M67001.AR.006295
MCB CAMP LEJUENE
5090.3a

# FINAL SITE SPECIFIC FIELD SAMPLING AND ANALYSIS PLAN RCRA FACILITY INVESTIGATION SOLID WASTE MANAGEMENT UNIT 475 (SWMU 475) MCB CAMP LEJEUNE NC

3/1/2007

CH2M HILL

FINAL

# Site Specific Field Sampling and Analysis Plan
# RCRA Facility Investigation
# SWMU 475

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina


Prepared for

## Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic Division
Norfolk, Virginia

Contract No.
N62470-02-D-3052
CTO-0134
Navy Clean III

March 2007

Prepared by

CH2MHILL

# FINAL

# Site Specific Field Sampling and Analysis Plan

# RCRA Facility Investigation

# SWMU 475

## Marine Corps Base
## Camp Lejeune, North Carolina

Prepared for

**Department of the Navy**
**Mid-Atlantic Division**
**Naval Facilities Engineering Command**


Under the

**CLEAN III Program**
**Contract N62470-02-D-3052**

**Contract Task Order 134**

**March 2007**

Prepared by


**Raleigh, North Carolina**

# Contents

# List of Figures

# Acronyms and Abbreviations

| | |
|---|---|
| CLEAN | Comprehensive Long-Term Environmental Action Navy |
| CSM | Conceptual Site Model |
| CTO | Contract Task Order |
| DoN | Department of Navy |
| DPT | Direct push Technology |
| DQO | Data Quality Objective |
| EDD | Electronic Data Deliverable |
| EIMS | Environmental Information Management System |
| ERA | Ecological Risk Assessment |
| GPS | Global Positioning System |
| HASP | Health and Safety Plan |
| HHRA | Human Health Risk Assessment |
| MCAS | Marine Corps Air Station |
| MCB | Marine Corps Base |
| MSL | Mean Sea Level |
| NAVFAC | Naval Facilities Engineering Command |
| NCDENR | North Carolina Department of Environment and Natural Resources |
| NEESA | Naval Energy and Environment Support Activity |
| PCB | Polychlorinated Biphenyls |
| PPE | Personal Protective Equipment |
| PRG | Preliminary Remediation Goal |
| QAPP | Quality Assurance Project Plan |
| RAC | Remedial Action Contractor |
| RAGS | Risk Assessment Guidance for Superfund |
| RCRA | Resource Conservation and Recovery Act |
| RFI | RCRA Facility Investigation |
| SI | Site Inspection |
| SLERA | Screening Level Ecological Risk Assessment |
| SOP | Standard Operating Procedures |
| SVOC | Semi-volatile Organic Compound |
| SWMU | Solid Waste Management Unit |
| TOC | Total Organic Carbon |
| TPH | Total Petroleum Hydrocarbons |
| USEPA | United States Environmental Protection Agency |
| VOC | Volatile Organic Compound |

# 1.0 Introduction

This Site-Specific Work Plan presents the strategy and technical approach for a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) 475 – White Street Water Treatment Facility at Marine Corps Base (MCB) Camp Lejeune, North Carolina (the Base). A general location/Index map of the Base showing the location of SWMU 475 is provided as **Figure 1-1**.

This Site-Specific Work Plan was prepared by CH2M HILL under Contract Task Order (CTO) 0134 of the Department of the Navy's (DoN's) Comprehensive Long-Term Environmental Action Navy (CLEAN) Program. CH2M HILL is responsible for implementation of this project. It should be noted that this Site-Specific Work Plan is to be used in conjunction with the Master Project Plans, which include the Master Work Plan, Master Quality Assurance Project Plan (QAPP), and Master Health and Safety Plan (HASP) (CH2M HILL, 2005). The Master Project Plans will be referenced to the greatest extent possible.

# 2.0 Background Information

Background information for the Base, including location, topography, geology, and regulatory history, is presented in the Master Project Plans and is not repeated herein. Site-specific background information for SWMU 475 is presented below.

SWMU 475 has been identified as areas of impacted soils within a site being developed for the expansion of a water treatment plant facility at the MCAS-New River of MCB Camp Lejeune. The facility is located southeast of the intersection of Curtis Road and White Street at the MCAS-New River. **Figure 2-1** shows the general SWMU area.

During recent construction activities at the site, contaminated soils were identified at two general areas. One area of soil contamination was identified during the excavation of a new stormwater retention pond located near the west side of the site and White Street (**Figure 2-1**). The second area of soil contamination was identified during the excavation activities south and east of the new water treatment plant process building. Buried debris, including a metal shelf unit, and stained soils were reported within a subsurface utility excavation trench south of the new process building. In addition, buried perforated metal oil drain pans were reported within an excavation area east of the new process building (**Figure 2-1**). The perforated metal pans were organized end to end and stacked on top of each other in some locations. In total there were eight to ten metal pans removed during the excavation activities. Soil samples were collected from the excavation area by the construction contractor in January and March 2006.

Petroleum based volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) and Total Petroleum Hydrocarbons (TPH) - Oil and Grease were reported in the soil samples collected from the excavations. Some of the impacted material was removed during this excavation effort; however, the construction contractor stated that the extent was not defined vertically in any of the locations. The deepest the construction contractor excavated was 8 feet to 9 feet below ground surface (ft bgs). The approximate horizontal area where contaminated soils were removed during excavation activities is shown on **Figure 2-1**; the extent of contamination beyond these areas is unknown. It is estimated that the horizontal extent of contamination can be approximately defined in the area to the west where a previous soil investigation and removal effort has been conducted for SWMU 299 (**Figure 2-1**).

# 3.0 Preliminary Conceptual Site Model

The preliminary Conceptual Site Model (CSM) is an essential element of a results-based corrective action program. It is an important assessment tool that integrates the information needed to understand how COPCs move through the environment and potentially come in contact with human and ecological receptors. Development of a CSM is an iterative process; the model is refined as new information becomes available. The CSM is an effective tool in identifying additional data needs, and supporting management decisions regarding sampling strategies, project constraints, and regulatory compliance. Key elements of the CSM are grouped into major categories identifying potential sources, extent of contaminant migration, constituent fate and transport, as well as potential exposure pathways and receptors.

## 3.1 Source

The source of contamination at this SWMU is unknown. However, based on the extent of the contaminated and stained soils, the metal perforated pans that were removed, and the results from the construction contractor's analytical samples, it appears that this area may have been used for disposal activities associated with used oil.

## 3.2 Fate and Transport Mechanisms

Fate and transport analysis can improve understanding of the distribution of observed constituents, support risk assessments, and aid in identifying potential remedial alternatives, if necessary. A transport pathway describes the mechanisms whereby SWMU-related constituents, once released, can be transported from a source to an exposure media.

### 3.2.1 Soil

Reported concentrations of petroleum-based VOCs and SVOCs and TPH - Oil and Grease in subsurface soils are caused by downward migration from the source areas. Different contaminants sorb to soil particles as a function of the soil characteristics (for example, organic content and clay percentage), as a function of soil conditions (such as pH and temperature), and as a function of the chemical properties of the contaminant (for example, solubility and partitioning coefficient). The extent of soil impacts both vertically and horizontally, relative to the source is a data need for this RFI. This work plan proposes the collection of soil data to better define the extent of soil impacts, which will also assist in the assessment of fate and transport mechanism likely operating at this SWMU.

### 3.2.2 Groundwater

Groundwater flow and depth information is not available for this SWMU; however this information was collected at nearby SWMU 299 located immediately southeast of SWMU 475. Groundwater in the vicinity of SWMU 299 appears to flow east to northeast (Shaw, 2006). Depth to groundwater below ground surface (bgs) at SWMU 299 ranges from 0.9 to 2.2 feet; however, depth to groundwater at SWMU 475 is expected to be deeper based on observations during recent

excavation at the SWMU associated with the new construction. No previous groundwater investigations have been conducted at SWMU 475; therefore it is uncertain whether contaminants in soil have migrated to groundwater. A determination of whether groundwater has been impacted and if it has been impacted the extent of impact both vertically and horizontally is a data need for this RFI. This work plan proposes the collection of groundwater data to make these determinations.

### 3.2.3 Surface Water/Sediment

A drainage ditch currently runs east to west from one of the areas where contaminated soils were removed discharging into a storm water retention pond constructed in the spring of 2006 (**Figure 2-1**). Overflow from the stormwater retention pond enters a roadside ditch; the roadside ditch runs north to south along White Street. Prior to the creation of the stormwater pond, the drainage ditch ran all the way to the roadside ditch along White Street. No previous surface water or sediment investigations have been conducted within the drainage ditches of SWMU 475 or the roadside ditches of White Street. It is uncertain whether there has been overland runoff from the source areas that has resulted in contamination of the sediments or if the runoff has impacted the new retention pond. Since data from SWMU 299 suggests a shallow groundwater table, groundwater impacts to the retention pond at SWMU 475 may be possible, though indications that flow is in the east and northeast direction may suggest otherwise. A determination of whether overland runoff or groundwater discharge to the drainage system ditches and retention pond has impacted surface water or sediment and the extent of impact is a data need for this RFI. This work plan proposes the collection of surface water and sediment data to make these determinations.

## 3.3 Exposure Pathways and Receptors

An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. An exposure pathway must be complete for exposure to occur. The preliminary exposure pathways identified for this SWMU are described below.

### 3.3.1 Human Health Exposures

Inhalation of VOCs and particulates emitted from soils and VOCs emitted from groundwater could be a complete exposure pathway, during construction, and in the future, particularly in the new water treatment plant facility or if surface paving or soils at the SWMU are disturbed during intrusive activities. In addition, direct contact with contaminants in subsurface soil or groundwater could be a complete exposure pathway for human receptors during construction of the new water treatment plant facility or any future intrusive activities. Direct contact with exposed surface soil could be a current and future exposure pathway for receptors. The most likely human receptors for contact with constituents in soil or groundwater are construction workers or facility workers.

### 3.3.2 Ecological Exposures

The on-site terrestrial habitat that presents a potentially complete exposure pathway is limited to surface soils (i.e., 0 to 6 inches) in the source areas. Lower trophic level receptors (e.g., plants, earthworms and insects) could be directly exposed to constituents that are present in surface soils.

Exposure via the ingestion of contaminated prey (i.e., lower trophic level organisms) by upper trophic level receptors is most likely a complete exposure pathway for herbivorous, insectivorous, omnivorous and carnivorous birds, mammals, and reptiles exposed to bioaccumulative compounds (e.g., some SVOCs). The exposure areas are very small, thus, exposure to most of the wide-ranging mobile receptors such as carnivorous birds and mammals is likely minimal and would not be of concern.

Surface water runoff does pose the potential to transport particulate-bound constituents into drainage areas, including historic runoff into the small wetland within the roadside ditch on the east side of White Street and recent runoff and/or groundwater discharge to the new retention pond. Exposure in the drainage ditches would include direct exposure to lower trophic organisms including plants, benthic invertebrates, juvenile amphibians, and crawfish. Exposure via the ingestion of contaminated prey (i.e., lower trophic level organisms) by upper trophic level receptors is a complete exposure pathway for omnivorous wildlife in these drainage ditches including frogs, toads, snakes, birds (e.g., herons and egrets), and possibly mammals (e.g., raccoons and possums). Exposure pathways in the retention pond would be similar to those in the drainage ditches though direct exposure to fish and juvenile amphibians is the most likely. Ingestion pathways within the retention pond are complete for similar groups of wildlife and a more broad range of birds (e.g., both piscivores and omnivores).

The drainage system discussed above does eventually drain into the New River. The distance to the New River is approximately 1.2 miles. Currently the extent of contamination is unclear; however, it is unlikely that the contamination has reached the New River due to the distance away. The design of this work plan includes the collection of analytical chemistry and physical parameter data from surface water and sediments of this drainage system to help understand the extent of contamination and address this uncertainty.

Exposure to wildlife via dermal and inhalation pathways may be complete for upper trophic level wildlife within all of the exposure areas discussed. There is limited data available to evaluate these pathways quantitatively. Furthermore, although limited data is available, exposure via these pathways is generally thought to be much lower than the pathways discussed above, i.e. direct contact and ingestion. Inhalation of volatile compounds within confined areas such as animal burrows can be an exception; however, no animal burrows were observed onsite. For these reasons, the work plan does not specify collecting data to evaluate these pathways.

# 4.0 Data Quality and Sampling Objectives

The site-specific objectives presented in this section have been developed using the U.S. Environmental Protection Agency (USEPA) seven-step data quality objectives (DQOs) process, as presented in the USEPA Guidance for the Data Quality Objectives Process (USEPA, 2000a) and USEPA Data Quality Objectives Process for Hazardous Waste Site Investigations (USEPA, 2000b).

