volume can be removed. If the pump is placed deep into the water column, the water above the pump may not be removed, and the subsequent samples, particularly if collected with a bailer, may not be representatives of the groundwater. After the pump is removed from the well, all wetted portions of the hose and the pump should be cleaned as outlined in Appendix E. Careful consideration should be given to using pumps to purge wells, which are excessively contaminated with oily compounds, because it may be difficult to adequately decontaminate severely contaminated pumps under field conditions. When wells of this type are encountered, alternative purging methods, such as bailers, should be considered.



(a) Wells Without Plumbing or In-Place Pumps

- i. Purging with Pumps - When peristaltic pumps or centrifugal pumps are used, only the intake line is placed into the water column. The line placed into the water should be either standard-cleaned (See Appendix E) Teflon<sup>®</sup> tubing for peristaltic pumps, or standard-cleaned stainless steel pipe attached to a hose for centrifugal pumps. When submersible pumps (bladder, turbine, displacement, etc.) are used, the pump itself is lowered into the water column. The pump should be cleaned as specified in Appendix E of this document.
- ii. Purging with Bailers - Standard-cleaned closed-top Teflon<sup>®</sup> bailers with Teflon<sup>®</sup> leaders and arid new nylon rope are lowered into top of the water column, allowed to fill, and removed. The water should be contained and managed as investigation-derived waste. It is critical that bailers are slowly and gently immersed into the tip of the water column, particularly during the final stages of purging, to minimize turbidity and disturbance of volatile organic constituents.
- iii. General Low Flow/Low Stress Method Preference - Low flow/low stress purging is a procedure using a device with the lowest pump or water removal rate, and creating the least amount of stress to a well. If a bailer and a peristaltic pump both work in a given situation, the pump should be selected because it will greatly minimize turbidity, providing a higher quality sample. If a Fultz<sup>®</sup> pump or a Grundfos Redi-Flow<sup>®</sup> (or their equivalents) could both be used, the Redi-Flow (or its equivalent) may be given preference because the speed can be controlled to provide a lower pump rate, thereby minimizing turbidity.
- iv. Low flow/low volume purging techniques/procedures are procedure(s) used to minimize purged water volumes. Flow rates do not exceed the recharge rate of the aquifer (no decrease in the water level in the monitoring well). The pump intake is placed within the screened interval at the zone of sampling, preferably, the zone with the highest flow rate. The water level is monitored with a water level recorder or similar device while pumping. These techniques are only acceptable under certain hydraulic conditions and are not considered standard procedures. A plan documenting that the required hydraulic conditions do exist at the site under investigation will be required for ADEM review and approval determination.

(b) Wells with In-Place Plumbing

- i. Permanent Monitoring Wells - Permanent monitoring wells generally are sampled only occasionally and require purging as described for wells without in-place pumps (i.e., 3 to 5 well volumes and stable parameters).
- ii. Continuous Running Pumps - If the pump runs more or less continuously, no purge (other than opening a valve and allowing it to flush for a few minutes) is necessary. If a storage tank is present, a spigot, valve or other sampling

point should be located between the pump and the storage tank. Otherwise, locate the valve closest to the tank. Measurements of pH, specific conductance, temperature, and turbidity are recorded at the time of sampling.

