DRAFT

Work Plan/Sampling and Analysis Plan

Monitoring Well Installation

RED HILL BULK FUEL STORAGE FACILITY
JOINT BASE PEARL HARBOR-HICKAM, HAWAII

DOH FACILITY ID: 9-102271
DOH RELEASE ID: 990051, 010011, 020028, 140010

11 July 2014

Department of the Navy
Naval Facilities Engineering Command, Hawaii
400 Marshall Road
JBPHH, HI 96860-3139

NAVFAC
Naval Facilities Engineering Command
NAVFAC HAWAII

Contract No. N62583-11-D-0515, Delivery Order No. KB01

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MONITORING WELL INSTALLATON
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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
bgs	below ground surface
BPM	Battelle Project Manager
BTEX	benzene, toluene, ethylbenzene, and xylenes
BWS	Board of Water Supply
°C	degrees Celsius
CFR	Code of Federal Regulations
COC	Chain of Custody
COPCs	Contaminants or Constituents of Potential Concern
DLNR	State of Hawaii Department of Land and Natural Resources
DO	dissolved oxygen
DoD	Department of Defense
HDOH	State of Hawaii Department of Health
DQO	data quality objectives
EAL	Environmental Action Level
EPA	U.S. Environmental Protection Agency
ESI	Environmental Science International
F-76	marine diesel fuel
FISC	Fleet and Industrial Supply Center
FM	Field Task Manager
HAR	Hawaii Administrative Rules
HDOH	State of Hawaii Department of Health
HECo	Hawaiian Electric Company
HPWS	Hawaii rules relating to public water systems
HSA	Hollow-stem auger
ID	Identification
IDW	Investigation-derived waste
JBPHH	Joint Base Pearl Harbor-Hickam
JP-5	Jet Fuel Propellant-5
JP-8	Jet Fuel Propellant-8
LCS	laboratory control samples
LD	laboratory duplicate
L/min	liters per minute
LOQ	limit of quantitation
LTM	long-term groundwater and soil vapor monitoring
MDL	method detection limit
MCL	maximum contaminant level
MS	matrix spike

ACRONYMS AND ABBREVIATIONS (Continued)

MSD	matrix spike duplicate
NAVFAC	Naval Facilities Engineering Command
NAVSUP FLC	Naval Supply Systems Command Fleet Logistics Center
Navy	United States Navy
NPDES	National Pollutant Discharge Elimination System
NPDW	National Primary Drinking Water Act
OSHA	Occupational Safety and Health Administration
OWDF	Oily Waste Disposal Facility
ORP	oxidation-reduction potential
PAHs	polycyclic aromatic hydrocarbons
PAL	Project Action Level
pH	potential of hydrogen (hydrogen activity)
PID	photo-ionization detector
PM	Project Manager
POC	Point of Contact
PPE	personal protective equipment
PPM	Parsons Project Manager
PSHEP	Project Safety, Health, and Environment Plan
PVC	Polyvinyl chloride
QA	Quality Assurance
QA/QC	Quality Assurance/ Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RHMW	Red Hill Monitoring Well
RHSF	Red Hill Bulk Fuel Storage Facility
RI/FS	Remedial Investigation/Feasibility Survey
RPD	relative percent difference
RPM	Remedial Project Manager
SDWA	Safe Drinking Water Act
SSHO	Site Safety and Health Officer
TEC	The Environmental Company, Inc.
TPH	Total petroleum hydrocarbons
TPH-DRO	Total petroleum hydrocarbons-diesel range organics
TPH-GRO	Total petroleum hydrocarbons-gasoline range organics
TPH-RRO	Total petroleum hydrocarbons-residual range organics
US	United States
USACE	United States Army Corp of Engineers

ACRONYMS AND ABBREVIATIONS (Continued)

USCS	Unified Soil Classification System
USFWS	United States Fish and Wildlife Service
UST	Underground storage tank
UTM	Universal Transverse Mercator
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds
WP/SAP	Work Plan/Sampling and Analysis Plan

SECTION 1

INTRODUCTION

This Work/Sampling and Analysis Plan describes the purpose and methodology for installing two groundwater monitoring wells north of the Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam (JBPHH), Hawaii, hereafter referred to as the "Facility". The Facility is part of the JBPHH and is located on the Island of Oahu (Figure 1). The State of Hawaii Department of Health (DOH) Facility I.D. number for the Facility is 9-102271. The HDOH Release I.D. numbers are 990051, 010011, 020028, and 140010. Parsons has prepared this document for Naval Facilities Engineering Command (NAVFAC) Hawaii, under NAVFAC Pacific Prime Contract No. N62583-11-D-0515/DO KB01.

1.1 PROJECT PURPOSE

The purpose of this project is to install groundwater monitoring wells near the north perimeter boundary of the Facility to evaluate potential off-site migration of petroleum-related contamination in groundwater and to provide additional monitoring points to determine the distribution of hydraulic head for input into an existing groundwater model of this area. It is the United States Navy's (Navy) intention to continue compliance with DOH release response requirements for a reported release from Facility Tank 5. These requirements are documented in letters from DOH to the Navy dated 12 February 2014 and 26 February 2014 and are addressed by installing two monitoring wells along the border of the Facility. These locations have been agreed to in subsequent discussions and correspondence with the DOH.

1.2 LOCATION AND SETTING

The Facility is located on the island of Oahu, Hawaii, approximately 2.5 miles northeast of Pearl Harbor (Figure 1). The Facility is located on a low ridge on the western edge of the Koolau Mountain Range that divides Halawa Valley from Moanalua Valley. The Facility is bordered on the north by Halawa Correctional Facility and private businesses, on the west by the U.S. Coast Guard reservation, on the south by residential neighborhoods, and on the east by Moanalua Valley. A quarry is located less than a quarter mile away to the northwest. The

Facility occupies 144 acres and the elevation ranges from approximately 200 to 500 feet above mean sea level (amsl).

The Facility is located above the boundary of the Waimalu and Moanalua Aquifer Systems of the Pearl Harbor and Honolulu Aquifer Sector, respectively. Both aquifers are sources of potable water for several public water supply systems, including the Board of Water Supply (BWS) Halawa Shaft Pump Station (2353-01) approximately 3000 feet northwest from the Facility and the Navy Red Hill Pumping Station (designated 2254-01), located approximately 2,500 feet hydraulically down-gradient from the Facility.

Information obtained from the City and County of Honolulu Department of Planning and Permitting indicates that the Facility is located on federal government land (zoned F1- Military and Federal).

1.3 SITE HISTORY

The Facility was constructed by the U.S. Government in the early 1940s. The Facility contains 18 active and 2 inactive underground storage tanks (USTs) that are operated by Naval Supply Fleet Logistics Center (NAVSUP FLC) Pearl Harbor (formerly Fleet and Industrial Supply Center [FISC]).

The 20 USTs and a series of tunnels were field constructed in-place as a self-contained underground unit deep within a basalt ridge at Red Hill. The USTs were constructed of plate steel encased in 2-4 feet of concrete between the steel plate and surrounding basalt. The USTs are 245 feet long and 100 feet in diameter and are aligned vertically such that the upper domes of the tanks are between 100 feet and 200 feet below ground surface (bgs). The lower dome of each tank rests on an approximate 50-foot wide by 20-foot thick concrete pad that was placed prior to the construction of the tanks. The bottoms of the USTs are located between 80 and 100 above the underlying water table.

The USTs currently contain jet fuel propellant (JP-5 and JP-8) and marine diesel fuel (F-76). Several tanks in the past have stored Navy special fuel oil, Navy distillate, aviation gasoline, and motor gasoline (Environet, 2010).

Various environmental activities have been conducted at the Facility since the late 1990s. Site Investigations (SIs) were conducted in 1996 (Ogden Environmental and Energy Services Co., Inc. [Ogden]), 2002 (AMEC Earth and Environmental, Inc. [AMEC]), and 2007 (TEC, Inc.

[TEC]). A groundwater flow and contaminant transport model was completed as part of the 2007 TEC investigation and updated in 2010 by TEC. A Groundwater Protection Plan (GPP) was developed in 2008 based on results of the SIs, modeling, and Tier 3 Risk Assessment, also conducted by TEC in 2007. The GPP was updated in 2009.

The Navy has been conducting quarterly sampling of existing groundwater monitoring wells located inside and outside of the Red Hill tunnel since 2008. Currently, there are four monitoring wells located in the tunnel, one sample point located at the Red Hill Shaft, and two monitoring wells located outside of the tunnel that are sampled quarterly.

1.4 REGULATORY REQUIREMENTS

Groundwater sampling of the newly installed monitoring wells will be conducted in accordance with established LTM procedures at the Facility and applicable federal regulations that include the Resource Conservation and Recovery Act (RCRA) and Title 29 of the Code of Federal Regulations (CFR) describing Occupational Safety and Health Standards. Based on the history of the Site, the State and Federal regulatory requirements that apply to the Facility include the following:

- Safe Drinking Water Act (SDWA) and National Primary Drinking Water Act (NPDW); the NPDW regulations are located in 40 CFR Part 141 and the regulations implement the provisions of the SDWA. They establish the maximum contaminant levels (MCLs) for various substances in potable water.
- Hawaii Rules Relating to Public Water Systems (HPWS) – The DOH HPWS (Hawaii Administrative Rules (HAR) Title 11, Chapter 20) sets forth the MCLs of certain chemicals in public and private drinking water systems. These MCLs are analogous to those in the NPDW regulations.
- State of Hawaii UST Regulations (HAR, Title 19, Chapter 342L and HAR, Title 11, Chapter 281). Owners and operators of USTs that contain regulated substances such as petroleum are required to take specific actions when investigating releases from their USTs. Regulations and requirements are explained in detail in the Technical Guidance Manual for Underground Storage Tank Closure and Release Response (DOH, 2000).