## 4.1 Data Quality Objectives Process

DQOs are qualitative and quantitative statements, developed using the USEPA DQO process, that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as a basis for establishing the quality and quantity of data needed to support decisions. DQOs define the performance criteria that limit the probabilities of making decision errors by considering the purpose of collecting data, defining the appropriate type of data needed, and specifying tolerable probabilities of making decision errors. The seven-step DQO process is as follows:

- Step 1 – State the Problem
- Step 2 – Identify the Decision
- Step 3 – Identify the Inputs to the Decision
- Step 4 – Define the Boundaries of the Study
- Step 5 – Develop a Decision Rule
- Step 6 – Specify Tolerable Limits on Decision Errors
- Step 7 – Optimize the Design for Obtaining Data

The following sections present the seven-step DQO process developed for the RFI at SWMU 475.

### 4.1.1 Step 1 – State the Problem

The first activity associated with this step is to establish the planning team. The planning team will include the North Carolina Department of Natural Resources (NC DENR), Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division, MCB, Camp Lejeune, and CH2M HILL. These team members are decision-makers for the DQO Process.

The planning team's primary goal is to determine the potential for future corrective action at SWMU 475. Specifically, the objectives of the RFI are as follows:

- Characterize the extent of the contaminated soils via the collection of analytical data.
- Evaluate if contaminates have leached to groundwater via the collection of analytical data. If contaminates have leached to groundwater, characterize the extent of impact.

- Evaluate if contaminates have migrated to surface water or sediments via the collection of analytical data. If contaminates have migrated to surface water or sediments, characterize the extent of impact.
- Review the risk of contaminants associated with the SWMU to human health and ecological environment.
- Provide recommendations for site management.

The final activity associated with this step is to identify available resources, constraints, and deadlines. The project team organization and project schedule are presented in Sections 5.0 and 6.0 of this Site-Specific Work Plan, respectively. The schedule presents the anticipated completion and/or submittal dates for specific tasks or documents.

### 4.1.2 Step 2 – Identify the Decision

The principal study question identified is:

- What is the nature and extent of contamination in the vicinity of SWMU 475?

Before a decision statement can be formulated, a definition of "contaminated" must be clarified. For the RCRA program, soil and groundwater will be considered "contaminated" if concentrations exceed the applicable North Carolina 2L Standards, NC DENR soil to groundwater screening criteria and/or USEPA Region IX Preliminary Remediation Goals (PRGs) and the established background/secondary criteria (for metals only). Surface water and sediment will be considered "contaminated" if concentrations exceed the applicable screening criteria in the *Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management* (NC DENR, 2003).

Considering the principal study question and definition of "contaminated," the decision statement is as follows:

- Define the nature and extent of contamination in the vicinity of the SWMU by determining whether or not the concentration of a given constituent at any given sampling point exceeds the regulatory driven criteria.

### 4.1.3 Step 3 – Identify the Inputs to the Decision

Existing information regarding the nature of contamination in the vicinity of SWMU 475 comes from analytical samples collected by the construction contractor. However, extent of contamination was not determined visually or through analytical sampling during the excavation conducted as part of the new construction in the area of SWMU 475; therefore additional data is required to characterize and define the extent of contamination at the SWMU.

The type of data and sources used to resolve the decision statement include the following:

| Kinds of Information | Sources of Information |
|---|---|
| Nature and extent of contaminated soil | New analytical soil data |
| Determinations of whether groundwater is contaminated; if groundwater is contaminated, define the nature and extent of contamination. | New analytical groundwater data |
| Groundwater flow/hydrogeologic characteristics | New groundwater elevation data |
| Determinations of whether surface water and sediments are contaminated; if they are contaminated, define the nature and extent of contamination. | New analytical surface water and sediment data |

The criterion for determining the presence of contamination will be based on analytical results and applicable regulatory driven criteria as described in Section 4.1.2. Groundwater, soil, surface water, and sediment samples will be analyzed for VOCs, SVOCs, Pesticides/Polychlorinated Biphenyls (PCBs), and total RCRA Metals. In addition, surface water samples will also be analyzed for dissolved metals and hardness and sediments samples will be analyzed for pH, total organic carbon (TOC), and grain size. All samples will be submitted to a fix-based analytical laboratory.

### 4.1.4 Step 4 – Define the Boundaries of the Study

Soil, groundwater, surface water, and sediment samples will be collected at the locations shown in **Figure 4-1** and at monitoring wells that will be installed based on the Direct Push Technology (DPT) sampling. In addition, one additional surface water and sediment sample will be collected from the ditch to the south of Curtis Street and to the east of Bancroft Street; this sample will provide information on constituents associated with urban runoff (i.e., anthropogenic sources). The estimated depth of groundwater sampling is expected to range from 10 to 15 feet bgs.

Temporal changes in the extent of contamination are expected to be limited. Loss of contaminant mass does occur through natural attenuation processes (e.g., dilution, biodegradation, dispersion). As a result, data collection is not time dependent and the decision regarding the nature and extent of contamination will be based on existing conditions at the time of the investigations.

Practical constraints to sample collection are minor to moderate. Weather conditions (such as heavy rain or lightning) can delay the field activities, but is not a serious constraint.

### 4.1.5 Step 5 – Develop a Decision Rule

The decision rule developed for the RFI at SWMU 475 is as follows:

- If a given concentration at a given sampling point exceeds the regulatory driven criteria for that contaminant, then that sampling point will be considered to be within the extent of contamination.

### 4.1.6 Step 6 – Specify Tolerable Limits on Decision Errors

Specification of tolerable limits on the decision errors will not be performed at this time. The sampling scheme is flexible and will include points inside and outside the suspected contaminated area so that the extent of contamination should be sufficiently defined. Specification of tolerable limits on the decision errors may be developed at a later date as determined by the planning team.

### 4.1.7 Step 7 – Optimize the Design for Obtaining Data

There are two fundamental goals for Step 7, and both rely on review of existing data and information:

- To evaluate the decision rule
- To design and optimize the sampling and analysis program

The decision rule developed in Step 5 has been shown to be valid following review of existing data. In this case, a simple statistical hypothesis test, broadly classified as a one-sample test was used. The test involved comparison of individual analytical data to a known value (regulatory driven criteria and established background/secondary criteria).

Existing information/data has been reviewed to evaluate and develop the data collection strategy for the field program. The development of alternate sampling plans is not practical given the nature of the RFI.

# 5.0 RFI Tasks and Responsibilities

## 5.1 Project Management

Project management activities include such items as daily technical support and oversight; budget and schedule review and tracking; preparation and review of invoices; personnel resource planning and allocation; and coordination with NAVFAC Mid-Atlantic, MCB, Camp Lejeune, and subcontractors.

## 5.2 Subcontractor Procurement

This task includes procurement, scheduling and coordination of subcontractors. The primary subcontractors required for the RFI include a utility locator, land surveyor, DPT sampling subcontractor, well driller, a fixed-base analytical laboratory and an independent data validator. Miscellaneous subcontractors may also be procured for various support services.

## 5.3 Field Activities

The field activities for the RFI at SWMU 475 will include the following subtasks:

- Mobilization/Demobilization
- Soil and Groundwater sampling using DPT
- Surface Water and Sediment Sampling
- Monitoring Well Installation and Sampling
- Laboratory Analytical Program
- Quality Assurance/Quality Control (QA/QC)
- Sample Handling
- Investigative Derived Waste (IDW) Management
- Surveying

The following subsections present a discussion of the proposed field activities.

### 5.3.1 Mobilization/Demobilization

Mobilization/demobilization consists of securing equipment and supplies necessary for the field activities and shipping or transporting those items both to and from the field. Travel time to and from the Base, construction of decontamination areas, location of IDW storage areas, field establishment of sampling locations, and subsurface utility clearance are all included under this task. Activity personnel will be consulted during mobilization efforts.

## 5.3.2 DPT Sampling

### Soil Investigation

In order to determine the nature and extent of contaminated soils at SWMU 475, eleven (11) soil borings (SWMU475-IS01 through SWMU475-IS11) will be installed near the areas where contaminated soils have been observed using DPT for lithological characterization and VOC screening. Based upon field observations from the initial eleven borings, additional borings may be completed for lithological characterization and VOC screening. The soil borings will be advanced from the ground surface down to the water table (approximately 10-15 ft bgs), **Figure 4-1**. Soil sampling will be conducted in accordance with Navy CLEAN SOPs, CH2M HILL SOPs, and the Master Project Plans (CH2M HILL, 2005). Surface and subsurface soil samples will be collected from each of the eleven borings and submitted to a fixed-base laboratory for VOC, SVOC, and RCRA Metal analyses with a quick 14-day turnaround time. Additional surface and subsurface soil samples will be collected from borings IS03, IS04, IS06, IS08, and IS09 and submitted for Pesticide/PCB analyses with a quick 14-day turnaround time.

In order to assist in calculating site-specific soil-to-groundwater migration values, four (4) additional soil samples will be collected from borings IS03, IS04, IS06, and IS09 and submitted for TOC analysis.

### Groundwater Investigation

In order to determine if groundwater is contaminated and evaluate the extent of impacted groundwater at SWMU 475, seven (7) groundwater grab samples will be collected from the shallow aquifer (approximately 15-20 ft bgs) using a screen point groundwater sampler during the DPT boring activities, **Figure 4-1**. The groundwater grab samples will be collected in accordance with Navy CLEAN SOPs, CH2M HILL SOPs, and the Master Project Plans (CH2M HILL, 2005). Groundwater samples will be collected from DPT borings IS02, IS03, IS04, IS06, IS07, IS08 and IS11 and submitted to a fixed-based laboratory for VOC and SVOC analysis with a quick 14-day turnaround time.

## 5.3.3 Shelby Tube Sampling for Geotechnical Parameters

Three undisturbed soil samples will be collected using Shelby tubes within the vicinity of SWMU 475 for the determination of grain size and vertical permeability analyses. All three samples will be collected from new monitoring well borings. The three samples will be collected from the depths of 2 ft to 4 ft bgs, 6 ft to 8 ft bgs, and 10 ft to 12 ft bgs. Once collected, the undisturbed Shelby tube samples will be submitted to a fixed-base geotechnical laboratory for analyses.

## 5.3.4 Monitoring Well Installation and Development

Based upon the results of the DPT soil and groundwater sampling, a maximum of six (6) Type II and one (1) Type III permanent monitoring wells will be installed at SWMU 475 during the RFI field activities. Type II monitoring wells will be installed in the shallow aquifer (approximately 15-20 ft bgs) using hollow stem auger (HSA) drilling techniques, while the Type III cased well will be installed in an intermediate aquifer zone (approximately 40 ft bgs) using both HSA and mud rotary drilling techniques. The monitoring wells will be installed in accordance with Navy CLEAN SOPs,

CH2M HILL SOPs, and the Master Project Plans (CH2M HILL, 2005). Standard split-spoon soil samples will be collected from each well boring for lithological descriptions and VOC screening.

In order to limit potential cross-contamination during construction, the Type III intermediate well will be constructed utilizing a permanent casing to isolate the surficial aquifer unit. The boring for the surface casing will be advanced using rotary hollow-stem augers. Once the target depth for the surface casing is reached, a 6-inch diameter Schedule 80 PVC casing will be added in the boring and grouted in place. After the grout has cured for a minimum of 24-hours, the well boring will be advanced through the surface casing down to the intermediate aquifer zone using mud rotary drilling techniques.

Boreholes for shallow monitoring wells will be advanced to anticipated depths of 15 feet to 20 feet bgs, while intermediate monitoring wells will be advanced to anticipated depths of approximately 40 feet bgs. The screened interval of each well will be placed on the basis of the lithology data collected during the borehole installations. In general, layers having assumed higher permeability than adjacent layers will be selected for screening. This is consistent with well installations at other MCB Camp Lejeune Installation Restoration Program (IRP) sites and with the Master Project Plans (CH2M HILL, 2005). Precise well construction depths will be determined in the field following review of the boring logs. Boring logs and well completion diagrams will be provided in the RFI Report.

The monitoring wells will be constructed using 2-inch diameter Schedule 40 polyvinyl chloride (PVC) riser and either 10-feet (shallow wells) or 5-feet (intermediate wells) of ten-slot (0.010-inch) PVC screen. Each monitoring well will be completed at the surface with either an 8-inch diameter steel, manhole type, protective cover with concrete pad or a steel, stick-up protective cover with concrete pad (depending on the location of the well). The drilling and well installation activities will be conducted by a North Carolina licensed well driller under the supervision of a CH2M HILL engineer or hydrogeologist in accordance with the Well Construction Standards provided in the North Carolina Administrative Code (NCAC) 15A Subchapter 2C Section 0100.

Each new monitoring well will be developed within 48 hours after installation depending on scheduled field activities. Wells will be developed in accordance with Navy CLEAN SOPs, CH2M HILL SOPs, and the Master Project Plans (CH2M HILL, 2005). Well development will include surging and over pumping with a submersible pump across the length of the well screen. With respect to the volume of groundwater removed, adequate well development is normally achieved when the column of water in the well is free of visible sediment. With respect to groundwater geochemical parameters, adequate development is achieved when the pH, specific conductance, and temperature of the groundwater have stabilized and the turbidity has either stabilized or is below 10 Nephelometric Turbidity Units (NTUs). Stabilization occurs when pH measurements remain constant within 0.1 standard unit (SU), specific conductance varies no more than 10 percent, and the temperature is constant for three consecutive readings.