- iii. Intermittently Running Pumps - If the pump runs intermittently, it is necessary to determine, if possible, the volume to be purged, including storage/pressure tanks that are located prior to the sampling location. The pump should then be run continuously until the required volume has been purged. If construction characteristics are not known, best judgment should be used in establishing how long to run the pump prior to collecting the sample. Generally, under these conditions, 30 minutes will be adequate. Measurements of pH, specific conductance, temperature and turbidity should be made and recorded at intervals during the purging, and the final measurements made at the time of the sampling.
- (c) Temporary monitoring wells from permanent wells because temporary wells are installed in the groundwater for immediate sample acquisition. Wells of this type may include standard well screen and riser placed in boreholes created by hand augering, power augering, or by drilling. They may also consist of a rigid rod and screen that is pushed, driven, or hammered into place to the desired sampling interval, such as the Direct Push Wellpoint<sup>®</sup>, the Geoprobe<sup>®</sup> and the Hydropunch<sup>®</sup> (or their equivalents). As such, the efforts to remove several volumes of water to replace stagnant water do not necessarily apply in these situations because, generally, stagnant water is non-existent. However, the longer a temporary well is in place and not sampled, the more appropriate it may be to apply, to the extent possible, standard permanent monitoring well purging criteria to it. Temporary wells to be sampled immediately may require purging to mitigate the impacts of the installation activities that have resulted in increased turbidity. Therefore, purging may be conducted to reduce the turbidity and remove the volume of water in the area directly impacted by the installation activities. If the water level is no greater than approximately 25 feet below the pump head elevation, a peristaltic pump may be used to purge temporary monitoring wells and collect low turbidity samples by low-flow purging and sampling techniques. At the onset of purging, the tubing should be slowly lowered to the bottom of the screen and used to remove any formation material which may have entered the well screen. After formation material is removed from the bottom of the well, the tubing is slowly raised through the water column to near the top of the column. If the water level is determined to be stable, the tubing should be secured and maintain this pumping rate until relatively clear, low turbidity water samples can be collected. If the water level is lowered, and the pump is not in a variable speed, continue to lower the tubing as the water level is lowered. If the water level continues to lower, "chase" the water column until the well is evacuated. The recovered water column, after complete evacuation of the well, may be relatively free of turbidity and can be sampled. It may take several episodes of recovery to provide an adequate volume of water for all required samples. If a variable speed peristaltic pump is being used and drawdown is observed on initiation of pumping, reduce the pump speed and attempt to match the drawdown of the well. Sustained pumping at these slow rates should be conducted until relatively clear, low turbidity water samples can be collected. With many of the direct push sampling techniques, no purging is conducted. The

sampling device is simply pushed to the desired depth, opened, and the sample is collected and retrieved.

#### **C.4. Groundwater Sampling**

Groundwater sampling is the process of obtaining, containerizing, and preserving a groundwater sample after the purging process is complete. Submersible, centrifugal and Fultz<sup>®</sup> pumps (or their equivalents) are not appropriate for the collection of groundwater samples from any monitoring wells. The only devices that should be used to collect groundwater samples from monitoring wells are: peristaltic pump/vacuum jug assembly, a stainless steel and Teflon<sup>®</sup> bladder pump, and a closed-top, Teflon<sup>®</sup> bailer (or its equivalent). Industrial or municipal supply wells or private residential wells, where a well may be equipped with a dedicated pump from which a sample would not normally be collected, should be sampled in accordance to this guidance document and USEPA Region 4 Standard Operating Procedures and Quality Assurance Manual (recent edition). Groundwater samples should be collected in the order of the volatilization (highest ability to volatilize to the lowest). Groundwater samples for VOC analysis should be collected initially prior to all other samples. All sampling equipment, including pumps, bailers, water level measurement equipment, etc., which comes into contact with the water in the well must be decontaminated in accordance with the decontamination procedures as described in Appendix E prior to its use in all subsequent monitoring wells. When conducting groundwater sampling, the following evaluations should also be conducted and noted in the field logbook and in a Groundwater Sampling Data Form. First, determine the order in which the wells will be sampled (least contaminated to the most contaminated). Note the construction and condition of the well (pad condition, ponding of water, or vertical openings between the casing and the backfill material). Note any standing water inside the protective casing (if this freezes, may collapse casing). There should be a weep hole at the bottom of the protective casing to prevent standing water. Note if the well is locked and the condition of the lock (broken, rusted, or missing). Note the condition of all well construction materials and any damage that may need to be repaired, or if the well should be abandoned and replaced. Check for dangerous vapors with the proper air monitoring equipment. Finally, note the time of the sampling, the sample station location, the method of sampling, the color of sample, any odors detected, and any sediment observed.