SECTION 2
PROJECT ORGANIZATION

This section provides a summary of the key project personnel, subcontractors, the project organizational structure, planning, schedule, and project safety.

2.1 ROLE AND RESPONSIBILITIES

A clear understanding of each individual and organization's role and responsibilities will be instrumental in the completion of this project. Key personnel and organizations for this project are included in Table 1 (tables are provided at the end of this work plan).

This organizational structure is designed to ensure that all personnel involved with the project will receive proper instructions and information. Appropriate project safety and quality assurance (QA) procedures will be followed. The roles and responsibilities of key personnel directly involved with work planning, field, data review, and reporting activities are included below.

2.1.1 NAFAC Remedial Project Manager

Mr. Bruce Tsutsui is the NAVFAC Remedial Project Manager (RPM) and oversees the Red Hill Phase 1B Monitoring Well Installation program for NAVFAC and is responsible for providing Navy technical guidance for the project and coordinating access to monitoring well locations.

2.1.2 Battelle Project Manager

Ms Carolyn Scala is the Battelle Project Manager (BPM) and is responsible for the overall management of the project and reports to the NAVFAC RPM. The BPM is responsible for the operations of the overall project and ensuring activities are conducted in accordance with the project scope and within contract terms and conditions. The BPM will provide management and direction to the project personnel assigned to the project including Parsons and other subcontractors. The BPM is responsible for ensuring completion of the work in accordance with applicable codes and standards, including Battelle corporate, Occupational Safety and Health Administration (OSHA), and any client-specific requirements, and ensuring compliance with programs and procedures applicable to the project. The BPM is also responsible for coordination with the NAVFAC RPM.

2.1.3 Parsons Project Manager

Mr. Gene Wright, P.G. is the Parsons Project Manager (PPM) and is responsible for the management of the work planning, field, and reporting activities subcontracted to Parsons and reports to the Battelle Project Manager. The PPM is responsible for the daily operations of Parsons personnel assigned to the project and ensuring daily activities are conducted in accordance with the project scope and within subcontract terms and conditions. The PPM will provide management and direction to the Parsons personnel assigned to the project and subcontractors as directed by Battelle. The PPM is responsible for ensuring completion of the field tasks in accordance with applicable codes and standards, ensuring compliance with environmental, health, and safety requirements, including Parsons corporate, OSHA, and any client-specific requirements, and ensuring compliance with programs and procedures applicable to the project. In addition, the PPM is also responsible for coordination with the NAVFAC RPM within the scope of the subcontract.

2.1.4 Field Task Manager

Mr. Thomas (Mitch) Jensen, P.G., is the Field Task Manager (FM) and reports to the PPM. The FM will be responsible for the management of site activities and personnel. The FM is responsible for the following: supervising site personnel, coordinating with subcontractors and vendors (as approved by Battelle), ensuring completion of the field tasks in accordance with the contract documents, applicable codes and standards, ensuring compliance with environmental, health, and safety requirements, including Parsons corporate, OSHA, and any client-specific requirements, and ensuring compliance with programs and procedures applicable to the project. Mr. William Stohler, P.G., and Mr. John Hall, P.G., P.E., are Alternate FMs and will have the same responsibilities as Mr. Jensen.

2.1.5 Site Safety and Health Officer

Mr. Jensen will also serve as Site Safety and Health Officer (SSHO) and has the responsibility and authority to implement the Project Safety, Health, and Environment Plan (PSHEP) and to verify compliance. Mr. William Stohler, P.G., is the Alternate SSHO and also has responsibility and authority to implement the PSHEP, and to verify compliance. The SSHO or Alternate SSHO has the authority to halt site work if unsafe conditions are detected. The specific responsibilities of the SSHO include managing the safety and health functions on-site; serving as the project's Point of Contact (POC) for safety and health matters; ensuring site monitoring, worker training, and effective selection and use of personal protective equipment (PPE); assessing site conditions for unsafe acts and conditions and providing corrective action; maintaining effective safety and health records as described in the PSHEP; coordinating with the PPM and others as necessary for safety and health efforts. Mr. Stohler may also serve as the Alternate FM.

2.1.6 Chemist

Ms Tammy Chang is the Project Chemist is responsible for reviewing analytical data to ensure that the data meet the data quality objectives for the project. Upon receipt of analytical data from Battelle, Ms. Chang or designated alternate will perform a check to verify that contract deliverables have been met; will perform a review of sample custody, receipt conditions, and holding times; and will perform a review of sample results (including limits of quantitation and results for field duplicates).

The Project Chemist will be responsible for communicating any deviations from the Work Plan to the BPM and PPM. The chemist will work with the BPM and PPM to make any decisions based on laboratory Quality Assurance/Quality Control (QA/QC) issues.

2.1.7 QA Manager

The BPM and PPM will serve as QA Managers and will be responsible for implementing and maintaining the QA program; monitoring QA activities to ensure conformance with authorized policies, procedures, and sound practices; conduct meetings with personnel covering the QA procedures and requirements, as appropriate; identifying and resolving non-conformances in accordance with the requirements of applicable procedures and policies; monitoring corrective action documentation for conditions adverse to quality; tracking and verifying implementation of corrective actions; providing closeout documentation upon completion of corrective action; ensuring that records, logs, permits, regulatory-required documentation, manufacturers' instructions, warrantees, standard procedures, and project plans are maintained and stored in a retrievable manner and that controlled copies of standard procedures and project plans are available to appropriate personnel.

2.1.8 Subcontractors

All subcontractors will report to the BPM and furnish all personnel, equipment, and materials required to complete their tasks. The inspection and approval of all subcontracted work will be the responsibility of Parsons on behalf of Battelle.

2.2 PLANNING

The BPM and PPM are responsible for the project set-up and planning. The planning tasks include the following.

- Obtaining RAPIDGate or temporary security passes for all personnel and vehicles requiring access to the Facility and surrounding properties. All member of the field team will have a valid background check including fingerprinting, as required by NAVFAC Hawaii, prior to commencing any fieldwork.
- Acquiring additional information which includes utility maps, as-built drawings and record drawings, historical data, and any other pertinent information.
- Obtaining all federal, state, and local permits and approvals required to perform the fieldwork.
- Identifying the staging and decontamination area, and material storage.
- Attending site visits and other meetings.
- Preparing and submitting draft and final planning documents prior to initiating fieldwork.

2.3 PERMITTING

All work will be performed in compliance with all applicable federal regulations. In addition, the work will be performed to meet the requirements of state and local laws, rules, and regulations.

2.4 PROJECT SCHEDULE

Fieldwork will be scheduled between Monday and Friday, between the hours of 0700 to 1700 hours. Parsons assumes normal work schedule access within the security fence perimeter of the

Facility and neighboring properties. The project schedule is provided in Appendix A. The task on the schedule specific to this work plan is Task D, Field Work Phase 1B – Monitoring Well Installation. As shown on the schedule, it is anticipated that field work will commence on or before 1 September 2014 and be completed on or about 7 November 2014.

The sequence and estimated duration of the drilling program is anticipated to be as follows:

- Conduct site preparation to include vegetation clearance and installation of a temporary perimeter fence;
- Drill location (1) shown on Figure 2 first and allow three weeks for drilling and well installation and development;
- Drill location (2) shown on Figure 2 and allow three weeks for drilling and well installation and development;
- Sample wells, and;
- Survey well locations; and
- Restore site to include permanent perimeter fence.

Additional drilling and fencing details are provided in Section 3.

2.5 HEALTH AND SAFETY REQUIREMENTS

All members of the field team are required to read, and sign the PSHEP as verification that they understand the plan. Parsons will take all necessary measures to provide a safe work environment during field activities. The PSHEP includes appropriate Activity Hazard Analyses, and outlines personnel risk minimization through compliance with OSHA and the U.S. Army Corp of Engineers (USACE) safety regulations. The PSHEP is provided as Appendix B.

SECTION 3

FIELD ACTIVITIES AND METHODOLOGY

This section comprises the Facility sampling and analysis plan and describes the pre-investigation activities, drilling, well installation, development, soil and groundwater sampling, and related procedures to install two monitoring wells at the Facility. Field activities are proposed that utilize field screening technologies and appropriate real-time communication and decision-making, if needed. Therefore, the work plan is intended to be flexible to adapt to unforeseen conditions.

3.1 PRE-INVESTIGATION ACTIVITIES

Pre-investigation activities to be completed prior to and/or concurrent with field mobilization are described in this subsection. The two proposed monitoring wells are located within the Facility property boundary. Pre-investigation activities include:

1. Conducting site reconnaissance surveys, including:
    - Inspecting drill locations for aboveground and buried utilities, temporary fence layout, vegetation clearance, and drill rig set-up area and configuration needed for all drilling equipment and support vehicles.
    - Reviewing available maps showing utilities in the area of the drilling locations.
    - Identifying site-specific hazards and performing hazards analysis assessments to protect employees, subcontractors, visitors, and JBPHH personnel from any potential job-related accidents and injuries during field work.
2. Obtaining NAVFAC clearances and approvals, and generating traffic control plans. The following clearance, approvals, and plan may be required:
    - Temporary fence installation approval from Physical Security.
    - Realigned permanent fence approval from Physical Security.
    - Informal traffic control plan, which includes drawings and traffic control management (signs).
3. Locating underground utilities. The Hawaii One Call Center (phone: 866-423-7287) will be the initial contact point for utility clearances for public utilities that may cross Navy property. However, the following types of utilities and responsible entities may also be contacted in the process of obtaining clearances for public utilities that may cross Navy property:

- Municipal Water/Sewer (City and County of Honolulu, Board of Water Supply)
- Electric (Hawaiian Electric Company)
- Natural Gas (The Gas Company)
- Telephone/Communications (Hawaiian Telcom/AT&T)

In addition, drilling locations will be cleared by a geophysical utility locating subcontractor.