### 5.3.5 Monitoring Well Purging and Sampling

All seven (7) new monitoring wells (SWMU475-MW01 through SWMU475-MW07) will be sampled. The wells will be purged and sampled using peristaltic pumps and low-flow purging/sampling methods in accordance with Navy CLEAN SOPs, CH2M HILL SOPs, and the Master Project Plans (CH2M HILL, 2005). New disposable tubing will be used for each monitoring well. Groundwater samples will be submitted to a fixed-based laboratory for VOC, SVOC, Pesticide/PCB, and RCRA

Metal analysis with a standard turnaround time. Specific sampling procedures are presented in the Master Project Plans and summarized below:

- The well cap will be removed and escaping gasses will be measured at the wellhead using a PID. This will determine the need for respiratory protection.
- After proper respiratory protection has been donned, as necessary, the static water level will be measured. The total depth of the monitoring well will not be measured, as not to stir up any sediment. The total well depth will be obtained from Well Construction Records. The water volume in the well will then be calculated.
- The sampling device intake will be slowly lowered until the bottom end is two to three feet below the top of the well screen or the top of the water level, whichever is greater. Next, the water level probe will be placed into the monitoring well just above the water.
- Purging will begin. The pumping rate will be set to create a sustainable flow (approximately 0.3 liters/minute or less) without causing a significant drop in water level in the well. The static water level will be periodically measured throughout purging to verify that a significant drop in water level has not occurred.
- Water Quality Parameters (WQPs), including pH, specific conductance, temperature, oxidation-reduction potential (ORP), turbidity, and dissolved oxygen will be measured frequently.
- Purging will be complete when three successive readings of pH, specific conductance, and temperature have stabilized within 10 percent (0.1 Standard Units for pH), turbidity is less than 10 NTUs, or there is no further discernable upward or downward trend. However, a minimum of one well volume will be removed prior to sampling. If a well is purged dry, the well will be allowed to recharge (preferably to 70 percent of the static water level) prior to sampling.
- Upon WQP stabilization, groundwater samples will be collected and placed into the appropriate sample container(s).

### 5.3.6 Slug Testing

Rising head slug tests will be performed on four of the groundwater monitoring wells. The slug test will consist of submerging a poly bailer or solid cylinder (PVC or stainless-steel) of known volume (slug) in a test well, allowing the static water level time to equilibrate, rapidly removing the slug, and recording the changes in head over time. The test will be allowed to continue until the water level returns to within 10 percent of the original static water level.

Slug test equipment will be used in accordance with Navy CLEAN SOPs, CH2M HILL SOPs, and the Master Project Plans (CH2M HILL, 2005) and will include a data logger and pressure transducer, a nylon rope, and a bailer or solid PVC or stainless-steel slug. Prior to the initial slug test and between each well tested, all downhole equipment will be decontaminated according to the procedures described in this Work Plan.

Slug testing will be completed using the following procedure:

1. Remove the well cap or cover and monitor for volatile organic vapors using the appropriate instrument listed in the Health and Safety Plan.

2. Measure the depth to water in the well and the total well depth using a clean electronic water level indicator. Calculate the groundwater elevation and the height of the water column. If the well screen is not fully submerged in the water column, then the data reduction methods must be modified accordingly. If the pressure transducer and slug cannot be fully submerged in the water column, then the well should be evaluated for slug response. If a non-fully submerged slug will result in adequate drawdown, then the test should be performed. Otherwise, the well should not be used to perform a slug test.
3. Lower the pressure transducer into the well and suspend in the water column in the screened interval.
4. Lower the slug into the well and suspend in the water column above the pressure transducer.

### 5.3.7 Surface Water and Sediment Sampling

In order to determine if surface water or sediment is contaminated and to evaluate the extent of impacted media at SWMU 475, four (4) surface water and four (4) sediment samples will be collected. The sediment samples will be collected from 0 – 6 inches and the surface water samples will be sampled using peristaltic pumps and low-flow purging/sampling methods in accordance with Navy CLEAN SOPs, CH2M HILL SOPs, and the Master Project Plans (CH2M HILL, 2005), **Figure 4-1**[1]. Three of the locations will be used to evaluate the extent of impacts, if any, within the drainage ditch system that flows west and south off of the site, while the fourth location will be sampled to assess urban runoff (i.e., anthropogenic reference). Field parameters including pH, temperature, conductivity, and dissolved oxygen will be measured in the surface water at each location. Surface water samples will be submitted to a fix-based laboratory for VOCs, SVOCs, Pesticides/PCBs, Total RCRA Metals, and Dissolved RCRA Metals analyses with a standard turnaround time. Sediment samples will also be submitted to a fixed-based laboratory and analyzed for VOCs, SVOCs, Pesticides/PCBs, RCRA Metals, pH, grain size, and TOC.

### 5.3.8 Field Quality Assurance/Quality Control

Specific Quality Assurance/Quality Control (QA/QC) requirements are presented in the Master QAPP, which is contained in the Master Project Plans (CH2M HILL, 2005). The Master QAPP describes the different levels of sample analysis and the associated QC procedures required with each. Adherence to established USEPA chain-of-custody (COC) procedures during the collection, transport, and analyses of the samples will be maintained throughout the project. Laboratory analyses of the samples will conform to accepted QA requirements.

The following QA/QC samples will be collected/prepared during the field activities to ensure precision, accuracy, representativeness, completeness, and comparability:

- Equipment rinsate blanks
- Trip blanks
- Field blanks
- Field duplicates

- Matrix Spike/Matrix Spike Duplicates (MS/MSDs)

Equipment rinsate blanks will be collected by running laboratory-supplied de-ionized water over/through the sampling equipment and placing it into the appropriate sample containers for laboratory analyses. Equipment rinsate blanks will be collected from selected disposable sampling equipment (i.e., roll of tubing, stainless steel spoon, etc.); one equipment rinsate blank will be collected each day for reusable sampling equipment. The results will be used to verify that the sampling equipment has not contributed to contamination of the samples.

One field blank will be collected from each source of water used in decontamination. The field blanks will be collected by pouring the water from the original container or spigot directly into the sample bottle set. Field blanks will not be collected in dusty environments. The results will be used to verify that the water used in decontamination has not contributed to contamination of the samples.

Field duplicate samples will consist of one unique sample, split into two aliquots, and analyzed independently. Duplicate soil samples analyzed for parameters other than VOCs will be homogenized and split. Samples for VOC analyses will not be mixed, but select segments of the soil will be collected. Duplicate water samples will be collected simultaneously. The duplicate samples will be analyzed to verify the reproducibility of the laboratory results and degree of variability of reported concentrations. Duplicate samples will be collected at a frequency of 10 percent; the samples will be taken from locations anticipated to be contaminated.

MS/MSD samples will be prepared in the field to address aliquoting reproducibility and to provide information on matrix reproducibility otherwise unobtainable from samples reported below analytically reproducible and statistically valid levels. MS/MSD samples will be prepared at a frequency of 5 percent for each group of samples of a similar matrix; the samples will be taken from locations anticipated to be contaminated.

### 5.3.9 Sample Handling and Analysis

Samples for chemical analyses will be placed into laboratory–prepared sample containers with the appropriate preservatives and stored on ice in a cooler at approximately 4° Celsius (or less) until shipped to the laboratory.

Sample preservation details are presented in the Master Project Plans. The type of container used for each sampling effort, as well as a summary of preservation requirements is described in the Master QAPP.

Proper COC documentation will be maintained for all samples from the time of collection until they are shipped to the analytical laboratory. The COC forms will contain the following information: project number (CTO), sampler names, sample numbers, number of containers, methods of preservation, date and time of sample collection, analysis requested, date and time of transportation to the laboratory, method of transportation, and any other information pertinent to the samples. Specific COC procedures are presented in the Master Project Plans.

[1] One additional surface water and sediment sample will be collected from the drainage swale along the south side of Curtis Street and to the east of Bancroft Street.

Samples will either be hand delivered to the laboratory via courier or shipped via overnight courier.

### 5.3.10 Investigation Derived Waste Management

IDW will be managed in accordance with Section 4.20 of the Master Project Plans. IDW will consist of soil cuttings, health and safety disposables, decontamination fluids, and purged groundwater. Health and safety disposables, such as sampling gloves, will be placed in plastic bags and disposed in an on-site dumpster. Water IDW will be placed in poly-tanks or 55 gallon drums, or, if low volumes are expected, in 5-gallon containers. The drums and poly-tanks will be transported to and staged at a designated 90-day storage pending final disposition.

### 5.3.11 Surveying

All of the DPT borings, monitoring wells, and surface water/sediment sampling locations will be surveyed by a North Carolina licensed surveyor. Horizontal and vertical datum will be collected for each of the locations. The elevation point for the monitoring wells shall be established at the top of the PVC well casing.

## 5.4 Data Management and Validation

It is anticipated that data management activities will consist primarily of entering field and laboratory data onto computerized spreadsheets using database software and tabulating field and analytical results for preparation of the report.

An independent data validator will be subcontracted for data validation. The laboratory analytical results will be evaluated to assess the technical adequacy and usability of the data. The data will be technically reviewed based on specifications set forth in the Naval Energy and Environmental Support Activity (NEESA) and USEPA guidance documents.

## 5.5 Data Evaluation

The laboratory analytical results for soil and groundwater will be compared with the applicable North Carolina 2L Standards, NC DENR soil-to-groundwater screening criteria and/or USEPA Region IX PRGs and the established background/secondary criteria (for metals only). Because the SWMU and its surroundings are not used for military housing, industrial PRGs will be used as comparison criteria. Surface water and sediment will be compared with the applicable screening criteria in the *Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management* (NC DENR, 2003).

## 5.6 Risk Assessment

An ecological risk assessment (ERA) and a Human Health Risk Assessment (HHRA) will be conducted after data evaluation. The HHRA and ERA will identify existing or potential risks that may be posed to human health and/or the environment and will serve to support the evaluation of the threats posed by a site with respect to current and future potential exposure scenarios. Only RFI data that has been validated will be used in the risk assessments.

### 5.6.1 Ecological Risk Assessment

The ERA task includes completing an ecological checklist and a screening-level ERA (SLERA). The checklist and SLERA documentation will be compliant with *Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management* (NC DENR, 2003). The SLERA will be completed and documented through Step 2 of the ERA process. Up to three conference calls with the NCDENR are anticipated to discuss the approach to the SLERA, the results at the conclusion of Step 2, and the initial comments on the SLERA portion of the RFI report. If Step 3a is required, based on the results of Step 2, then it will be conducted in accordance with current EPA guidance.

### 5.6.2 Human Health Risk Assessment

The baseline HHRA will be conducted in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (USEPA, 1990a). The primary guidance document for the HHRAs will be the *Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A) Interim Final* (USEPA, 1989). Additional guidance documents will be consulted, including the following:

- U.S. Environmental Protection Agency (USEPA). *Supplemental Guidance to RAGS: Region 4 Bulletins*, Human Health Risk Assessment Bulletins. EPA Region 4, originally published November 1995, Website version last updated May 2000: http://www.epa.gov/region 4/waste/oftecser/healthbul.htm Office of Technical Services, USEPA Region 4. 2000.
- U.S. Environmental Protection Agency (USEPA). *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments*. Office of Solid Waste and Emergency Response. EPA 540-R-97-033. OSWER 9285.7-01D. December 2001.
- U.S. Environmental Protection Agency (USEPA). *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final*. OSWER 9285.7-02EP. July 2004.

The primary objective of the baseline human health risk assessment is to assess the health risks associated with exposure to SWMU 475 soil and groundwater for human receptors under current and future site conditions. The risk assessment will be comprised of the following components:

- **Identification of Chemicals of Potential Concern**—Identification of the contaminants found onsite and selection of the COPCs. COPCs represent the subset of all chemicals detected at the site that provides the largest contribution to total site risks. COPCs in soil will be identified using USEPA Region 9 PRGs. Groundwater data will be compared to the USEPA Region 9 tap water PRGs.
- **Exposure Assessment**—Identification of the potential pathways of human exposure, and estimation of the magnitude, frequency, and duration of these exposures.
- **Toxicity Assessment**—Assessment of the potential adverse effects of the COPCs and compilation of the toxicity values used for developing numerical risk estimates.

- **Risk Characterization**—Integration of the results of the exposure and toxicity assessments to develop numerical estimates of health risks, and characterization of the potential health risks associated with potential exposure to site-related contamination.
- **Uncertainty Assessment**—Identification and discussion of sources of uncertainty in the risk assessment.

## 5.7 Report Preparation

An RFI Report will be prepared detailing the new sampling results and evaluation of risk associated with the COPCs identified at the site. The report will include, but not be limited to, the following:

- Information to supplement and/or verify the environmental setting of the SWMU including geology and hydrogeology
- A summary of the investigation/sampling activities
- Characterization of the source(s)
- Evaluation of the nature and extent of contamination
- Human health risk assessment
- Ecological risk assessment
- Conclusions and recommendations

A draft RFI report will be submitted to MCB, Camp Lejeune and NC DENR for comments and approval. Response to comments and necessary revisions will be made to the draft report before issuing a final report.