##### **C.4.1 Sampling Techniques**

- (a) **Monitoring Wells with In-Place Plumbing** - Following all purging activities, reduce the flow rate to minimize sample disturbance (particularly if VOCs are the COPCs). If the well is purged to dryness, the pump should be shut off and the well should be allowed to recharge such that the required groundwater samples can be collected. Collect all groundwater samples from dedicated, decontaminated Teflon<sup>®</sup> tubing directly into the appropriate sample containers.
- (b) **Potable Water Supply Wells with In-Place Plumbing** - Purge the system for at least 15 minutes. If the samples must be collected at a point in the water line beyond pressurization or holding tank, a sufficient volume of water should be purged to provide a complete exchange of fresh water into the tank and at the location where the sample is collected. After purging for 15 minutes, measure the turbidity, pH, specific conductivity and temperature of the groundwater. Continue to monitor these parameters until three consistent readings are obtained. Disconnect any hoses,

filters, or aerators attached to the tap before sampling. Reduce the flow rate of the tap or spigot and collect all groundwater samples directly into the appropriate sample containers (see Table 1 of Appendix G). When sampling for bacterial content, the sample container should not be rinsed before use due to possible contamination of the sample container or removal of the thiosulfate dechlorinating agent (if used). When filling the sample container, care should be taken so that splashing drops of water from the ground or sink do not enter into either the bottle or cap. Obtain the name(s) of the resident or water supply owner/operator, the resident's exact mailing address, and the resident's home and work telephone numbers.

(c) Wells Without Pumps

- i. A peristaltic pump/vacuum jug can be used for sample collection because it does not allow the sample to come into contact with the pump tubing. Place a Teflon<sup>®</sup> transfer cap assembly onto the neck of a standard cleaned 4-liter (1-gallon) glass container. Connect Teflon<sup>®</sup> tubing (1/4-inch outside diameter) from the glass container to both the pump and the sample source. The pump creates the vacuum in the container, thereby drawing the sample into the container without it coming into contact with the pump tubing. Samples for VOC analysis should be collected using a bailer or by filling the Teflon<sup>®</sup> tube, by one of two methods, and allowing it to drain into the sample vials. The tubing is momentarily attached to the pump to fill the tube with water. After the water is discharged through the pump head, the tubing is quickly removed from the pump and a gloved thumb placed on the tubing to stop the water from draining out. The tubing is then removed from the well and the water is allowed to drain into the sample vials. The tubing is lowered into the well at the desired depth. A gloved thumb is placed over the end of the tubing to stop the water from draining out. The tubing is then removed from the well and the water is allowed to drain into the sample vials. Under no circumstances should the sample for VOC analysis be collected from the contents of any other previously filled container.
- ii. Bladder Pumps - After purging is completed with the bladder pump, the sample should be collected directly from the pump discharge. If the discharge rate of the pump during the purging is too great, so as to make sample collection difficult, care should be taken to reduce the discharge rate at the onset of actual sample collection. This is necessary to minimize sample disturbance, particularly with respect to samples collected for VOC analysis.
- iii. Bailers - Place new plastic sheeting on the ground around each well to provide a clean working area. Attach nylon rope to the bailer. Lower the bailer slowly and gently into the top of the water column until just filled. Carefully remove the bailer and empty its contents into the appropriate sample containers (see Table 1 of Appendix G).