4. Implementing best management practices. A National Pollutant Discharge Elimination System (NPDES) permit is required if direct or indirect discharge to storm drains is anticipated and if the area affected by site clearance operations is larger than one acre. A NPDES permit will not be required for the site activities being conducted. There will be no direct or indirect discharges to storm drains and substantially less than one acre of ground will be affected by site clearance operations. Best management practices will be implemented, including but not limited to: preservation of existing vegetation where possible; using waste (trash) and investigation-derived waste (IDW) containers; street sweeping; and dust suppression of drill cuttings.

5. Abiding by the National Historic Preservation Act. The National Historic Preservation Act, Section 106 [36 Code of Federal Regulations (CFR) Part 800], requires federal agencies to take into account the effects of their undertakings on historic properties and afford a reasonable opportunity to comment on such undertakings. As part of pre-investigation activities for this project, Section 106 was discussed with the NAVFAC Environmental Cultural Resource personnel. As a result of this discussion, a Section 106 compliance request is not required.

6. Abiding by the Endangered Species Act. The Endangered Species Act, Section 7, requires federal agencies to take into account the effects of their undertakings on endangered species. As part of pre-investigation activities for this project, site conditions and endangered species issues were discussed with the NAVFAC Environmental Natural Resources personnel. As a result of this discussion, a Section 7 compliance request is not required.

3.2 SCOPE OF FIELD ACTIVITIES

Field work at Facility is scheduled to begin on or before September 1, 2014. The work will include:

- Site and drilling location preparation and planning;

- Rock coring and geologic logging including field screening, corehole reaming, and installation of monitoring wells in the Pearl Harbor Basal Aquifer at two locations along and near the north lower access road within the Facility property boundary;
- Sampling soil/saprolite to the competent basalt contact at both monitoring wells for logging descriptions, field screening, and potential laboratory analysis of samples for contaminants of potential concern (COPCs);
- Sampling core for potential laboratory analysis of basalt for COPCs if visible staining or odor is detected;
- Determining well deviation with downhole instruments;
- Sounding the monitoring wells for groundwater elevation and potential free product and making any necessary corrections to water levels based on the well deviation and/or presence of free product;
- Casing off overburden sediments from the bedrock within the boreholes to facilitate coring/drilling and to mitigate potential vertical migration of contamination to groundwater;
- Constructing above-ground wellhead completions with concrete pads, protective bollards, and secure, tamper-proof protective casings;
- Developing monitoring wells, installing dedicated bladder pumps, and sampling groundwater monitoring wells for potential COPCs;
- Surveying monitoring wells to establish northing and easting coordinates and elevations;
- Managing IDW generated during the drilling and sampling activities; and
- Restoring the drilling locations.

3.3 ANALYTICAL METHODS AND REGULATORY COMPARISON CRITERIA

The soil and groundwater samples collected for laboratory analysis will be analyzed for gasoline and diesel range TPH, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs) to include naphthalenes, and dissolved lead. Groundwater also will be analyzed for methane and the general water chemistry anions. The corresponding soil and groundwater analytical methods are provided in Table 2 - Soil Analytical Methods, Project Action Limits, and Laboratory Specific Limits and in Table 3 - Groundwater Analytical Methods, Project Action Limits, and Laboratory Specific Limits.

DOH environmental action levels (EALs) for soil and groundwater will be used for comparison purposes (DOH, 2012) and are provided in Table 2 - Soil Analytical Methods, Project Action Limits and Laboratory Specific Limits and in Table 3 - Groundwater Analytical Methods, Project Action Limits and Laboratory Specific Limits.

3.4 DRILLING LOCATION ACCESS, SITE PREPARATION, AND FENCING

Proposed drilling locations along the lower access road will require varying degrees of site preparation to include installation of a temporary security fence and perimeter security fence removal (discussed below), vegetation removal, site grooming if needed, and permanent reconfiguration of the perimeter fence to incorporate the new monitoring wells and allow future access for groundwater sampling activities. In addition to vegetation removal, the area may be groomed to remove tire hazards, and the ground surface graded or filled as needed to provide a level base for the drill rigs if the ground slope is greater than leveling timbers can correct. Additionally, vegetation including trees must be cleared a minimum of 10 feet away from the outside of the temporary of the temporary fence per NAVFAC security requirements.

The following sequence for temporary security fence installation will be followed.

1. The temporary security fence will be installed completely before taking down the permanent perimeter security fence. The temporary fence area will allow sufficient space to accommodate drill rigs, support vehicles, and IDW roll-off containers without encroaching onto the access road. The temporary fence posts will be driven approximately two feet into the ground rather than boring holes and placing posts in concrete as done for permanent posts. Physical Security will approve these temporary fencing assumptions or provide alternatives for construction. The drill site area and temporary security fence configurations will depend on ground conditions and how the drill rigs will be oriented relative to the existing security fence. The drill rig orientations may be approximately parallel or perpendicular to the existing security fence. The temporary fence panels will be 13 feet wide by 6 feet tall

2. After the temporary security fence is installed, the permanent fence fabric will be rolled back and the fence posts will be cut flush with the concrete. Only a necessary number of posts will be removed for equipment access.

3. Perform the required drilling, installation of the monitoring well, and completion of the well with a reinforced concrete pad (2 feet thick), steel protective casing and cap with protective hood for the lock, and steel bollards at each corner of the concrete pad. The monitoring well will be sampled prior to permanent security fence reconstruction.

4. Prior to the temporary security fence removal, the new security fence configuration will be marked around the monitoring well. The concrete around the cut-off posts that will be needed

for the new construction will be hammered out a few inches below ground surface, the cut posts will be welded back on, and new concrete will be poured around the reinstalled posts. The new concrete will extend above the weld so the weld will not be visible.

5. The new security fencing around the monitoring well will be constructed approximately perpendicular to existing security fence line. The fencing around the monitoring well and up to the existing fence line will be attached to new posts set in bored holes and concrete. The existing security fence will be rolled back to the new fence corner posts at the entrance to the monitoring well access. The reconstructed permanent perimeter fence will be built in accordance with Navy fencing specifications.

6. After the reconstructed permanent perimeter fence is in place, the temporary fence and posts will be taken down and removed from the drilling locations and Facility.

3.5 TRAFFIC CONTROL

Traffic control will be implemented as necessary. A minimum 12-foot clearance is required for emergency access along the lower access road. Traffic cones and signs (if warranted) will be placed along the roadway near the drilling operations to provide warning to JBPHH personnel and contractors of work along the lower access road.

3.6 DRILLING, WELL INSTALLATION, AND SAMPLE COLLECTION ACTIVITIES

Monitoring wells will be drilled and installed at the approximate locations shown on Figure 2. The locations may be moved as required from the shown locations due to the actual ground conditions and siting concerns related to drill rig set up and orientation, and safety. Proposed monitoring wells 1 and 2 will be installed near the lower access road north of the permanent security fence. The anticipated drilling depths of the wells are approximately 300 feet bgs.

3.6.1 Drilling and Soil Sampling

A Mobile B-59 or similar drill rig will used to advance hollow-stem augers (HSAs) into the incompetent soil/saprolite overlying basalt and for rock coring in basalt beneath the soil/saprolite. A larger, air rotary drilling rig (Atlas Copco T3 or Mobile B90) will be used to enlarge the boreholes within the soil/saprolite to set 12-inch-diameter conductor casing and to enlarge the coreholes to 8-

inch diameter for installation of monitoring wells. Conductor casing will be grouted in place from the bedrock surface to ground surface.

3.6.1.1 Hollow Stem Auger

Initially, the boreholes will be advanced to refusal using HSAs and soil core samples will be collected at 10-foot intervals with 2-inch-diameter split spoons. Near-surface petroleum contamination is not expected at these downgradient locations; however, if high photo-ionization detector (PID) readings, petroleum odor, visual staining, or other indications of soil contamination are encountered, soil samples will be collected and submitted for laboratory chemical analysis. PID screening results, logging information, and depth of auger refusal will be recorded in the field book and computer-generated geologic logs with all pertinent information will be constructed. The depth of auger refusal could be shallow, depending on the location and subsurface conditions. For instance, if basalt boulders were to be encountered or if saprolite contains competent layers, augering will not be possible. Conductor casing will be set at the depth of auger refusal or the larger, air rotary drilling rig will be utilized to further extend the depth of the conductor casing. Soil/saprolite will be described according to standard logging procedures using the unified soil classification system (USCS) and a Munsell™ soil color chart will be used for color determination.

If soil samples are collected, soil samples for VOC analysis for benzene, toluene, ethylbenzene, and xylenes (BTEX) will be collected in EnCore® samplers. Samples for other analyses will be collected in analyte appropriate containers supplied by the laboratory. Soil samples will be handled in accordance with the quality assurance project plan (QAPP) in Section 4.