# 6.0 Project Management and Staffing

The proposed management and staffing for the amended RFI at SMWU 475 is shown on **Figure 6-1**. CH2M Hill's primary participants for this project (CTO-0134) are as follows:

- Mr. Matt Louth – Activity Coordinator
- Mr. Dan Tomczak – Project Manager
- Ms. Louise Palmer – Senior Consultant
- Task Managers

Mr. Tomczak and the Task Managers will have the overall responsibility for conducting the field activities and completing the reports associated with this CTO. They will be supported by geologists, engineers, scientists, biologists, and clerical personnel, as needed. The Task Managers will report to Mr. Tomczak and Mr. Louth who will then relay pertinent issues and maintain close contact with NAVFAC Mid-Atlantic and the Base.

# 7.0 Project Schedule

The project schedule is presented in **Figure 7-1**. The schedule presents the anticipated completion and/or submittal dates for specific tasks or documents.

# 8.0 References

CH2M HILL, 2005. *Master Project Plans, Marine Corps Base Camp Lejeune, North Carolina*. 2005

North Carolina Department of Natural Resources (NC DENR), 2003. *Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management*. October 2003.

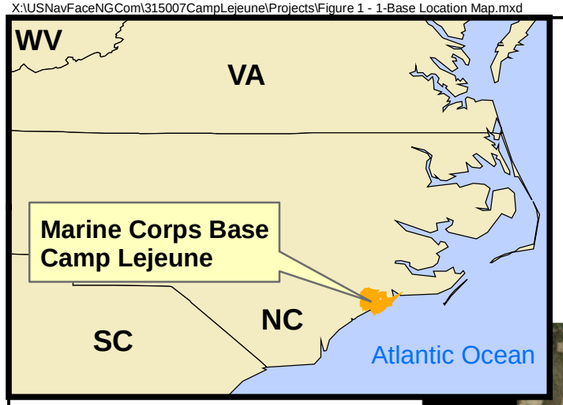
Shaw Environmental, Inc. 2006. *Interim Remedial Measures Implementation Report for Solid Waste Management Units 254, 258, 293, 299, 314, and 303/318 MCB, Camp Lejeune, North Carolina*. March 2006.

United States Environmental Protection Agency. 2000a. *Guidance for Data Quality Objectives Process.* 2000.

United States Environmental Protection Agency. 2000b. *Data Quality Objectives Process for Hazardous Waste Site Investigations.* 2000.

# Figures

X:\USNavFaceNGCom\315007CampLejeune\Projects\Figure 1 - 1-Base Location Map.mxd





**Legend**
Installation Area

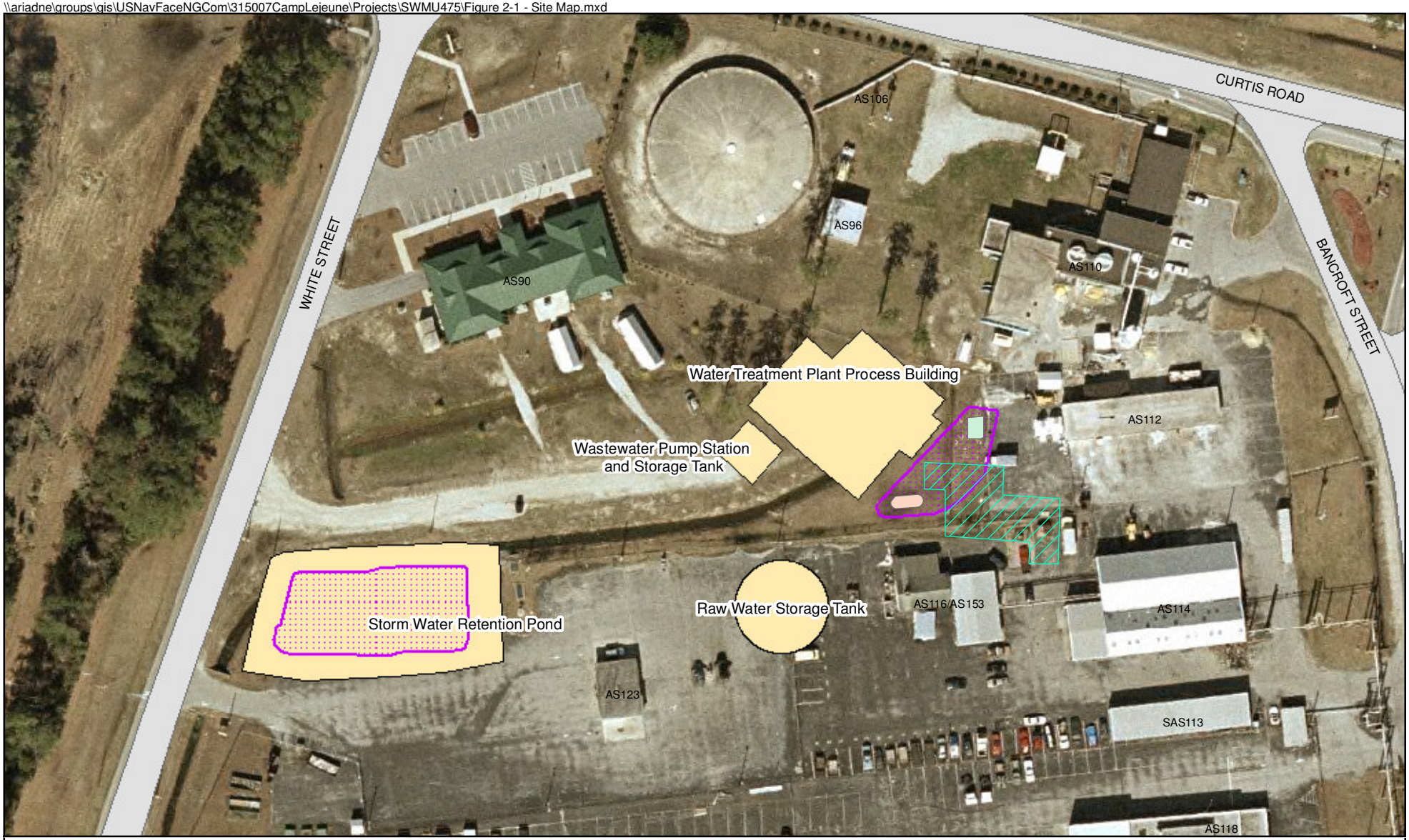
N
W E
S

0 2.5 5
Miles

Figure 1-1
Base Location Map
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

\\ariadne\groups\gis\USNavFaceNGCom\315007CampLejeune\Projects\SWMU475\Figure 2-1 - Site Map.mxd




**Legend**

- New Construction
- Approximate Impacted Soils Removal Areas
- Roads
- SWMU 299 Interim Soil Removal Area
- Oil Drain Pans
- Buried Debris/Metal Shelf

Coordinate System:
NAD 1983 UTM Zone 18N

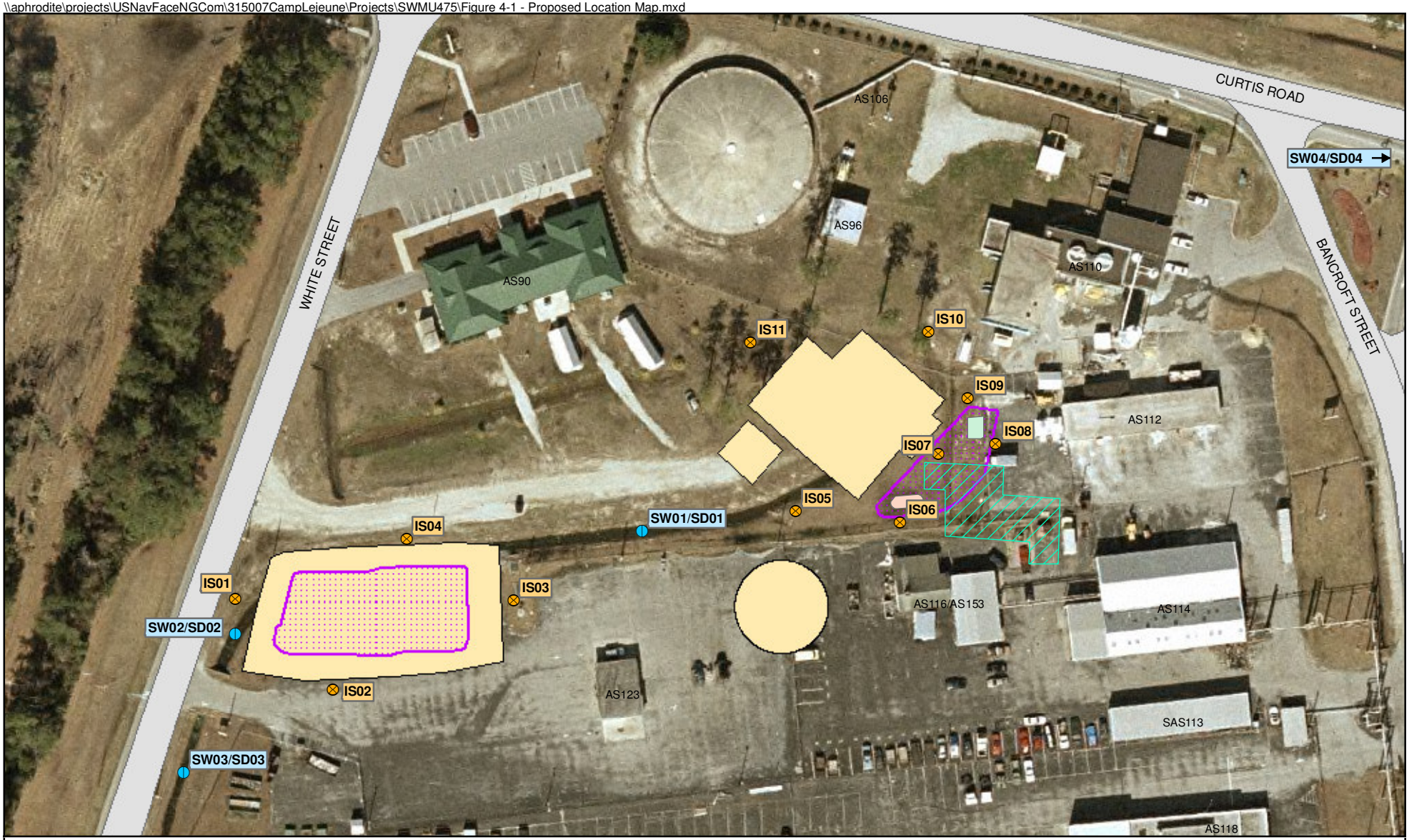
N
W E
S

0 50 100
Feet

Figure 2-1
Site Map
SWMU 475 RFI
MCB Camp Lejeune, North Carolina

CH2MHILL

\\aphrodite\projects\USNavFaceNGCom\315007CampLejeune\Projects\SWMU475\Figure 4-1 - Proposed Location Map.mxd




**Legend**

- New Construction
- Approximate Impacted Soils Removal Areas
- Roads
- SWMU 299 Interim Soil Removal Area
- Oil Drain Pans
- Buried Debris/Metal Shelf
- DPT Location
- Surface Water/Sediment Sample Location

Coordinate System:
NAD 1983 UTM Zone 18N

N
W E
S

0 50 100
Feet

Figure 4-1
Proposed Sample Locations
SWMU 475 RFI
MCB Camp Lejeune, North Carolina