- (d) Direct-Push Technologies - Groundwater sampling using direct push (DP) technology is generally used during a one-time sampling event, and for screening purposes only. Once the contamination plume is delineated using DP technology,

permanent monitoring wells installed using conventional methods should be used to verify DP screening results. Permanent wells installed utilizing direct push technologies is program dependent and determined site-specifically. A plan should be submitted to the Department and approved prior to any small diameter permanent well installation (see Appendix B-3). DP technology may also be used for determining groundwater gradients early in the site investigation. DP tools used for single-event sampling are divided into two groups – exposed-screen samplers and sealed-screen samplers. Exposed-screen samplers have a short (e.g.: 6 inches to 3 feet) interval of exposed fine mesh screens, narrow slots, or small holes at the terminal end of the tool. There are several varieties of exposed-screen samplers – a well point, drive-point profiler, and an innovative exposed-screen sampler used in conjunction with cone penetrometer testing. The advantage of the exposed screen is that it allows multi-level sampling in a single DP hole without withdrawing the DP rods. The disadvantages of the exposed screen are the following:

- i. Dragging down of NAPLs, contaminated soil, and/or contaminated groundwater in the screen can occur;
- ii. Clogging of the exposed screen (by silts and clays) typically occurs as it passes through sediments;
- iii. Significant purging of sampler and/or the sampling zone because of drag down and clogging concerns are necessary; and,
- iv. The fragility of the sampler because of the perforated open area.

Sealed-screened samplers are groundwater samplers that contain a well screen nested inside a watertight sealed body. The screen is exposed by retracting the probe rods once the desired sampling depth has been reached. The design of sealed-screen samplers is extremely variable. The advantages of sealed-screen samplers are the following:

- i. The well screen is not exposed to soil while the tool is being pushed to the depth, thus, the screen cannot become plugged or damaged;
- ii. The potential for sample cross-contamination is greatly reduced;
- iii. Can collect depth-discrete groundwater samples beneath areas with soil in the vadose zone;
- iv. Screened samplers do not require purging;
- v. Some allow sample collection by bailers, check-valve pumps, peristaltic pumps, and bladder pumps (used with wide diameter cased DP systems only); and,
- vi. Can be used in cased DP systems for the collection of deeper groundwater samples.

The disadvantages of this type of sampler are:

- i. The o-rings must be replaced frequently; and,
- ii. Sealed-screened samplers that collect groundwater in sealed chambers:
  - A. if the storage chamber is above the screen intake, groundwater samples must be collected sufficiently below the water table to create enough hydrostatic pressure to fill the chamber; and,
  - B. only sample chambers located below the screen intake are useful for collecting groundwater or LNAPL samples at or above the water table.

**C.4.2 Sample Preservation** - The minimum amount of preservative needed should be added to the sample immediately (See Table 1 of Appendix G). Care should be taken not to touch the preservative container to the sample bottle. After preserving, the sample pH should be checked by pouring a small volume over a piece of pH paper. Do not put pH-paper or probe into the sample container. Sample preservation should be done ASAP. Laboratories that supply the required sample containers may submit all containers with the required preservative. These sample containers are appropriate; however, the pH of the final sample should be checked with the results recorded in the field logbook and Groundwater Sampling Data Form.

#### **C.4.3 Special Sample Collection Procedures**

- (a) **Trace Organic Compounds and Metals** - All sampling equipment, including pumps, bailers, water level measurement equipment, etc., which comes into contact with the water in the well should be decontaminated in accordance with the decontamination procedures described in Appendix E of this document. Pumps should not be used for sampling unless the interior and exterior portions of the pump and the discharge hoses are thoroughly decontaminated (Appendix E). Blank samples should be collected to determine the adequacy of cleaning prior to collection of any sample using a pump. Filtered groundwater sample results will not be accepted as representative of existing aquifer conditions.
- (b) **Filtering** will only be used for flow system analysis and for the purpose of geochemical speciation modeling.
- (c) **Bacterial Sampling** - Whenever wells (normally potable wells) are sampled for bacteriological parameters, care should be taken to ensure the sterility of all sampling equipment and all other equipment entering the well.

**C.4.4 Specific Sampling Equipment Quality Assurance Techniques** - All equipment used to collect groundwater samples should be cleaned and repaired, if necessary, before being stored at the conclusion of field studies as outlined in Appendix E of this document. Cleaning procedures or repairs utilized in the field should be thoroughly documented in the field records or field logbook.