3.6.1.2 Rock Coring

Rock coring will commence at the depth where competent bedrock is contacted. Because the proposed monitoring wells (1 and 2) are located near or within a natural drainage, a substantial thickness of saprolite and/or alluvium may be encountered. If the thickness of this material extends much greater than 50 feet bgs such that the conductor casing also extends to this depth, coring within the conductor casing becomes difficult due to wobble of the rock coring drill stem within the large-diameter conductor casing. In the event that this potential wobble cannot be overcome, rock coring may not be possible, unless a separate borehole is drilled with small diameter casing installed.

Continuous rock cores will be obtained in a 5-foot-long HQ core barrel (approximate 4-inch outside diameter yielding an approximate 2.75 inch rock core) using a wireline and quad-latch retrieval system. Rock coring will advance to a depth of approximately 20 feet below the water table. Compressed air will be used for circulation fluid at shallower depths. Compressed air mixed with clean, potable water will be used for the circulation fluid at increasing depths. An accessible source of potable water will be required for rock coring and drilling use. This source of clean water may be an on-site Navy fire hydrant or off-site BWS fire hydrant. The potable water will be analyzed prior to use. A 55-gallon drum with an air stack filter on the top will be used to catch and mitigate fine drilling dust.

Rock cores will be described in accordance with standard logging procedures. A summary rock core chart will be used in the field as a guide to aid in the descriptions. In general, rock color; texture; strength; degree and orientation of fracturing; shape, size and volume of voids; weathering; and secondary staining or mineralization will be noted on the geologic logs. The Geological Society of America rock color chart with Munsell™ color chips will be used for color determination. Lithologic descriptions, PID screening results and other observations will be provided on a geologic log.

3.6.1.3 Air Rotary

The coreholes will be reamed or over-drilled to 8-inch diameter. The borehole will be advanced to total depth using conventional, open-hole air rotary with an air hammer. A diverter will be bolted to the top of the conductor casing to discharge entrained air, water, and rock cuttings via a large hose to a cyclone mounted on a roll-off bin. Limited amounts of clean, potable water and environmentally safe drilling foam (as required) will be injected during drilling to mitigate dust and to increase fluidization to remove cuttings from the boreholes. Cuttings return using this method can be variable, therefore, limiting the ability to log the rock formation where rock coring is not conducted.

3.6.2 Monitoring Well Installation

The monitoring wells will be installed in basalt and screened within the basal aquifer. Four-inch diameter, Schedule 80 polyvinyl chloride (PVC) monitoring wells with 20 feet of 0.020-inch slotted, Schedule 80 PVC screens will be constructed within the 8-inch boreholes. The 20-foot screens will straddle the water table such that about 15 feet of screen is below the water table and 5 feet is above to allow for water level fluctuation. The wireline on the Mobile B-59 or similar drilling rig will be used to place the sections of screen and blank casing. Additionally, a 1-inch diameter PVC sounding tube for the purpose of measuring water levels will be attached to the outside of each well casing and placed with the well during construction. The sounding tubes will be slotted and screened over the same interval as the monitoring wells. A sounding tube is necessary to obtain accurate water levels because the tape of a water level indicator can become entangled in the dedicated-pump sample tubing within the well. Depth to water in the open well casing (prior to pump installation) and in the sounding tube will be measured and compared and any differences will be noted. For consistency, all water levels will be measured with the same water level indicator.

Coarse #3 Monterey silica sand will be tremied in the borehole annulus beneath, within, and approximately 5 to 8 feet above the well screen, followed by a bentonite pellet seal, then bentonite chips or viscous, wet bentonite grout up to the bottom of the conductor casing (less viscous cement-bentonite grout should not be used because of high rock porosity). Dry bentonite pellets and chips where used will be tremied and hydrated with clean, potable water. The annular space between the well casing and conductor casing will be finished with cement-bentonite grout to near surface. Well construction diagrams will be provided on the geologic logs.

The monitoring wells will be completed about 2.5-feet above ground with an 8-inch-diameter steel protective casing fitted with a locking, tamper proof lid that covers the protective casing and well head. The lock will be recessed or covered for added protection. The steel casings will be set in concrete at the wellhead for strength, security, and to provide a surface seal. A 3.5-foot by 3.5-foot square by 2-foot-thick concrete pad will be installed around each protective steel casing. Steel bollards (4) will be placed slightly beyond each corner of the pad. The bollards will extend below ground surface about 2 feet and above ground surface about 3 feet with each individually set in concrete. The protective steel casings also will extend about 3 feet above ground so there is about 6 inches of clearance between the wellhead and locking lid. Coarse sand will be poured into the space between the well and protective casing to a level of about 6 inches below the wellhead. The bollards and protective steel casing will be painted bright yellow for high visibility.

3.6.3 Monitoring Well Development, Pump Installation and Groundwater Sampling

3.6.3.1 Monitoring Well Development

Monitoring well development will consist of surging and bailing groundwater until fines are removed and the water clarifies. This normally occurs between a minimum of five well volumes and a maximum of 10 well volumes and ensures that formation water enters the well and that the water affected by drilling is removed. The parameters of dissolved oxygen (DO), oxidation-reduction potential (ORP), potential of hydrogen (pH), temperature, specific conductance, and turbidity will be monitored during the development cycle. Because DO and ORP are affected by the agitation of surging and bailing, the values obtained for these parameters during development may vary. If the development water is not relatively clear and sediment free after 10 well volumes, it will be assumed that further development will not be beneficial, and development will end. Development activities will be recorded in the field book and computer generated well development forms with all pertinent information will be constructed.

3.6.3.2 Dedicated Groundwater Pump System Installation

Dedicated pneumatic bladder pump sampling systems will be installed in each monitoring well after well development. The sampling system will consist of a stainless-steel bladder pump with the screen intake 3-feet below the top of the pump, small-diameter teflon coated stainless steel safety cable, 1/4-inch inside-diameter by 3/8-inch outside-diameter polyethylene air and discharge tubing, and a well cap assembly with fittings. The bladder pumps will be installed with the intake approximately 8 feet below the water table to allow for a decrease in water table elevation. The pre-determined, exact length of tubing and safety cable will be requested when ordered. Cable ties will be applied about every 10 feet to secure the tubing to the safety cable. Pump installation will require two or more workers to lower the pump assembly into the well. The sampling ports of the bladder pump system terminate in a PVC plate and are part of a well cap assembly that consists of the plate and a 4-inch sleeve. This sleeve assembly slips over the 4-inch well casing at the wellhead. The sounding tubes will be finished at approximately the same elevation datum as the well cap assembly. All water level measurements will be from the sounding tube measuring-point datum.

3.6.3.3 Groundwater Depth Monitoring, Purging, and Sampling

Depths to groundwater will be measured with a water level interface probe through the sounding tubes installed with each well. Because the monitoring wells will be installed at depths greater than 200 feet bgs, vertical deviation of monitoring wells will be measured after development using a WellNav™ (or similar) centralized camera system provided and operated by the drilling contractor. Deviations of less than 3 degrees are expected. Groundwater elevations will be corrected if need, based on the measured deviations. This is necessary to obtain more accurate groundwater elevations for evaluation of hydraulic head.

Groundwater purging and sampling with a bladder pump is a low flow or micropurge technique that is considered applicable for use in permeable formations that have minimal water level drawdown, such as in the Pearl Harbor Basal Aquifer. For this technique, water level drawdown should be less than approximately 0.33 foot during purging. Drawdown measured in the monitoring wells during purging is anticipated to be negligible because of high formation permeability. Low flow purging requires water in the well to be in equilibrium with the aquifer formation and flow into the pump intake to be horizontal and laminar so that mixing from turbulence does not occur.

Therefore, this technique minimizes disturbance in the well screen and aquifer, which reduces turbidity, aeration, mixing, and loss of VOCs.

The pumping flow rates should average about 0.5 liters per pump cycle, which is within the acceptable range of 0.1- to 0.5-liters per minute (L/min) for low flow purging. Liquefied nitrogen gas will be used as the compressed gas source for operation of the bladder pumps. It is anticipated that one or two large bottles of compressed gas will be needed to complete the purge and sample cycle including collecting quality assurance/quality control (QA/QC) samples.

During purging the water quality parameters of DO, ORP, temperature, pH, specific conductance, and turbidity will be measured and recorded. These groundwater sampling parameters will be measured continuously through use of a flow-thru cell connected to a U-52 multi-parameter meter, or similar meter. The sampling parameters and other pertinent sampling information will be included on the groundwater sampling form that is provided in Appendix C. Stabilization of the water quality parameters is the criterion for sample collection. Samples will be collected after three successive measurements of the water quality field parameters have stabilized according to the criteria shown on the groundwater sampling form. It is anticipated that about 5 gallons of water will be purged from each well. Following purging, the flow-through cell will be bypassed so that samples are collected directly from the pump discharge line. Approximately 1.25 gallons (5 liters) of water will be collected for each sample set. In total, about 6.25 gallons will be removed from each well during the low-flow purging and sampling process.

Groundwater samples will be analyzed for the COPCs listed on the groundwater sampling Form (Appendix C). The analytical methods, container types and volumes, and preservation also are shown on the form. Additional details including holding times are provided on Table 4.

Only initial baseline samples will be collected from the monitoring wells after installation and development to determine if contamination is present. Results of the initial samples will be provided in a data summary report. Future monitoring and frequency will be determined by NAVFAC pending the analytical groundwater results.