CH2MHILL

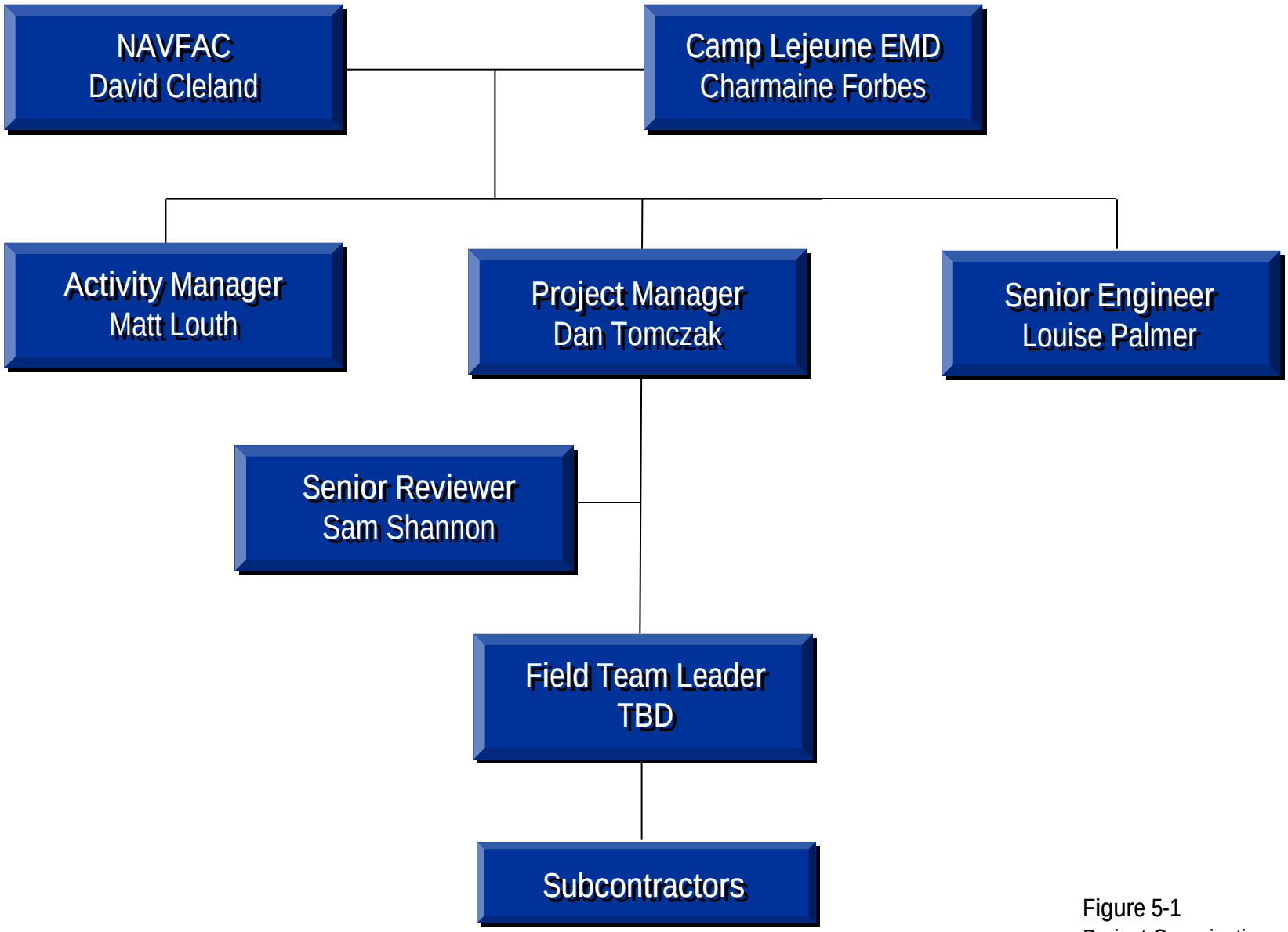



Figure 5-1
Project Organization
SWMU 475 Work Plan
MCB Camp Lejeune

## FIGURE 6-1
## PROPOSED PROJECT SCHEDULE
## SWMU 475 RFI
## MCB CAMP LEJEUNE, NORTH CAROLINA

| TASK NAME | DURATION (days) | Start Date |
|---|---|---|
| Draft RFI Work Plan | 90 | 1 day after contract award |
| Final RFI Work Plan | 60 | 1 day after comments received |
| RFI Field Work | 30 | 1 day after Final Work Plan submittal |
| Laboratory Analysis/Data Validation | 60 | 3 days after start of field work |
| Draft RFI Report | 210 | 1 day after receiving validated data |
| Agency Review | 40 | 1 day after Draft Report submittal |
| Final RFI Report | 30 | 30 days after comments received |

# FINAL

# Site Specific Quality Assurance Project Plan

# RCRA Facility Investigation

# SWMU 475

## Marine Corps Base
## Camp Lejeune, North Carolina

Prepared for

**Department of the Navy**
**Mid-Atlantic Division**
**Naval Facilities Engineering Command**


Under the

**CLEAN III Program**
**Contract N62470-02-D-3052**

**Contract Task Order 134**

**March 2007**

Prepared by


**Raleigh, North Carolina**

# Table of Contents

# Acronyms and Abbreviations

| | |
|---|---|
| AM | Activity Manager |
| COC | Chain of Custody |
| RFI | RCRA Facility Investigation |
| DPT | Direct Push Technology |
| DQO | Data Quality Objective |
| ER | Equipment Rinse blank |
| FB | Field Blank |
| FTL | Field Team Leader |
| MCB | Marine Corps Base |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| PM | Project Manager |
| QA/QC | Quality Assurance/ Quality Control |
| QAPP | Quality Assurance Project Plan |
| RCRA | Resource Conservation and Recovery Act |
| RTL | Review Team Leader |
| SSC | Site Safety Coordinator |
| SWMU | Solid Waste Management Unit |
| TB | Trip Blank |

# 1.0 Introduction

This site-specific *Quality Assurance Project Plan* (QAPP) is meant to serve in conjunction with the Marine Corps Base (MCB) Camp Lejeune Master Project QAPP (CH2M HILL, 2005). The specific information contained in this site-specific QAPP supplements the general information contained in the Master QAPP. This document applies only to the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) 475. The QAPP describes the data quality objectives, specific quality assurance (QA) and quality control (QC) activities, and laboratory activities necessary to achieve the data quality objectives (DQOs) of the project. Subcontractors will be required to review both the Master QAPP and the site-specific QAPP. Subcontractors will be expected to adhere to the procedures specified in these documents. All field activities will be conducted by CH2M HILL or subcontractors under the direct supervision of CH2M HILL.

Sections 1 and 2 of the Site-Specific Work Plan provide a detailed project description and site history for SWMU 475.

# 2.0 Project Organization and Responsibilities

This section identifies key team members for each project; lists the QA/QC responsibilities associated with each position; and describes communication procedures that will be followed throughout the specific project.

## 2.1 Project Team Members

The organizational structure and responsibilities are designed to provide project QA/QC for the field investigation activities at SWMUs 475. Each position is described in the MCB Camp Lejeune Master QAPP. The project team for the RFI investigation is:

| | |
|---|---|
| Project Manager (PM) | Dan Tomczak |
| Activity Manager (AM) | Matt Louth |
| Senior Engineer | Louise Palmer |
| Senior Consultant and Review Team Leader (RTL) | Sam Shannon |
| Lead Data Manager | Ryan Van Oosten |
| Field Team Leader (FTL) & Site Safety Coordinator (SSC) | James Frank |
| Field Engineer | David Seed |
| Health and Safety Manager | Michael Goldman |
| Project Accountant | Katya Maltseva |
| Project Delivery Leader | Bill McElroy |

## 2.2 Subcontractors

Subcontractors will be used for the RFI activities at SWMU 475. The following services will be provided by subcontractors:

- Utility location
- Soil and groundwater sample collection using direct push technology (DPT)
- Installation of monitoring wells
- Surveying
- Fixed base analytical laboratory services
- Data validation services

Procurement of subcontractors will be performed in accordance with the Navy CLEAN Contract Procurement Manual.

## 2.3 Project Communication

Communications among all project personnel will be conducted in accordance with the MCB Camp Lejeune Master QAPP.

# 3.0 Sample Identification and Custody

An electronic sample tracking program will be used to manage the flow of information from the field sampling team to the laboratory and to internal and external data users.

The method of sample identification used depends on the type of sample collected and the sample container.

- The field analysis data are recorded in field logbooks or on data sheets, along with sample identity information, while in the custody of the sampling team.
- Labels for samples sent to a laboratory for analysis will be produced electronically. If they cannot be produced electronically, they must be written in indelible ink. The following information typically is included on the sample label:
  - Site name or identifier
  - Sample identification number
  - Date and time of sample collection
  - Sample matrix or matrix identifier
  - Type of analyses to be conducted

Each analytical sample will be assigned a unique number of the following format:

Site # - Media-Station # -QA/QC – Year/Round or Depth Interval

An explanation of each identifier is provided below:

| Site # | SWMU 475 |
|---|---|
| Media | SS – Surface soil |
| | SB – Subsurface soil |
| | GW – Groundwater |
| | SW – Surface Water |
| | SD - Sediment |
| | WT – Water (rinsate, decontamination fluid, ambient potable water) |
| Station | IS – in situ soil sample collected by DPT |
| QA/QC | FB = Field blank |
| | DUP = Duplicate sample (following sample type/number) |
| | TB = Trip blank |
| | ER = Equipment rinsate |
| Depth | The number will reference the depth interval of the sample. For example, “0-1” = 0 to 1 feet below ground surface (bgs), ”1-2” = 1 to 2 feet bgs, ”2-3” = 2 to 3 feet bgs, etc. |

| Site # | SWMU 475 |
|---|---|
| Round | The two-digit number and letter (A, B, C, D) will indicate the year and quarter, respectively, at which the samples were collected. For example, "06D" is for fourth quarter 2006, "07A" is first quarter 2007, "07B" is second quarter 2007, "07C" is third quarter 2007, etc. |

All matrix spike/matrix spike duplicate (MS/MSD) samples will be entered in the same line on the chain of custody as the field sample. The total number of sample containers submitted will be entered on the chain of custody and "MS/MSD" will be indicated in the comments section.

Using this sample designation format, the sample designation SWMU475-IS01-0-1-07A refers to:

| | |
|---|---|
| SWMU475-IS01-0-1-07A | SWMU 475 |
| SWMU475-IS01-0-1-07A | Soil sample collected from DPT location IS01 |
| SWMU475-IS01-0-1-07A | Collected from the depth of 0 to 1 ft bgs |
| SWMU475-IS01-0-1-07A | Sample collected from the first quarter in 2007 |

The sample designation SWMU475-GW-IS02-10-14-07A refers to:

| | |
|---|---|
| SWMU475-GW-IS02-10-14-07A | SWMU 475 |
| SWMU475-GW-IS02-10-14-07A | Groundwater sample collected |
| SWMU475-GW-IS02-10-14-07A | Sample collected from DPT location IS02 |
| SWMU475-GW-IS02-10-14-07A | Collected from the depth of 10 to 14 ft bgs |
| SWMU475-GW-IS02-10-14-07A | Sample collected from the first quarter in 2007 |

The sample designation SWMU475-GW03-07A refers to:

| | |
|---|---|
| SWMU475-GW03-07B | SWMU 475 |
| SWMU475-GW03-07B | Groundwater sample collected from new monitoring well MW03 |
| SWMU475-GW03-07B | Sample collected from the second quarter in 2007 |

The sample designation SWMU475-SW02-07A refers to:

| | |
|---|---|
| SWMU475-SW02-07B | SWMU 475 |
| SWMU475-SW02-07B | Surface Water sample collected from location SW02 |
| SWMU475-SW02-07B | Sample collected from the second quarter in 2007 |

The sample designation SWMU475-SD02-07A refers to:

| | |
|---|---|
| SWMU475-SD02-07B | SWMU 475 |
| SWMU475-SD02-07B | Sediment sample collected from location SD02 (collocated with SW02) |
| SWMU475-SD02-07B | Sample collected from the second quarter in 2007 |

For QA/QC samples that include TB, ER, and FB, the date of collection is included in the sample designation. For example, the sample designation SWMU475-TB011507 refers to:

| | |
|---|---|
| SWMU475-TB011507 | SWMU 475 |
| SWMU475-TB011507 | Trip blank for the day of January 15, 2007 |

This sample designation format will be followed throughout the RFI for SWMU 475, where applicable. **Table 3-1** and **3-2** list all of the sample designations and QA/QC samples for the soil and groundwater sampling at SWMU 475. Soil and groundwater sampling depths determined in the field are identified by "X-Y". Monitoring well soil borings from which Shelby Tube samples will be collected will be determined in the field and are therefore identified as SB0X, SB0Y, and SB0Z. Required deviations to this format will be documented in the field logbook.

Sample custody and COC records will be maintained in accordance with the MCB Camp Lejeune Master QAPP.