3.7 SAMPLE IDENTIFICATION, HANDLING, AND SHIPPING

Soil and groundwater samples will be identified on sample containers and on the chain-of-custody (CoC) forms in accordance with the existing site protocol and nomenclature. The last well installed at the Facility was RHMW05. Therefore, the next wells installed will be RHMW06 and RHMW07. Soil samples will be designated with an SO identifier followed by the sample depth. For example, RHMW06-SO-10 indicates a soil sample collected at 10 feet bgs. Groundwater samples will be designated with a GW identifier followed by the sequential sample number. For example, RHMW06-GW-01 indicates the first groundwater sample from well RHMW06.

Standard COC protocol will be maintained during sample collection, handling, management, and shipment to the laboratory. Soil and water samples will be kept on ice after collection to keep them cool (4 +/-2 degrees Celsius [°C]) and packaged in coolers to be shipped to the laboratory as expeditiously as possible (normally the same day of collection). The EnCore® soil samples, if collected, which require preservation to 0°C, will be packed with dry ice to keep them frozen following collection and during transportation. With the exception of coolers containing dry ice, a temperature blank (a vial filled with distilled water) will be included in every cooler to determine the internal temperature of the cooler upon receipt at the laboratory. Soil samples and water samples will be shipped separately, and the samples for VOC analysis will be combined in one cooler and shipped with a trip blank. All samples will be shipped to APPL Inc. in Clovis, California via Federal Express for the earliest next day delivery to ensure that the samples arrive at the proper temperature.

Copies of the laboratory provided CoC with signatures will be retained for verification and documentation. The field manager will coordinate shipment to the laboratory, and the project manager will contact the laboratory to determine any discrepancies or deficiencies upon receipt of the samples.

3.8 EQUIPMENT DECONTAMINATION

All down-hole-drilling and sampling tools will be cleaned prior to and after each use. A previously used staging area near the Adit 3 entrance at the Facility or another acceptable location will be used for decontamination. Liquids will be captured and containerized in properly labeled DOT approved 55-gallon drums or other suitable temporary containers.

3.9 INVESTIGATION-DERIVED WASTE MANAGEMENT

IDW will include soil and rock cuttings generated during borehole drilling operations, well development and purge water, and decontamination water. Non-hazardous waste labels with the required labeling information will be placed on the IDW containers. These labels will include contract information, site activity, date, contents, project type, comments, and NAVFAC contact information. IDW will be properly disposed of pending analytical results. Off-site disposal will be coordinated with the NAVFAC environmental directorate for approval and signing of non-hazardous waste manifests. Documentation will be maintained and included as required in the applicable reports.

3.10 SURVEYING

Surveying of the monitoring wells and other pertinent site features will be performed as needed. The monitoring wells will be surveyed after individual completion, or after they are both installed, and tied into an established control point at the Facility. Northing and easting coordinates will be referenced to the Universal Transverse Mercator (UTM) projection and grid system (Zone 4). Ground surface and well datum elevations (in feet) will be referenced to mean sea level. The survey data will be provided on the geologic and well construction logs and compiled in a data table.

SECTION 4

QUALITY ASSURANCE PROJECT PLAN

This QAPP further defines the sampling and analysis discussed in Section 3 with procedures and methods incorporated. The QAPP includes the discussions of the following:

- Summary of the data quality objectives (DQO) process,
- QA/QC sampling and sample handling procedures,
- Laboratory QC,
- Field QC,
- Analytical data quality review,
- Data reporting and documentation,
- Oversight and assessment, and
- Corrective action.

This QAPP is based on the previously approved work plan/sampling and analysis plan prepared by ESI (2012).

4.1 SUMMARY OF THE DATA QUALITY OBJECTIVES PROCESS

The overall sampling and analysis strategy was developed using the Environmental Protection Agency (EPA) Guidance for Quality Assurance Project Plans, EPA QA/G-5, Quality Assurance Management Systems (EPA, 2001).

4.1.1 Statement of the Problem

Petroleum constituents have been detected in groundwater beneath the USTs at the Facility at concentrations above DOH EALs. These constituents may have the potential to impact groundwater production wells in the area.

4.1.2 Identify the Goals

The purpose of this project is to provide monitoring locations near the north perimeter boundary of the Facility to evaluate potential off-site migration of petroleum-related contamination in groundwater and to provide additional monitoring points to determine the distribution of hydraulic head for input into an existing groundwater model of this area.

4.1.3 Identify the Information

The decisions will be made by comparing the groundwater analytical results to the DOH EALs for a site where groundwater is a current or potential drinking water source and a surface water body is located greater than 150 meters from the site (DOH, 2012). The Project Action Levels (PALs) are the most conservative of either the drinking water toxicity level or the gross contamination level and were previously agreed upon by the DOH and Navy for the Red Hill LTM program (ESI, 2012). The PALs for soil and groundwater are provided in Tables 2 and 3, respectively.

4.1.4 Define the Boundaries of the Study

The monitoring is limited to one round of baseline groundwater sampling of the new monitoring wells to be located within the Facility along the northern perimeter fence and lower access road.

4.1.5 Develop the Analytical Approach

- If COPC concentrations at a groundwater monitoring well exceeds the screening criteria, then the potential risk to groundwater exposure needs to be evaluated.
- If COPC concentrations in groundwater do not exceed the screening criteria, then further monitoring needs to be conducted and fate and transport of COPCs in groundwater need to be evaluated.

4.1.6 Specify Performance Acceptance Criteria

The probability of procedural errors will be controlled through the consistent application of the standard sampling and analysis procedures and sound data quality management.

4.1.7 Develop the Plan for Obtaining Data

The monitoring well locations were chosen based upon previous investigations and monitoring, and groundwater modeling requirements. The analytical methods and criteria are presented in subsequent sections. Also discussed are field and laboratory QA, data management, and data evaluation.

4.2 QA/QC SAMPLING AND SAMPLE HANDLING PROCEDURES

All QA/QC sampling and sampling handling procedures will be performed in accordance *Technical Guidance Manual for Underground Storage Tank Closure and Release Response* (DOH, 2000).

4.2.1 Sample Collection Method

Collection and handling procedures have been designed to ensure that project personnel will be able to collect, label, preserve, and transport samples in a consistent manner to maintain sample integrity for the intended purposes. Field activities will be performed in accordance with the procedures described in Section 3. Analytes, sample containers, preservation, and holding times for water samples are provided in Table 4. Groundwater samples collected for dissolved lead analysis will be field filtered.

4.2.2 Field QC Samples

The field QC samples for this project will consist of duplicates, matrix spike/matrix spike duplicates (MS/MSDs), and trip blanks.

4.2.2.1 Duplicates

Field duplicate samples are used to document the overall precision of the sample collection program. Field duplicate samples will be collected at a minimum of ten percent. The field duplicate sample will be assigned a unique identification number. The duplicate will be analyzed for the same parameters as project samples.

4.2.2.2 MS/MSD

Laboratory MS and MSD analysis are used to assess analytical accuracy and precision in response to potential matrix interference. If all of the MS and MSD recoveries are within specified ranges, then all the data is considered accurate.

4.2.2.3 Trip Blanks

Trip blanks are used to detect VOC contamination attributable to shipping and field handling procedures. The trip blanks will be prepared by the analytical laboratory using reagent grade water in 40 milliliter volatile organic analysis (VOA) vials. Trip blanks will accompany every cooler that contain samples to be analyzed for VOCs and TPH-GRO. The trip blanks will travel with the cooler from the analytical laboratory to the field and will be returned to the analytical laboratory along with the project samples. The trip blanks will be analyzed for the same VOCs and TPH-GRO as the project samples with which they are shipped.

4.2.3 Sample Containers

The groundwater samples for chemical analyses will be placed in the sample containers listed in Table 4, preserved as indicated, and analyzed within the holding times. These containers, preservatives, and holding times are specified in the respective analytical methods. The contract laboratory will supply the required sample containers.

4.2.4 Sample Labeling

Soil and groundwater samples will be identified on sample containers and on the CoC forms in accordance with the existing site protocol and nomenclature as described in Section 3.7. The new wells installed at the Site will be identified as RHMW06 and RHMW07.

4.2.5 Field Instrument Calibration/Documentation

The following activities and documentation will be performed and maintained for all field equipment requiring periodic calibration:

- Electronic equipment requiring calibration will be calibrated prior to use by those persons directly responsible for the equipment, such as the field staff.
- Field equipment will be checked daily to verify that all of the equipment is calibrated according to the manufacturer's instructions and is operating properly prior to use.
- Field equipment that has been dropped, damaged, or is believed to be inaccurate will be tagged as in operable, removed from service and recalibrated. Field equipment that cannot be repaired or recalibrated will be replaced.
- Documentation pertinent to the calibration and maintenance of field equipment will be maintained in a bound field logbook. Entries made into the logbook regarding the status of field equipment will contain, but are not necessarily limited to, the following information:
    - Date, time, and calibration readings;
    - Name of person conducting calibration; and
    - Type of field equipment being serviced and identification number (e.g., serial number) and reference standard used for calibration (e.g., pH of buffer solution).

The field logbook or photocopies of applicable pages will be made part of the permanent project record upon completion of the project.

4.3 LABORATORY REQUIREMENTS

All laboratory activities will be performed in accordance with the Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories, Version 4.2 (DoD, 2010).

4.3.1 Project Analytes

Analytical data will be generated using EPA methodologies published in “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846” (EPA, 1996). The following analytical methods will be used during this investigation:

- TPH-GRO – EPA Method 8015B;
- TPH-DRO – EPA Method 8015B;
- VOCs – EPA Method 8260B;
- PAHs – EPA Method 8270C SIM;
- Dissolved Lead – EPA Method 6020;
- Methane – RSK SOP 175
- Alkalinity – EPA 310.1
- Sulfate – EPA 9056A
- Nitrate/Nitrite as N – EPA Method 353.2.

Standard sample preparation and extraction procedures for each analytical method will be used by the laboratory. Soil samples, if collected for VOC, PAH, and the TPH hydrocarbon fraction range analyses, will be analyzed by the same methods as the water samples with the same holding times.

4.3.2 Reporting Limits

Reporting limits are established by the laboratory based on the limits of quantitation (LOQs), historical data, and EPA limits established for the analytical methods employed. The reporting limits for samples may require adjustment due to the matrix interference or if high analyte concentrations necessitate sample dilution before analysis. Matrix interference and sample dilutions have the effect of increasing the reporting limits. Failure to meet the specified reporting limits will be described in the sample delivery group case narrative and summarized in the data review reports.

4.4 ANALYTICAL DATA QUALITY REVIEW

Data quality will be assessed by evaluating the accuracy, precision, representativeness, completeness, comparability, and sensitivity parameters.

4.4.1 Accuracy

Accuracy is defined as the degree of agreement of a measurement to an accepted reference or true value. When applied to a set of observed values or measurements, accuracy will be a combination of random and systematic error. Analytical accuracy will be defined as the percent recovery of an analyte in a reference standard or spiked sample. Accuracy limits for laboratory control samples are established by individual laboratories. The acceptance criteria for accuracy are dependent on the analytical method, and are based on historical laboratory data. Failure to meet the accuracy limits will be described in the sample delivery group as a case narrative and summarized in the data review reports.

The percent differences of the continuing calibration are also an indication of accuracy. Sample results are qualified "UJ" for non-detects and "J" for detects, if the percent differences for a continuing calibration is out of the acceptable range, this will be reported by the laboratory in the analytical analysis.

4.4.2 Precision

Precision is defined as the agreement between a set of replicate measurements without assumption or regard about the true value. Precision limits for the laboratory measurements will be evaluated from the sample/sample duplicate analyses results. Field sampling precision will be evaluated from the field duplicate sample analyses results.

The relative percent difference (RPD) measured between two duplicate samples will serve as the quantitative measure of precision. Precision for sampling is evaluated separately from precision for analytical data. Field co-located samples help clarify the distinction between uncertainty due to analytical variability and heterogeneity of the sample matrix. Laboratory control samples (LCS) and duplicate LCS analyses results will be used to assess analytical precision.

4.4.3 Completeness

Completeness is defined as the overall percentage of valid analytical results (including estimated results) compared to the total number of analytical results reported by the analytical laboratory. The completeness goal for this project is 90 percent. Successful completion of data acquisition can only be accomplished if both the field and laboratory portions of the project are performed according to the procedures described in the QAPP.

4.4.4 Representativeness

Representativeness is the degree that data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness will be achieved by conducting sampling in compliance with the sample collection procedures described in Section 3. Field duplicate samples will be collected and used as a means to assess field representativeness.

4.4.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set. Comparability can be related to accuracy and precision because these quantities are measures of data reliability. Data are considered comparable if collection techniques, measurement procedures, methods, and reporting are equivalent for the samples within a sample set. Comparability for sampling will be determined to be acceptable based on the following criteria: a consistent approach to sampling was applied throughout the program; samples were consistently preserved; and samples were collected under similar physical conditions.

4.4.6 Sensitivity

Sensitivity is defined as the ability of an analytical method or instrument to detect the target analytes at the level of interest. Sensitivity is assessed based on calibration criteria, and instrument method detection limits (MDLs) and LOQs, which are presented in Table 2 and Table 3. Sensitivity will be measured by including a calibration standard for the analytes at or close to the quantitation limit.

4.5 DATA REPORTING AND DOCUMENTATION

The laboratory will prepare and retain full analytical and QC documentation. The following items present the key components of the hard copy deliverables that will be generated:

- Data packages along with supporting QC data,
- Original copy CoC forms or certified copies,
- Cover sheet listing the samples included in the report and narrative comments describing problems encountered during the analysis,
- Tabulated presentation of analytical results for all samples including reporting limits for all analyses and any laboratory assigned data qualifiers (data qualifiers will be defined and documented in the case narrative),
- Tabulated presentation of the results for all method and preparation blanks as applicable, and
- Analytical results for all laboratory QC sample analyses (LCS results and recoveries, surrogate recoveries, recoveries, and RPDs, laboratory duplicate (LD), and serial dilution results).

4.6 OVERSIGHT AND ASSESSMENT

The QA/QC protocols and procedures will be implemented for all project activities. The plans and procedures implemented in the field and laboratory will be evaluated by direct oversight of activities, surveillance, and review of the documentation and data. The oversight and assessment of project activities will be performed by the BPM, PPM, or designated alternate. If problems or incidences of nonconformance are identified, the following section identifies personnel that will deal with them and corrective measures that will be implemented.

4.7 CORRECTIVE ACTION

The BPM and PPM are responsible for maintaining quality throughout this project. The FM is responsible for ensuring the day-to-day quality of field activities.

All incidences of nonconformance with the established QC procedures will be expeditiously identified and controlled. No additional work that is dependent on a nonconforming activity that potentially affects data quality will be performed until the identified nonconformance is corrected. Documentation describing the nonconformity will be submitted to the BPM and PPM. The documentation will include corrective measures to prevent nonconformity from recurring.

When errors, deficiencies, or out-of-control situations exist, the QA program provides systematic procedures, called “corrective actions,” to resolve problems and restore proper functioning to the analytical system. Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside acceptable limits for precision and accuracy;
- Blanks or LCS contain contaminants above acceptable limits;
- There are unusual changes in detection limits;
- Deficiencies are detected during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received from clients.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, and instrument sensitivity. If the problem persists or cannot be identified, the matter is referred to the laboratory technical personnel, Laboratory PM, and/or QA managers (BPM and PPM) for further investigation. Once the problem is resolved, full documentation of the corrective action procedure will be filed with the QA managers through an anomaly or non-conformance form. This form will be kept by both QA managers. Corrective action documentation is routinely reviewed by the QA managers.

Corrective action is dictated by the type and extent of the non-conformance. Corrective action may be initiated and carried out by non-supervisory staff, but final approval and data review by management is necessary before reporting any information. All potentially affected data must be thoroughly reviewed for acceptance or rejection. Samples are monitored closely so that they can be analyzed within the recommended holding time. However, should a sample be analyzed outside of the specified holding time, a Holding Time Violation Notification is filled out and the Laboratory PM is informed immediately. It is the Laboratory PM's responsibility to inform the BPM and PPM so that a decision can be made to re-sample.

The Laboratory PM or QA officer share the responsibility of reviewing all laboratory analytical activities to ensure compliance with the QC requirements outlined in this QAPP. This review serves as a control function in that it should be conducted frequently so deviations from method requirements will be immediately identified and corrected.

4.7.1 Field Corrective Action

The FM will review the procedures being implemented in the field for consistency with the established protocols. Sample collection procedures will be checked for completeness. When procedures are not strictly in compliance with the established protocol, the deviation will be documented and reported to the BPM and PPM. Non-conformances will be expeditiously identified and controlled. No additional work that is dependent on a nonconforming activity that potentially affects data quality will be performed until the identified nonconformance is corrected.

Corrective actions will be defined by the BPM and PPM and documented as appropriate. After implementation of the corrective action, the FM will provide the BPM and PPM with a written memorandum documenting field implementation. The memorandum will become part of the project files.

4.7.2 Laboratory Corrective Action

The Laboratory QA/QC officer or designated alternate will be responsible for initiating corrective action as necessary. Non-conformance or problems occurring at the laboratory will be reported to the BPM and PPM within one working day of identification. Appropriate corrective action will be required if analyses of QC samples or laboratory conditions do not meet criteria specified in the respective methods, the laboratory QAPP, or this work plan.

The chemist or designated alternate will review the field and laboratory data generated for this project to determine if the project QA objectives are met. If any non-conformance is found in the laboratory analytical results or documentation procedures during data assessment and validation, the impact of those non-conformances on the overall project QA objectives will be assessed. Appropriate actions, including resampling or reanalysis, may be recommended to the BPM and PPM, so that the objectives can be achieved.

4.7.3 Corrective Action Following Data Assessment

The chemist or designated alternate will review the field and laboratory data generated for this project to determine if project QA objectives are met. If non-conformances are found in the field procedures, sample collection procedures, field documentation procedures, laboratory analytical and documentation procedures, or data review procedures, the impact of those non-conformances on the overall project objectives will be evaluated. Appropriate actions, including resampling or reanalysis, will be recommended to the BPM and PPM so that the project objectives can be achieved.

SECTION 5

REPORTING

A Remedial Investigation (RI) report that documents drilling, well installation, and groundwater sampling activities and presents results of soil and groundwater sampling will be prepared. Supporting figures, tables, and calculations will be included. The RI report will be submitted in draft and final versions. A response to comments on the draft submittal indicating how each Government/regulatory comment was addressed will be prepared. The reporting schedule is provided in Appendix A.

A tentative outline for the RI Report is as follows:

1. Introduction and Background Information
2. Remedial Investigation Activities
3. Remedial Investigation Results
4. Conclusions
5. References

Appendices: Boring Logs and Well Completion Diagrams, Field Data, Survey Data, Laboratory Analytical Reports, and Analytical Data Quality Assessment Reports.