**Table 3-1**
**Soil and Sediment Sample Analysis Summary**
SWMU 475 RFI
CTO-134
MCB Camp Lejeune, North Carolina

| Well/Station ID | Sample ID | Sample Depth (ft bgs) | DPT Soil Sample | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOCs | SVOCs | Pest/PCBs | RCRA Metals | pH | TOC | grain size |
| **DPT Location** | | | | | | | | | |
| SWMU475-IS01 | SWMU475-IS01-SS-0-1-07A | 0 - 1 | 1 | 1 | | 1 | | | |
| | SWMU475-IS01-SB-X-Y-07A | X - Y | 1 | 1 | | 1 | | | |
| SWMU475-IS02 | SWMU475-IS02-SS-0-1-07A | 0 - 1 | 1 | 1 | | 1 | | | |
| | SWMU475-IS02-SB-X-Y-07A | X - Y | 1 | 1 | | 1 | | | |
| SWMU475-IS03 | SWMU475-IS03-SS-0-1-07A | 0 - 1 | 1 | 1 | 1 | 1 | | | |
| | SWMU475-IS03-SB-X-Y-07A | X - Y | 1 | 1 | 1 | 1 | | 1 | |
| SWMU475-IS04 | SWMU475-IS04-SS-0-1-07A | 0 - 1 | 1 | 1 | 1 | 1 | | 1 | |
| | SWMU475-IS04-SB-X-Y-07A | X - Y | 1 | 1 | 1 | 1 | | | |
| SWMU475-IS05 | SWMU475-IS05-SS-0-1-07A | 0 - 1 | 1 | 1 | | 1 | | | |
| | SWMU475-IS05-SB-X-Y-07A | X - Y | 1 | 1 | | 1 | | | |
| SWMU475-IS06 | SWMU475-IS06-SS-0-1-07A | 0 - 1 | 1 | 1 | 1 | 1 | | 1 | |
| | SWMU475-IS06-SB-X-Y-07A | X - Y | 1 | 1 | 1 | 1 | | | |
| SWMU475-IS07 | SWMU475-IS07-SS-0-1-07A | 0 - 1 | 1 | 1 | 1 | 1 | | | |
| | SWMU475-IS07-SB-X-Y-07A | X - Y | 1 | 1 | 1 | 1 | | | |
| SWMU475-IS08 | SWMU475-IS08-SS-0-1-07A | 0 - 1 | 1 | 1 | 1 | 1 | | | |
| | SWMU475-IS08-SB-X-Y-07A | X - Y | 1 | 1 | 1 | 1 | | | |
| SWMU475-IS09 | SWMU475-IS09-SS-0-1-07A | 0 - 1 | 1 | 1 | 1 | 1 | | | |
| | SWMU475-IS09-SB-X-Y-07A | X - Y | 1 | 1 | 1 | 1 | | 1 | |
| SWMU475-IS10 | SWMU475-IS10-SS-0-1-07A | 0 - 1 | 1 | 1 | | 1 | | | |
| | SWMU475-IS10-SB-X-Y-07A | X - Y | 1 | 1 | | 1 | | | |
| SWMU475-IS11 | SWMU475-IS11-SS-0-1-07A | 0 - 1 | 1 | 1 | | 1 | | | |
| | SWMU475-IS11-SB-X-Y-07A | X - Y | 1 | 1 | | 1 | | | |
| Total Soil Samples | | | 22 | 22 | 12 | 22 | 0 | 4 | 0 |
| Field Duplicate Samples | | | 3 | 3 | 2 | 3 | | | |
| Matrix Spike Samples | | | 2 | 2 | 1 | 2 | | | |
| Matrix Spike Duplicate Samples | | | 2 | 2 | 1 | 2 | | | |
| Field Blanks | | | 3 | 3 | 2 | 3 | | | |
| Equipment Rinse Blanks | | | 3 | 3 | 2 | 3 | | | |
| Trip Blanks | | | | | | | | | |
| | | Total Number of Samples: | 35 | 35 | 20 | 35 | 0 | 4 | 0 |

**Table 3-1 (continued)**
**Soil and Sediment Sample Analysis Summary**
SWMU 475 RFI
CTO-134
MCB Camp Lejeune, North Carolina

| Well/Station ID | Sample ID | Sample Depth (ft bgs) | Sediment Sample | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | VOCs | SVOCs | Pest/PCBs | RCRA Metals | pH | TOC | grain size |
| **Sediment Location** | | | | | | | | | |
| SWMU475-SD01 | SWMU475-SD01-07B | 0 - 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| SWMU475-SD02 | SWMU475-SD02-07B | 0 - 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| SWMU475-SD03 | SWMU475-SD03-07B | 0 - 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| SWMU475-SD04 | SWMU475-SD04-07B | 0 - 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | |
| Total Soil Samples | | | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Field Duplicate Samples | | | 1 | 1 | 1 | 1 | | | |
| Matrix Spike Samples | | | 1 | 1 | 1 | 1 | | | |
| Matrix Spike Duplicate Samples | | | 1 | 1 | 1 | 1 | | | |
| Field Blanks | | | 1 | 1 | 1 | 1 | | | |
| Equipment Rinse Blanks | | | 1 | 1 | 1 | 1 | | | |
| Trip Blanks | | | | | | | | | |
| | | Total Number of Samples: | 9 | 9 | 9 | 9 | 4 | 4 | 4 |

| Well/Station ID | Sample ID | Sample Depth (ft bgs) | Shelby Tube Soil Sample | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | grain size | vertical permeability | | | | | |
| **Geotech Parameters** | | | | | | | | | |
| SWMU475-MW0X | SWMU475-SB0X-2-4 | 2 - 4 | 1 | 1 | | | | | |
| SWMU475-MW0Y | SWMU475-SB0Y-6-8 | 6 - 8 | 1 | 1 | | | | | |
| SWMU475-MW0Z | SWMU475-SB0Z-10-12 | 10 - 12 | 1 | 1 | | | | | |
| | | Total Number of Samples: | 3 | 3 | | | | | |

**Table 3-2**
**Groundwater and Surface Water Sample Analysis Summary**
Sampling for RFI for SWMU 475
CTO-134
MCB Camp Lejeune, North Carolina

| Well/Station ID | Sample ID | Sample Depth (ft bgs) | Groundwater and Surface Water | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | VOCs | SVOCs | Pest/PCBs | Total RCRA Metals | Dissolved RCRA Metals | Hardness |
| **DPT Location** | | | | | | | | |
| SWMU475-IS02 | SWMU475-GW-IS02-X-Y-07A | X-Y | 1 | 1 | | | | |
| SWMU475-IS03 | SWMU475-GW-IS03-X-Y-07A | X-Y | 1 | 1 | | | | |
| SWMU475-IS04 | SWMU475-GW-IS04-X-Y-07A | X-Y | 1 | 1 | | | | |
| SWMU475-IS06 | SWMU475-GW-IS06-X-Y-07A | X-Y | 1 | 1 | | | | |
| SWMU475-IS07 | SWMU475-GW-IS07-X-Y-07A | X-Y | 1 | 1 | | | | |
| SWMU475-IS08 | SWMU475-GW-IS08-X-Y-07A | X-Y | 1 | 1 | | | | |
| | | | | | | | | |
| **New Monitoring Well** | | | | | | | | |
| SWMU475-MW01 | SWMU475-GW01-07B | X-Y | 1 | 1 | 1 | 1 | | |
| SWMU475-MW02 | SWMU475-GW02-07B | X-Y | 1 | 1 | 1 | 1 | | |
| SWMU475-MW03 | SWMU475-GW03-07B | X-Y | 1 | 1 | 1 | 1 | | |
| SWMU475-MW04 | SWMU475-GW04-07B | X-Y | 1 | 1 | 1 | 1 | | |
| SWMU475-MW05 | SWMU475-GW05-07B | X-Y | 1 | 1 | 1 | 1 | | |
| SWMU475-MW06 | SWMU475-GW06-07B | X-Y | 1 | 1 | 1 | 1 | | |
| SWMU475-MW07 | SWMU475-GW07-07B | X-Y | 1 | 1 | 1 | 1 | | |
| | | | | | | | | |
| **Surface Water Location** | | | | | | | | |
| SWMU475-SW01 | SWMU475-SW01-07B | | 1 | 1 | 1 | 1 | 1 | 1 |
| SWMU475-SW02 | SWMU475-SW02-07B | | 1 | 1 | 1 | 1 | 1 | 1 |
| SWMU475-SW03 | SWMU475-SW03-07B | | 1 | 1 | 1 | 1 | 1 | 1 |
| SWMU475-SW04 | SWMU475-SW04-07B | | 1 | 1 | 1 | 1 | 1 | 1 |
| Total Soil Samples | | | 17 | 17 | 11 | 11 | 4 | 4 |
| Field Duplicate Samples | | | 2 | 2 | 2 | 2 | 1 | 1 |
| Matrix Spike Samples | | | 1 | 1 | 1 | 1 | 1 | 1 |
| Matrix Spike Duplicate Samples | | | 1 | 1 | 1 | 1 | 1 | 1 |
| Field Blanks | | | 2 | 2 | 2 | 2 | 1 | 1 |
| Equipment Rinse Blanks | | | 2 | 2 | 2 | 2 | 1 | 1 |
| Trip Blanks | | | 4 | | | | | |
| | | Total Number of Samples: | 29 | 25 | 19 | 19 | 9 | 9 |

# FINAL
# Site Specific Health and Safety Plan
# SWMU 475

## Marine Corps Base
## Camp Lejeune, North Carolina

Prepared for

**Department of the Navy**
**Mid-Atlantic Division**
**Naval Facilities Engineering Command**

Under the

**CLEAN III Program**
**Contract N62470-02-D-3052**
**Contract Task Order 134**

**March 2007**

Prepared by

**Raleigh, North Carolina**

# Introduction

The health and safety of site personnel and the public are a primary concern during investigative and remedial activities at potentially hazardous sites. This Site Specific Health and Safety Plan (HASP) template is to be used in the formation of site specific HASP's.

## CH2M HILL SITE SPECIFIC HEALTH AND SAFETY PLAN

(Reference CH2M HILL SOP 19, *Health and Safety Plans*)

This health and safety plan will be kept on the site during field activities and will be reviewed and updated as necessary. The plan adopts, by reference, the standards of practice (SOP) in the CH2M HILL *Corporate Health and Safety Program* as appropriate. The site safety coordinator (SC-HW) is to be familiar with these SOPs and the content of this plan. Site personnel must sign Attachment 1. In addition, this plan adopts procedures in the work plan for the project.

### 1.0 PROJECT INFORMATION AND DESCRIPTION

**CLIENT OR OWNER**: Department of the Navy
Mid-Atlantic Division
Naval Facilities Engineering Command

**PROJECT NO**: 324347

**CH2M HILL PROJECT MANAGER**: Dan Tomczak

**OFFICE**: RDU

**SITE NAME**: Marine Corps Base, Camp Lejeune; SWMU 475

**SITE ADDRESS**: Jacksonville, North Carolina

**DATE HEALTH AND SAFETY PLAN PREPARED**: November 16, 2006

**DATE(S) OF INITIAL VISIT**:

**DATE(S) OF SITE WORK**: February through July 2007

**SITE ACCESS**: good.

**SITE SIZE**: Approximately 2.75 acres

**SITE TOPOGRAPHY**: flat

**SITE DESCRIPTION AND HISTORY**:

SWMU 475 has been identified as areas of impacted soils within a site being developed for an expanded water treatment plant facility at the MCAS-New River of MCB Camp Lejeune. The facility is located southeast of the intersection of Curtis Road and White Street at the MCAS-New River.

During recent construction activities, contaminated soils and buried perforated metal pans, which appeared to be oil drain pans, were identified within excavation areas for a new retention pond and a building structure. The perforated metal pans were found close to Building AS110. They were organized end to end and were stacked on top of each other in some locations; in total there were eight to ten metal pans removed during the excavation activities. Soil samples were collected from the excavation area by the construction contractor in January and March 2006. Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), and Total Petroleum Hydrocarbon (TPH) - Oil and Grease were reported in the samples. No sampling has been conducted by CH2M HILL to date.

### 2.0 PROJECT ORGANIZATION AND TASKS TO BE PERFORMED UNDER THIS PLAN

### 2.1 PROJECT ORGANIZATION

**CLIENT**: Dave Cleland
Department of the Navy
NAVFAC Mid-Atlantic Division

Naval Facilities Engineering Command

**CH2M HILL**: Activity Manager: Matt Louth / VBO
Project Manager: Dan Tomczak / RDU
Health and Safety Manager: Mike Goldman / ATL
Field Team Leader: James Frank / RDU
Field Staff: Erin Must, David Seed (field geologist/engineer)

**CONTRACTORS and SUBCONTRACTORS**: Not Applicable

## 2.2 DESCRIPTION OF TASKS (Reference CH2M HILL SOP HS-19, *Written Plans*)

Refer to site-specific addenda (i.e., work plan, field sampling plan) for detailed task information. A health and safety risk analysis has been performed for each task and is incorporated into this HASP through task-specific hazard controls and requirements for monitoring and protection. Tasks in addition to those listed below and in the Master HASP require an approved amendment before additional work begins.

### 2.2.1 HAZWOPER-REGULATED TASKS

- Subsurface utility locating
- Soil and Groundwater sampling
- Groundwater level measurement
- Geoprobe drilling
- Hollow Stem Auger drilling
- Mud Rotary drilling
- Surface water and sediment sampling

### 2.2.3 Drilling

(Reference CH2M HILL SOP HS-35, *Drilling*)

- Only authorized personnel are permitted to operate drill rigs.
- Stay clear of areas surrounding drill rigs during every startup.
- Stay clear of the rotating augers and other rotating components of drill rigs.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Do not wear loose-fitting clothing or other items such as rings or watches that could get caught in moving parts. Long hair should have it restrained.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.
- Smoking around drilling operations is prohibited.

### 2.2.4 NON-HAZWOPER-REGULATED TASKS

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the HSM is required before these tasks are conducted on regulated hazardous waste sites.**

- None
-

## TABLE 2.3 TASK HAZARD ANALYSIS

Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.

| Potential Hazard (Refer to SOP, or HSP Section) | Engineering Controls, Administrative Controls, and Work Practices | Drilling, Well Installation, soil sampling | Groundwater Monitoring | Surface Water and Sediment Sampling | Surveying |
|---|---|---|---|---|---|
| Flying debris/objects | Wear safety eyewear and hardhat | X | | X | |
| Noise > 85dBA | Wear ear plugs/muffs | X | | | |
| Electrical | Locate underground and overhead utilities prior to task | X | X | X | X |
| Suspended Loads | Wear hardhat, Be aware of location of overhead hazards | X | | | |
| Buried Utilities, drums, tanks | Locate underground utilities prior to task. Stop if object is encountered | X | | | |
| Slip, trip, fall | Be sure of footing, especially in wet or muddy conditions | X | X | X | X |
| Back injury | Be careful when lifting and use proper lifting techniques | X | X | | |
| Visible lightning | Discontinue task if lightening is observed | X | X | | X |
| Drilling | Be careful of equipment and pinch points | X | | | |

### 3.1 HAZARDS POSED BY CHEMICALS BROUGHT ON THE SITE

This section discusses hazards posed by chemicals commonly used during RI/FS and other environmental investigation activities. Additional chemicals may be needed for future tasks.