SECTION 6

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FIGURES

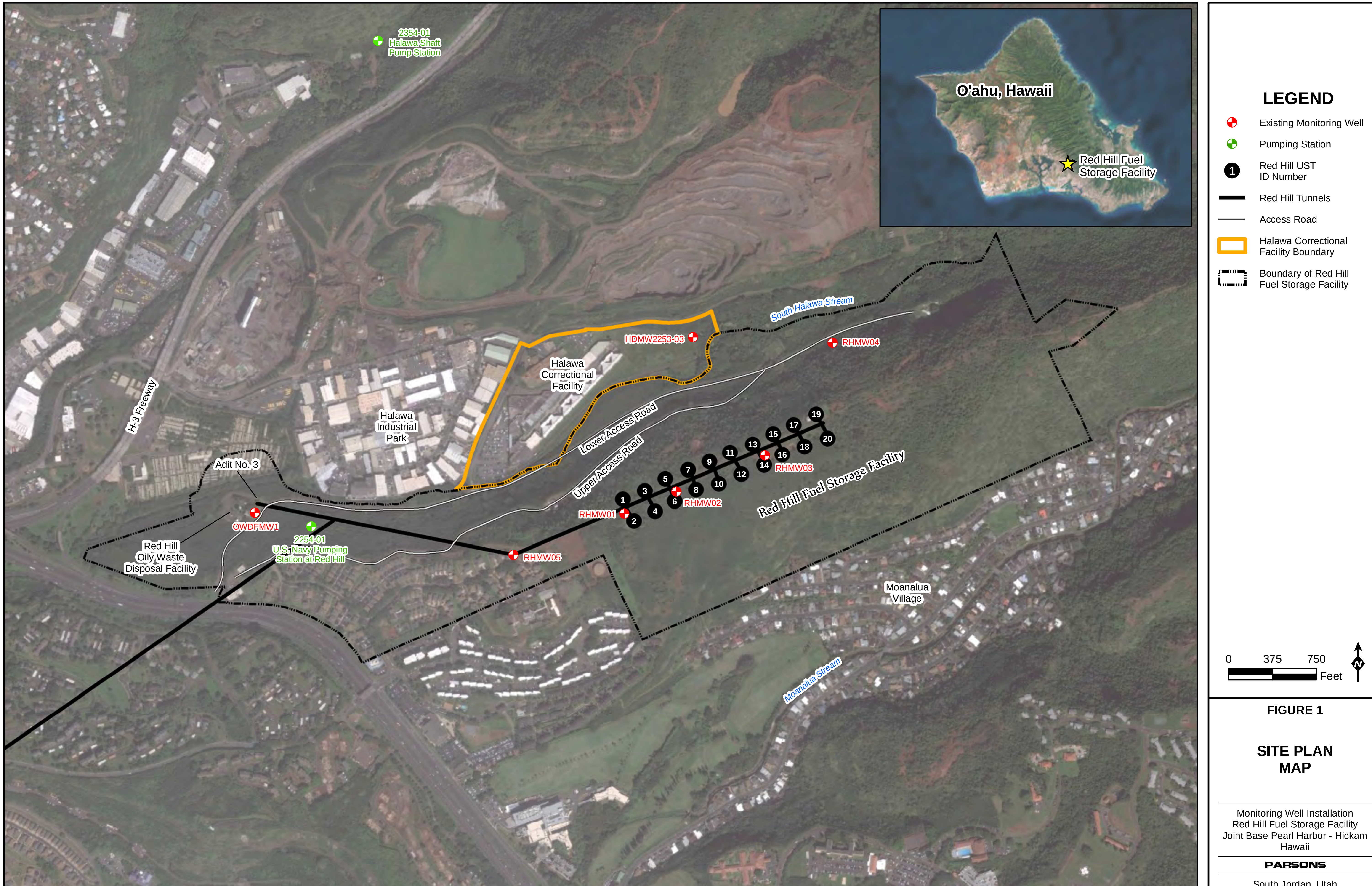

FIGURE 1

SITE PLAN MAP

Monitoring Well Installation
Red Hill Fuel Storage Facility
Joint Base Pearl Harbor - Hickam
Hawaii

PARSONS

South Jordan, Utah

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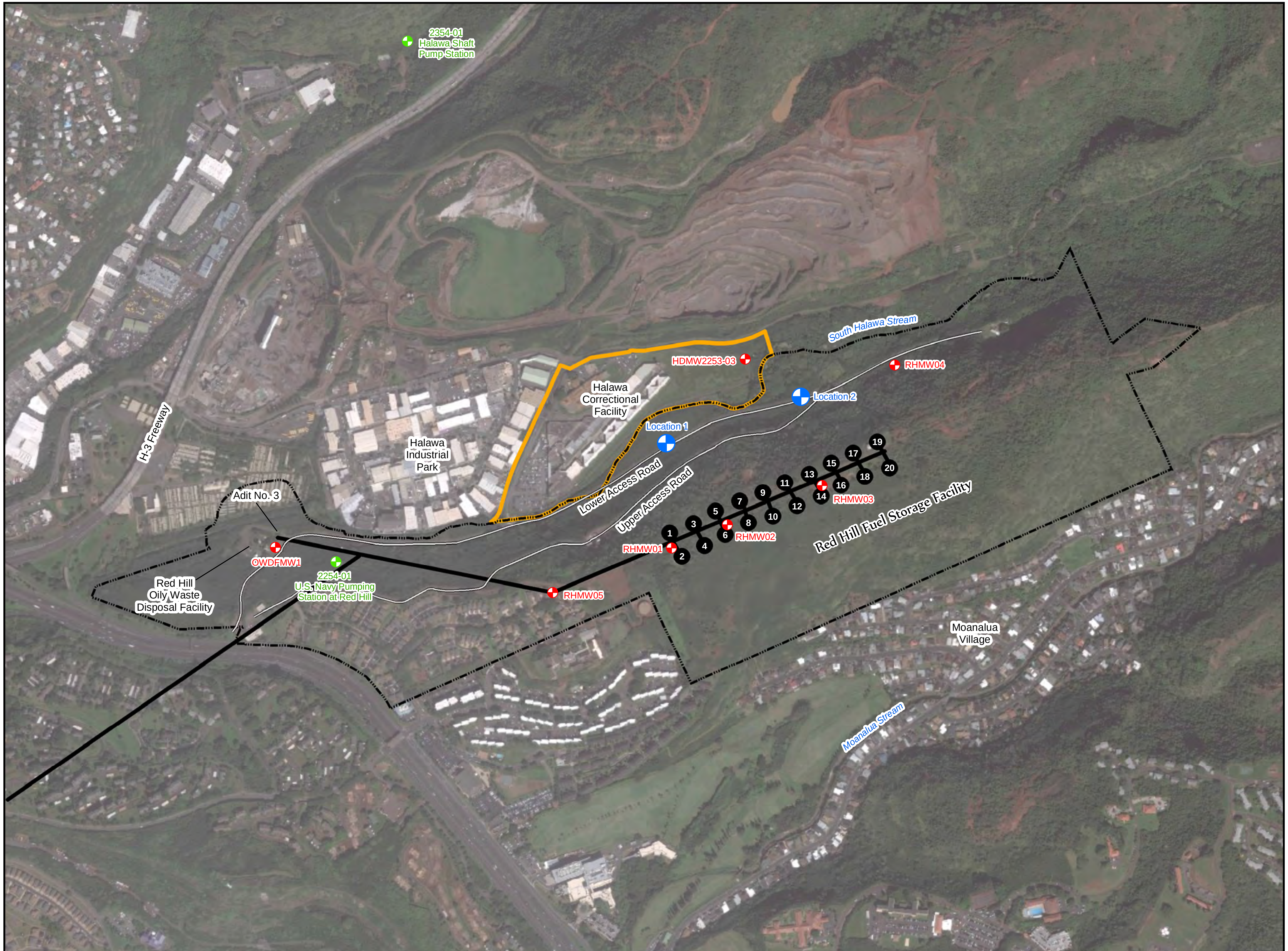

LEGEND

- Proposed Monitoring Well
- Existing Monitoring Well
- Pumping Station
- Red Hill UST ID Number
- Red Hill Tunnels
- Access Road
- Halawa Correctional Facility Boundary
- Boundary of Red Hill Fuel Storage Facility

0 375 750 Feet

N

FIGURE 2

PROPOSED MONITORING WELLS

Monitoring Well Installation
Red Hill Fuel Storage Facility
Joint Base Pearl Harbor - Hickam
Hawaii

PARSONS

South Jordan, Utah

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TABLES

TABLE 1
KEY PERSONNEL

Monitoring Well Installation
Red Hill Fuel Storage Facility
Joint Base Pearl Harbor-Hickam

Name	Title	Address	Phone/Fax	E-mail
Bruce Tsutsui	NAVFAC Hawaii Remedial Project Manager	400 Marshall Road, Building X-11 JBPHH, HI 96860-3139	Ph: 808-471-1171 x353	bruce.tsutsui@navy.mil
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John Ratz	Parsons Technical Resource	1776 Lincoln Avenue, Suite 600 Denver, CO 80290	Ph: 303-764-8718 Cell: 808-330-3432	john.ratz@parsons.com
Mitch Jensen	Parsons Field Task Manager for Site Characterization	10235 South Jordan Gateway, 3rd Floor South Jordan, UT 84095	Ph: 801-553-3311 Cell: 801-380-1375	mitch.jensen@parsons.com
William Stohler	Parsons Alternate Field Task / Safety Manager for Characterization	Honolulu Hi, Works from home	Cell: 808-258-7371	william.stohler@parsons.com
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TABLE 2