#### 3.1.1 HAZARD COMMUNICATION

(Reference CH2M HILL SOP HS-05, *Hazard Communication*)

The project manager is to request Material Safety Data Sheets (MSDSs) from the client or from the contractors and the subcontractors for chemicals to which CH2M HILL employees potentially are exposed. The SC-HW is to do the following:

- Give employees' required site-specific HAZCOM training.
- Confirm that the inventory of chemicals brought on the site by subcontractors is available.
- Before or as the chemicals arrive on the site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, if any.

The chemical products listed below will be used on the site. Refer to Master HASP for MSDSs.

| Chemical | Quantity | Location |
|---|---|---|

#### 3.1.2 SHIPPING AND TRANSPORTATION OF CHEMICAL PRODUCTS

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods*)

Nearly all chemicals brought to the site are considered hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive the CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

**TABLE 3.2**
**CONTAMINANTS OF CONCERN**

| Parameter | Max Concentrations (mg/kg) | Exposure Limit | IDLH | Symptoms and Effects of Exposure | PIP (ev) |
|---|---|---|---|---|---|
| 1,2,4-Trimethylbenzene | 103 | 25 ppm | 250 ppm | Irritation eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid) | 8.27 |
| 1,3,5-Trimethylbenzene | 19.4 | 25 ppm | 250 ppm | Irritation eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid) | 8.68 |
| 1-Methylnaphthalene | 2.24 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| 2-Methylnaphthalene | 1.94 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| 4-Isopropyltoluene | 14.3 | | | | |
| Acenaphthene | 0.801 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Acetone | 0.0282 | 2400 ppm | 2500 ppm | Irritation eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis | 9.69 |
| Anthracene | 0.395 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Benzo (a) anthracene | 1.03 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Benzo (a) pyrene | 1.14 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Benzo (b) fluoranthene | 1.72 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Benzo (g,h,i) perylene | 1.7 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Benzo (k) fluoranthene | 0.8 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Benzyl alcohol | 0.258 | 1 | 500 | Eyes, skin, respiratory system, blood, central nervous system, bone marrow | 9.24 |
| Bis (2-ethylhexyl) phthalate | 1.9 | 5 mg/m3 | 5000 mg/m3 | Eyes, respiratory system, central nervous system, liver, reproductive system, gastrointestinal tract | UK |
| Chrysene | 165 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Dibenzo (a,h) anthracene | 0.651 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Ethylbenzene | 0.0704 | 100 ppm | 800 ppm | Irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma | 8.67 |
| Fluoranthene | 1.7 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Fluorene | 1.17 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Indeno (1,2,3-c,d) pyrene | 0.117 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Indeno (1,2,3-cd) pyrene | 1.85 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Isopropylbenzene | 2.48 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| m-,p-Xylene | 0.19 | 100 ppm | 900 ppm | Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis | 8.44 |
| Methylene Chloride | 0.003 | 25 ppm | 2300 ppm | Eyes, skin, cardiovascular system, central nervous system | 11.32 |
| Naphthalene | 10.7 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| n-Butylbenzene | 14.7 | NA | NA | Irritation eyes, skin, nose, throat; dizziness, | UNK |
| n-Propyl benzene | 7.26 | NA | NA | Irritation eyes, skin, nose, throat; dizziness, | UNK |
| o-Xylene | 0.0396 | 100 ppm | 900 ppm | Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis | 8.44 |
| Phenanthrene | 3.25 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| Pyrene | 1.2 | 0.2 mg/$m^3$ | 80 mg/m3 | Respiratory system, skin, bladder, kidneys | < 10.6 |
| sec-Butylbenzene | 9.42 | NA | NA | Irritation eyes, skin, nose, throat; dizziness, | UNK |
| tert-Butylbenzene | 2.48 | NA | NA | Irritation eyes, skin, nose, throat; dizziness, | UNK |
| Toluene | 0.0382 | 200 ppm | 500 ppm | Irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage | 8.82 |
| TPH - DRO | 443 | 1 | 500 | Eyes, skin, respiratory system, blood, central nervous system, bone marrow | 9.24 |
| TPH - GRO | 0.0432 | 1 | 500 | Eyes, skin, respiratory system, blood, central nervous system, bone marrow | 9.24 |

| 3.3 POTENTIAL ROUTES OF EXPOSURE | | |
|---|---|---|
| DERMAL: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 5. | INHALATION: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in sections 5 and 6, respectively. | OTHER: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before eating, drinking, or smoking). |

## 4.0 PERSONNEL

## 4.1 FIELD TEAM CHAIN OF COMMAND AND COMMUNICATION PROCEDURES

### 4.1.1 CLIENT

| Client Contact | Base Contact |
|---|---|
| David Cleland | Charmaine Forbes |
| NAVFAC | Camp Lejeune - EMD |
| Code: OPCEV | Building 12 |
| 6506 Hampton Blvd | Marine Corps Base |
| Norfolk, Virginia 23508-1278 | Camp Lejeune, NC 28542-0004 |
| 757-322-4813 | (910) 451-5836 |
| 757-322-4805 fax | (910) 451-5997 fax |

### 4.1.2 CH2M HILL

| | |
|---|---|
| Activity Manager/Phone: | Matt Louth / VBO (757) 671-8311 ext 417 |
| Project Manager/Phone: | Dan Tomczak / RDU (919) 875-4311 ext 19 |
| Health and Safety Manager (HSM)/Phone: | Mike Goldman (770) 604-9182 ext 396 |
| Field Team Leader/Phone: | James Frank / RDU (919) 875-4311 ext 15 |
| Site Safety Coordinator/Phone: | James Frank / RDU (919) 875-4311 ext 15 |

The SC-HW is responsible for contacting the field team leader and the project manager. In general, the project manager either will contact or will identify the client contact. The Health and Safety Manager (HSM) should be contacted as appropriate. The SC-HW or the project manager must notify the client and the HSM when a serious injury or a death occurs or when health and safety inspections by OSHA or other agencies are conducted. Refer to Master HASP sections 11 and 12 for emergency procedures and phone numbers.

### 4.1.3 SUBCONTRACTORS

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner)*

When specified in the project documents (e.g., contract), this plan may cover CH2M HILL subcontractors. However, this plan does not address hazards associated with tasks and equipment that the subcontractor has expertise in (e.g., operation of drill rig). Specialty subcontractors are responsible for health and safety procedures and plans specific to their work. Specialty subcontractors are to submit plans to CH2M HILL for review and approval before the start of fieldwork. Subcontractors must comply with the established health and safety plan(s). CH2M HILL must monitor and enforce compliance with the established plan(s).

Subcontractor: Utility location, drilling, TBA
Subcontractor Contact:
Telephone:

### 4.1.4 CONTRACTORS

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner*)

This plan does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for directing contractor personnel and is not to assume responsibility through their actions. When the contractor is in control of the site, ask the contractor to conduct a briefing of their health and safety practices and to describe how they apply to CH2M HILL's activities. Request a copy of the contractor's health and safety plan.

Contractor: None covered
Contact Name:
Telephone:

## Table 5
## PPE Specifications [a]

| Task | Level | Required PPE | Head | Respirator [b] |
|---|---|---|---|---|
| General site entry<br>Surveying | D | Work clothes; steel-toe, leather work boots; work glove. | Hardhat [c]<br>Safety glasses<br>Ear protection [d] | None required |
| Drilling Operations | Modified D | Work clothes or cotton coveralls<br>Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers<br>Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves. | Hardhat [c]<br>Safety glasses<br>Ear protection [d] | None required |
| Groundwater sampling<br>Soil boring<br>Investigation-derived waste (drum) sampling and disposal | Modified D | Coveralls: Uncoated Tyvek®<br>Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers<br>Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves. | Hardhat [c]<br>Splash shield [c]<br>Safety glasses<br>Ear protection [d] | None required. |
| Tasks requiring upgrade | C | Coveralls: Polycoated Tyvek®<br>Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers<br>Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves. | Hardhat [c]<br>Splash shield [c]<br>Ear protection [d]<br>Spectacle inserts | APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent[e]. |

## Reasons for Upgrading or Downgrading Level of Protection

| Upgrade[f] | Downgrade |
|---|---|
| • Request from individual performing tasks.<br>• Change in work tasks that will increase contact or potential contact with hazardous materials.<br>• Occurrence or likely occurrence of gas or vapor emission.<br>• Known or suspected presence of dermal hazards.<br>• Instrument action levels (Section 5) exceeded. | • New information indicating that situation is less hazardous than originally thought.<br>• Change in site conditions that decreases the hazard.<br>• Change in work task that will reduce contact with hazard |

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to be determined by the SC.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.
[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)-, then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.
[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements[ have been approved by the HSM, and an SC qualified at that level is present.

## 6.1 Air Monitoring Specifications

(Reference CH2M HILL SOP HS-06, *Air Monitoring*

| Instrument | Tasks | Action Levels[a] | | Frequency [b] | Calibration |
|---|---|---|---|---|---|
| PID: OVM with 10.6eV lamp or equivalent | All intrusive work including excavation. | <1 ppm<br>1 to 10 ppm<br>>10 ppm | Level D<br>Level C<br>Evacuate the work are and contact the HSM | Initially and periodically during task | Daily |
| CGI: MSA model 260 or 261 or equivalent | All intrusive work including excavation. | 0-10% :<br>10-25% LEL:<br><br><br>>25% LEL: | No explosion hazard<br>Potential explosion hazard. Contact HSM in case the work area needs to be reclassified re Dow Hot Work Standard.<br><br>Explosion hazard; evacuate or vent. | Continuous during advancement of boring or trench | Daily |
| $O_2$Meter: MSA model 260 or 261 or equivalent | All intrusive work including excavation. | >25%[c] $O_2$:<br>20.9%[c] $O_2$:<br><19.5%[c] $O_2$: | Explosion hazard; evacuate or vent<br>Normal $O_2$<br>$O_2$ deficient; vent or use SCBA | Continuous during advancement of boring or trench | Daily |

[a] Action levels apply to sustained breathing-zone measurements above background.

[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).

[c] If the measured percent of $O_2$ is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent $O_2$ action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and $O_2$ action levels are required for confined-space entry (refer to Section 2).

[d] Refer to SOP HSE-10 for instructions and documentation on radiation monitoring and screening.

[e] Noise monitoring and audiometric testing also required.

## 6.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

| Instrument | Gas | Span | Reading | Method |
|---|---|---|---|---|
| PID: MiniRAE, 10.6 eV bulb | 100 ppm isobutylene | CF = 100 | 100 ppm | 1.5 lpm reg<br>T-tubing |
| CGI: MSA 260, 261, 360, or 361 | 0.75% pentane | N/A | 50% LEL<br>± 5% LEL | 1.5 lpm reg<br>direct tubing |

## 6.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

**Method Description**

**None Anticipated**

**Personnel and Areas**

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel. Results reported to:

HSM: Michael Goldman/ATL

## 7.0 APPROVAL

This site-specific health and safety plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

## 7.1 ORIGINAL PLAN

**WRITTEN BY:** Paul Weber/David Seed **DATE:** 12/6/2006

**APPROVED BY:** **DATE:**

## 7.2 REVISIONS

**REVISIONS MADE BY:** **DATE:**

**REVISIONS TO PLAN:**

**REVISIONS APPROVED BY:** **DATE:**

## 8.0 ATTACHMENTS

Attachment 1: Employee Signoff

## 12.0 EMERGENCY CONTACTS

If an injury occurs, notify the injured person's personnel office as soon as possible after obtaining medical attention for the injured person. Notification MUST be made within 24 hours of the injury.

# 24-Hour CH2M HILL Emergency Beeper – 1 (888) 444-1226

| | | |
|---|---|---|
| **Medical Emergency – 911 or** | | **CH2M HILL Medical Consultant** |
| | | Dr. Jerry Berke |
| Hospital ER (On-Base)#: | (910) 451-4840 | Health Resources, Woburn, MA |
| | (910) 451-4841 | (888) 631-0129 |
| | (910) 451-4842 | (After hours calls will be returned within 20 minutes) |
| Onslow County ER (Off-Base)#: | (910) 577-2240 | |
| Ambulance (On-Base)#: | (910) 451-3004 | |
| | (910) 451-3005 | |
| Ambulance (Public) #: | (910) 451-9111 | |
| LEPC (Poison Control) #: | (800) 222-1222 | |
| **Fire/Spill Emergency – 911 or** | | **Local Occupational Physician** |
| | | Occupational Medicine Specialists |
| Base Fire Response #: | (910) 451-9111 | 4815 Oleander Dr. |
| | | Wilmington, NC 28403 |
| | | (910) 451-1111 |
| Security & Police – **911 or** | | **Corporate Director Health and Safety** |
| | | Name: Mollie Grinell/DEN |
| Base Security #: | (910) 451-2555 | Phone: (715) 682-9334 |
| | | **24-hour emergency beeper: 888-444-1226** |
| **On-Scene Coordinator** | | **Environmental Management Division (EMD)** |
| Name: Fire Chief | | Name: Bob Lowder |
| Phone: | (910) 451-5815 | Phone: (910) 451-9607 |
| **Utilities Emergency** | | **Health and Safety Manager (EMD)** |
| Water | | Name: Michael Goldman/ATL |
| Gas: Contact Base EMD | | Phone: (770) 604-9182 x396 |
| Electric | | |
| **Designated Safety Coordinator (DSC) see Site-Specific HASP** Name: James Frank | | **Regional Human Resources Department** |
| Phone: 919-414-5960 (cell) 919-875-4311 x 15 | | Name: Mary Jo Jordan/GNV |
| | | Phone: (352) 355-2867 |
| **Project Manager see Site Specific HASP** | | **Corporate Human Resources Department** |
| Name: Dan Tomczak | | Name: John Monark/COR |
| Phone: 919-875-4311 x19 | | Phone: (303) 771-0900 |
| **Federal Express Dangerous Good Shipping** | | **Workers' Compensation and Auto Claims** |
| Phone: (800) 238-5355 | | Sterling Administration Services |
| **CH2M HILL Emergency # for Shipping Dangerous Goods** | | Phone: (800) 420-8926 After hours: (800) 497-4566 |
| Phone: (800) 255-3924 | | Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars |

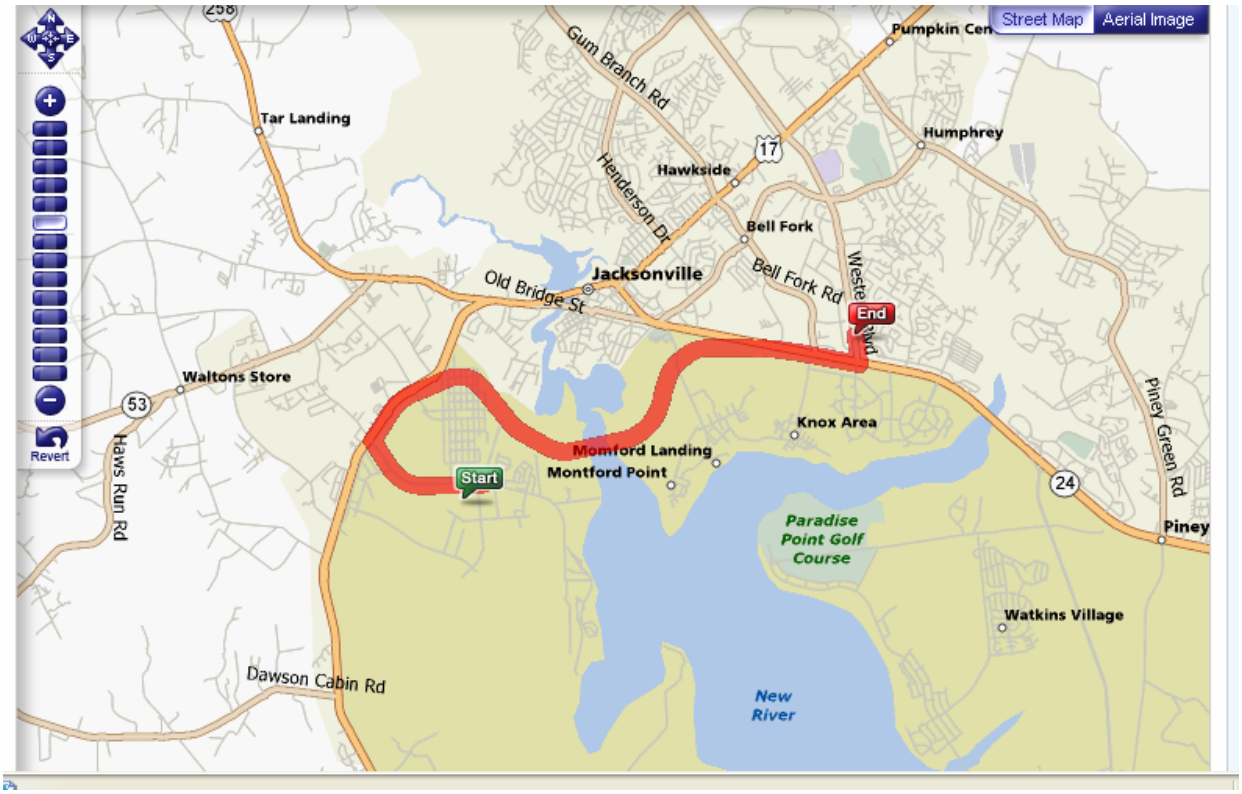
**Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.**

| | |
|---|---|
| **Facility Alarms:** TBD | **Evacuation Assembly Area(s):** TBD by the SC-HW; will probably be the local hotel where the field team is staying |

**Facility/Site Evacuation Route(s):** follow main roads towards access gates and off the Base

**Route to Hospital:**

Directions to **Onslow County Memorial Hospital** from SWMU 475
Start out going WEST on CURTIS RD toward A ST. for approximately 1.4 miles
Turn RIGHT onto WILMINGTON HWY/ US-17 N for approximately 0.8 miles
Merge onto NC-24 toward CAMP LEJEUNE/ MOREHEAD CITY for approximately 5.5 miles
Turn Left onto Western BLVD and end at 317 Western BLVD.




## 12.2 GOVERNMENTAL AGENCIES INVOLVED IN PROJECT

Contact the project manager. Generally, the Project Manager will contact relevant government agencies.

## EMPLOYEE SIGNOFF

The employees listed below have been given a copy of this health and safety plan, have read and understood it, and agree to abide by its provisions.

| EMPLOYEE NAME | EMPLOYEE SIGNATURE AND DATE |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

CH2MHILL

**HS&E Self-Assessment Checklist - DRILLING** 

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's written safety plan.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to drilling hazards, 2) CH2M HILL staff are providing support function related to drilling activities, and/or 3) CH2M HILL oversight of a drilling subcontractor is required.

Safety Coordinator may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed personnel shall be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards (complete Section 1).
☐ Evaluate CH2M HILL support functions related to drilling activities (complete Section 2)
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling safety requirements (complete entire checklist).
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in SOP HSE-35.

**SECTION 1 - SAFE WORK PRACTICES (4.1)**

| | Yes | No | N/A | N/O |
|---|---|---|---|---|
| 1. Personnel cleared during rig startup | ☐ | ☐ | ☐ | ☐ |
| 2. Personnel clear of rotating parts | ☐ | ☐ | ☐ | ☐ |
| 3. Personnel not positioned under hoisted loads | ☐ | ☐ | ☐ | ☐ |
| 4. Loose clothing and jewelry removed | ☐ | ☐ | ☐ | ☐ |
| 5. Smoking is prohibited around drilling operation | ☐ | ☐ | ☐ | ☐ |
| 6. Personnel wearing appropriate personal protective equipment (PPE), per written plan | ☐ | ☐ | ☐ | ☐ |
| 7. Personnel instructed not to approach equipment that has become electrically energized | ☐ | ☐ | ☐ | ☐ |

**SECTION 2 - SUPPORT FUNCTIONS (4.2)**

**FORMS/PERMITS (4.2.1)**

| | | | | |
|---|---|---|---|---|
| 8. Driller license/certification obtained | ☐ | ☐ | ☐ | ☐ |
| 9. Well development/abandonment notifications and logs submitted and in project files | ☐ | ☐ | ☐ | ☐ |
| 10. Water withdrawal permit obtained, where required | ☐ | ☐ | ☐ | ☐ |
| 11. Dig permit obtained, where required | ☐ | ☐ | ☐ | ☐ |

**UTILITY LOCATING (4.2.2)**

| | | | | |
|---|---|---|---|---|
| 12. Location of underground utilities and structures identified | ☐ | ☐ | ☐ | ☐ |

**SECTION 2 (Continued)**

| **WASTE MANAGEMENT (4.2.3)** | **Yes** | **No** | **N/A** | **N/O** |
|---|---|---|---|---|
| 13. Drill cuttings and purge water managed and disposed properly | ☐ | ☐ | ☐ | ☐ |
| **DRILLING AT HAZARDOUS WASTE SITES (4.2.4)** | | | | |
| 14. Waste disposed of according to project's written safety plan | ☐ | ☐ | ☐ | ☐ |
| 15. Appropriate decontamination procedures being followed, per project's written safety plan | ☐ | ☐ | ☐ | ☐ |
| **DRILLING AT ORDNANCE EXPLOSIVES (OE)/UNEXPLODED ORDNANCE (UXO) SITES (4.2.5)** | | | | |
| 16. OE plan prepared and approved | ☐ | ☐ | ☐ | ☐ |
| 17. OE/UXO avoidance provided, routes and boundaries cleared and marked | ☐ | ☐ | ☐ | ☐ |
| 18. Initial pilot hole established by UXO technician with hand auger | ☐ | ☐ | ☐ | ☐ |
| 19. Personnel remain inside cleared areas | ☐ | ☐ | ☐ | ☐ |
| **SECTION 3 - DRILLING SAFETY REQUIREMENTS (4.3)** | | | | |
| **GENERAL (4.3.1)** | | | | |
| 20. Only authorized personnel operating drill rigs | ☐ | ☐ | ☐ | ☐ |
| 21. Daily safety briefing/meeting conducted with crew | ☐ | ☐ | ☐ | ☐ |
| 22. Daily inspection of drill rig and equipment conducted before use | ☐ | ☐ | ☐ | ☐ |
| **DRILL RIG PLACEMENT (4.3.2)** | | | | |
| 23. Location of underground utilities and structures identified | ☐ | ☐ | ☐ | ☐ |
| 24. Safe clearance distance maintained from overhead power lines | ☐ | ☐ | ☐ | ☐ |
| 25. Drilling pad established, when necessary | ☐ | ☐ | ☐ | ☐ |
| 26. Drill rig leveled and stabilized | ☐ | ☐ | ☐ | ☐ |
| 27. Additional precautions taken when drilling in confined areas | ☐ | ☐ | ☐ | ☐ |
| **DRILL RIG TRAVEL (4.3.3)** | | | | |
| 28. Rig shut down and mast lowered and secured prior to rig movement | ☐ | ☐ | ☐ | ☐ |
| 29. Tools and equipment secured prior to rig movement | ☐ | ☐ | ☐ | ☐ |
| 30. Only personnel seated in cab are riding on rig during movement | ☐ | ☐ | ☐ | ☐ |
| 31. Safe clearance distance maintained while traveling under overhead power lines | ☐ | ☐ | ☐ | ☐ |
| 32. Backup alarm or spotter used when backing rig | ☐ | ☐ | ☐ | ☐ |
| **DRILL RIG OPERATION (4.3.4)** | | | | |
| 33. Kill switch clearly identified and operational | ☐ | ☐ | ☐ | ☐ |
| 34. All machine guards are in place | ☐ | ☐ | ☐ | ☐ |
| 35. Rig ropes not wrapped around body parts | ☐ | ☐ | ☐ | ☐ |
| 36. Pressurized lines and hoses secured from whipping hazards | ☐ | ☐ | ☐ | ☐ |
| 37. Drill operation stopped during inclement weather | ☐ | ☐ | ☐ | ☐ |
| 38. Air monitoring conducted per written safety plan for hazardous atmospheres | ☐ | ☐ | ☐ | ☐ |
| 39. Rig placed in neutral when operator not at controls | ☐ | ☐ | ☐ | ☐ |
| **DRILL RIG SITE CLOSURE (4.3.5)** | | | | |
| 40. Ground openings/holes filled or barricaded | ☐ | ☐ | ☐ | ☐ |
| 41. Equipment and tools properly stored | ☐ | ☐ | ☐ | ☐ |
| 42. All vehicles locked and keys removed | ☐ | ☐ | ☐ | ☐ |
| **DRILL RIG MAINTENANCE (4.3.6)** | | | | |
| 28. Defective components repaired immediately | ☐ | ☐ | ☐ | ☐ |
| 29. Lockout/tagout procedures used prior to maintenance | ☐ | ☐ | ☐ | ☐ |
| 30. Cathead in clean, sound condition | ☐ | ☐ | ☐ | ☐ |
| 31. Drill rig ropes in clean, sound condition | ☐ | ☐ | ☐ | ☐ |
| 32. Fall protection used for fall exposures of 6 feet (U.S.) 1.5 meters (Australia) or greater | ☐ | ☐ | ☐ | ☐ |
| 33. Rig in neutral and augers stopped rotating before cleaning | ☐ | ☐ | ☐ | ☐ |
| 34. Good housekeeping maintained on and around rig | ☐ | ☐ | ☐ | ☐ |

**SECTION 4**

Complete this section for all items checked "No" in previous sections. Deficient items must be corrected in a timely manner.

| Item # | Corrective Action Planned/Taken | Date Corrected |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Auditor: _____ Project Manager: _____