SOIL ANALYTICAL METHODS, PROJECT ACTION LEVELS, AND LABORATORY SPECIFIC LIMITS

Monitoring Well Installation
Red Hill Fuel Storage Facility
Joint Base Pearl Harbor-Hickam

Analytes	DOH EAL (mg/kg)		PAL (mg/kg)	PQL Goal (mg/kg)	Laboratory Specific Limits		
	Gross Contamination	Leaching & Groundwater Protection			LOQ (mg/kg)	LOD (mg/kg)	MDL (mg/kg)
Analytical Group: BTEX (EPA 8260C)							
Benzene	500	0.3	0.3	0.03	0.005	0.0020	0.0006
Toluene	500	3.2	3.2	0.32	0.005	0.0020	0.0006
Ethylbenzene	480	3.7	3.7	0.37	0.005	0.0020	0.0006
Xylenes	390	2.1	2.1	0.21	0.01	0.002	0.001
Analytical Group: PAHs (EPA 8270C SIM)							
Acenaphthene	1,000	120	120	12	0.005	0.0017	0.0010
Acenaphthylene	500	100	100	10	0.005	0.0017	0.0009
Anthracene	500	59	59	5.9	0.005	0.0017	0.0008
Benzo[a]anthracene	500	10	10	1	0.005	0.0017	0.0009
Benzo[g,h,i]perylene	500	35	35	3.5	0.005	0.0017	0.0013
Benzo[a]pyrene	500	20	20	2	0.005	0.0017	0.0009
Benzo[b]fluoranthene	500	9.2	9.2	0.92	0.005	0.0017	0.0011
Benzo[k]fluoranthene	500	39	39	3.9	0.005	0.0017	0.0010
Chrysene	1,000	30	30	3	0.005	0.0017	0.0008
Dibenzo[a,h]anthracene	500	12	12	1.2	0.005	0.0017	0.0009
Fluoranthene	500	1,200	500	50	0.005	0.0017	0.0012
Fluorene	500	370	370	37	0.005	0.0017	0.0010
Ideno[1,2,3-cd]pyrene	500	30	30	3	0.005	0.0017	0.0009
1,-methylnaphthalene	500	1.8	1.8	0.18	0.005	0.0017	0.0010
2,-methylnaphthalene	500	4.1	4.1	0.41	0.005	0.0017	0.0009
Naphthalene	500	4.4	4.4	0.44	0.005	0.0017	0.0009
Phenanthrene	500	570	500	50	0.005	0.0017	0.0011
Pyrene	500	610	500	50	0.005	0.0017	0.0012
Analytical Group: TPH (EPA 8015)							
TPH as Gasoline Range Organics	100	100	100	10	2.0	0.80	0.34
TPH as Diesel Range Organics	500	100	100	10	5.0	1.00	0.65
Analytical Group: Metals (EPA 6020A)							
Lead	1,000	73(1)	73	7.3	0.1	0.05	0.02

Notes:

(1) The background concentration for lead in soil will be used for preliminary data screening purposes.

DOH EAL – State of Hawaii Department of Health Hazard Evaluation and Emergency Response Office Environmental Action Levels for sites where groundwater is a current drinking water source and surface water is greater than 150 meters from the site – January 2012.

LOD – Limit of Detection
LOQ – Limit of Quantification
MDL – Method Detection Limit
PAL – Project Action Level
PQL – Project Quantification Limit

TABLE 3

GROUNDWATER ANALYTICAL METHODS, PROJECT ACTION LEVELS, AND LABORATORY SPECIFIC LIMITS

Monitoring Well Installation
Red Hill Fuel Storage Facility
Joint Base Pearl Harbor-Hickam

Analytes	DOH EAL (ug/L)		PAL (ug/L)	PQL Goal (ug/L)	Laboratory Specific Limits		
	Drinking Water Toxicity	Gross Contamination			LOQ (ug/L)	LOD (ug/L)	MDL (ug/L)
Analytical Group: BTEX (EPA 8260C)							
Benzene	5	170	5	0.5	1.0	0.30	0.16
Toluene	1,000	40	40	4	1.0	0.30	0.17
Ethylbenzene	700	30	30	3	1.0	0.50	0.23
Xylenes	10,000	20	20	2	2.0	0.30	0.19
Analytical Group: PAHs (EPA 8270C SIM)							
Acenaphthene	370	20	20	2	0.2	0.10	0.06
Acenaphthylene	240	2,000	240	24	0.2	0.10	0.06
Anthracene	1,800	22	22	2.2	0.2	0.10	0.05
Benzo[a]anthracene	0.092	4.7	0.092	0.0092	0.2*	0.10	0.07
Benzo[g,h,i]perylene	1,500	0.13	0.13	0.013	0.2*	0.10	0.08
Benzo[a]pyrene	0.2	0.81	0.2	0.02	0.2	0.10	0.06
Benzo[b]fluoranthene	0.092	0.75	0.092	0.0092	0.2*	0.10	0.06
Benzo[k]fluoranthene	0.92	0.4	0.4	0.04	0.2	0.10	0.07
Chrysene	9.2	1	1	0.1	0.2	0.10	0.05
Dibenzo[a,h]anthracene	0.0092	0.52	0.0092	0.00092	0.2*	0.10	0.05
Fluoranthene	1,500	130	130	13	0.2	0.10	0.08
Fluorene	240	950	240	24	0.2	0.10	0.06
Ideno[1,2,3-cd]pyrene	0.092	0.095	0.092	0.0092	0.2*	0.10	0.07
1,-methylnaphthalene	4.7	10	4.7	0.47	0.2	0.10	0.06
2,-methylnaphthalene	24	10	10	1	0.2	0.10	0.06
Naphthalene	17	21	17	1.7	0.2	0.10	0.05
Phenanthrene	240	410	240	24	0.2	0.10	0.07
Pyrene	180	68	68	6.8	0.2	0.10	0.08
Analytical Group: TPH (EPA 8015)							
TPH as Gasoline Range Organics	100	100	100	10	20	18.0	8.6
TPH as Diesel Range Organics	190	100	100	10	150	50.0	40.4
Analytical Group: Metals (EPA 6020)							
Dissolved Lead	15	50,000	15	1.5	3	0.4	0.19

TABLE 3 (Continued)

GROUNDWATER ANALYTICAL METHODS, PROJECT ACTION LEVELS, AND LABORATORY SPECIFIC LIMITS

Monitoring Well Installation
Red Hill Fuel Storage Facility
Joint Base Pearl Harbor-Hickam

Analytes	DOH EAL (ug/L)		PAL (ug/L)	PQL Goal (ug/L)	Laboratory Specific Limits		
	Drinking Water Toxicity	Gross Contamination			LOQ (ug/L)	LOD (ug/L)	MDL (ug/L)
General Chemistry							
Methane (RSK-175)	NA	NA	NA	NA	1.0	0.45	0.25
Sulfate (9056A)	NA	NA	NA	NA	1.0 mg/L	0.198 mg/L	0.090 mg/L
Nitrate/Nitrite (353.2)	NA	NA	NA	NA	0.1 mg/L	0.1 mg/L	0.028 mg/L
Alkalinity (SM2320B)	NA	NA	NA	NA	2.0 mg/L	1.7 mg/L	0.85 mg/L

Notes:

DOH EAL – State of Hawaii Department of Health Hazard Evaluation and Emergency Response Office Environmental Action Levels for sites where groundwater is a current drinking water source and surface water is greater than 150 meters from the site.

LOD – Limit of Detection

LOQ – Limit of Quantification

MDL – Method Detection Limit

PAL – Project Action Level

PQL – Project Quantification Limit

NA – Not applicable

* - In the case where an EAL for a specific chemical is less than the LOQ for a commercial laboratory, it is generally acceptable to consider the LOQ in place of the actions level.

TABLE 4

ANALYTICAL METHODS, SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR GROUNDWATER SAMPLING

Monitoring Well Installation
Red Hill Fuel Storage Facility
Joint Base Pearl Harbor-Hickam, Hawaii

Analyte	Number/ Type of Containers per Sample	Preservative	Holding Time	
			Extraction	Analysis
TPH-DRO	1-Liter amber glass	4° Celsius	7 days	40 days
TPH-GRO	Three 40 milliliter glass vials with Teflon-lined septum	4° Celsius	-	7 days
VOCs	Three 40 milliliter glass vials with Teflon-lined septum	4° Celsius	-	7 days
Methane	Three 40 milliliter glass vials with Teflon-lined septum	4° Celsius	-	28 days
PAHs	Two 1-liter amber glass bottle	4° Celsius	7 days	40 days
Alkalinity/ Sulfate	One 250 milliliter polyethylene bottle	4° Celsius	-	14 days/ 28 days
Nitrate/Nitrite	One 125 milliliter polyethylene bottle	sulfuric acid	-	28 days
Dissolved Lead	One 500 milliliter polyethylene bottle	HNO_3 to pH < 2, 4^{o}Celsius	--	180 days

TPH-DRO	Total Petroleum Hydrocarbon-Diesel Range Organics
TPH-RRO	Total Petroleum Hydrocarbon-Residual Range Organics
TPH-GRO	Total Petroleum Hydrocarbon-Gasoline Range Organics
PAH	Polycyclic Aromatic Hydrocarbons
VOC	Volatile Organic Hydrocarbons
HNO_3	Nitric Acid
Note:	Dissolved lead will be field filtered.